Working in groups within Science and English secondary classrooms: examining the behaviour of pupils and teachers.

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A thesis submitted in accordance with the regulations governing the award of the Degree of Doctor of Philosophy in Psychology.

Submitted: October 2010

Signed:

Date:

Abstract:

Many studies of primary education within the UK have focused upon small groups within classrooms, yet equivalent research within secondary education remains scarce. Although research has established effective group work approaches, such methodologies are tied to parameters derived from primary education and may be difficult for teachers to integrate within secondary classrooms. The scarcity of systematic research also includes a shortage of studies acknowledging teachers' importance within group work lessons, where focus, if any, is restricted to the interaction occurring between teacher and pupils, providing scant detail about how group work becomes embedded into classroom routines. Thus, the overall aim of the thesis is to readdress the scarcity of relevant research by exploring factors that contribute to productive group work and develop a method tailored to secondary classrooms.

Research was conducted in two stages. In each, group work was conceptualised as interaction between peers that has the potential to be productive, contributing to pupils' learning and social development. Study 1 explored the parameters of secondary school group work within Science and English classrooms. Naturalistic systematic observation of lessons utilising either conventional teaching or group work was conducted. Pupil and teacher questionnaires were incorporated to provide a more rounded understanding of classroom interaction. Pupils varied their behaviour tailoring their approach to task completion in accordance with the type of lesson in which they worked. When pupils completed tasks within groups, they produced a greater volume of productive dialogue than their counterparts taught by conventional means. Pupil engagement and enthusiasm regarding group work was also evident by their responses to questionnaire measures.

Findings relating to teacher behaviour suggested a number of unintended impediments to collaboration. The frequency of transitions made by teachers during lessons was equivalent within both types of lesson and indicated that when pupils worked in groups they experienced few instances of sustained group interaction. Although teachers' responses to the questionnaire and the organisation of the group work lessons showed that teachers have some grasp of the factors integral to group work, their behaviour prior to and following group work suggested otherwise. Little variation was evident between the two types of instruction, indicating that teachers can believe they understand the separation between whole-class instruction and small group work, yet their behaviour conflicts with their own reports.

Study 2 examined whether teachers could consolidate their understanding of principles supporting productive group work and reflect this in their approach to introducing and concluding group work lessons. Conventional teaching of a specific topic area was replaced with an intervention employing a programme of group work. Multiple measures were used to evaluate the intervention including observation of classroom interaction. The findings indicate that teachers showed more flexibility with their behaviour and talk, when compared with a control group that used conventional methods. Having been provided with a structure and specific guidance, teachers developed their strategies and incorporate new frameworks within lessons that make use of group work. Guidance tailored to secondary teachers led to teachers' beliefs becoming congruent with their pedagogical practice. The positive and supportive nature of the classroom environment contributed to teacher and pupils' experience of the intervention. Pupils honed their group work behaviour, which is argued to contribute to positive changes in pupils' peer relationships reported by both pupils and teachers in their assessment of the classroom

interaction. Pupils' responses to questionnaire measures indicate that group work retains particular value and significance. Trends in teachers' and pupils' behaviour during group work require further attention: questions are ubiquitous within conventional teaching but their role in contextualising pupils' contributions needs to be considered more specifically as does assistance given by teachers during group work – a larger study could help investigate this and help to replicate the present findings.

Taken together, the chapters of the thesis present a broad range of evidence that sets out the nature of group work within secondary education. Learning undertaken in groups has the potential to contribute to pupils' social and academic experience within secondary education. Potential barriers to learning were addressed and teachers proved they can facilitate group interaction, allowing it to become embedded within the range of teaching and learning practices they rely upon. Future directions for research are signalled, indicating that there is much yet to investigate regarding the use of group work within classroom contexts. It is clear that guidance needs to incorporate recommendations relating to teachers' behaviour, explaining when and how teachers ought to support pupils' knowledge, paying particular attention to contributions stemming from content developed during group work.

Acknowledgements:

I wish to express my sincere thanks to all those who have contributed to this research.

I am indebted to the support and guidance received from my supervisor Professor Christine Howe, whose encouragement since my MSc year at Strathclyde cannot be understated. Further acknowledgement must go to my second supervisor Professor Jim Boyle and panel member Dr Alison Sanford: your kind words and advice are fondly remembered.

On a personal note Rodrigo, my family and friends each deserve a special mention having provided a wealth of support and without whom this process would have been far more difficult.

Mean air mhean is ceum air cheum, tha mi air a' chrìoch a ruighinn leis an tràchdas is gun mhisneachd, cha b' urrainn dhomh a dhèanamh.

This doctoral research was funded by a 3-year ESRC studentship. Thanks are also due to the participating teachers and pupils for their commitment and assistance during each of the studies.

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Chapter 1

The variable nature of groups when used within education

There is considerable evidence that small group work has the potential to benefit pupils' academic achievement and social development within educational contexts. Research also demonstrates that group work is a prominent feature within classrooms. Despite this, only a minority of studies have examined what group work actually means when it occurs within classroom environments and a lack of research is particularly evident regarding secondary teaching, as primary schools have overwhelmingly been the focus of research to date. This thesis reports an investigation into how teachers and pupils in Scottish secondary schools operate in small group contexts in comparison with whole-class teaching. It provides evidence on whether they comply with what research suggests is best practice (Study 1) and considers an intervention geared towards improving practice (Study 2). To set the scene, the introduction is arranged into two chapters: the first outlines factors that can help define the nature of group work within education. The second chapter examines theory, policy and research evidence relating to teachers' strategies and actual practices both within the UK and internationally, exploring what supports group work within educational contexts.

Grouping practices have been identified as an integral part of effective teaching and are a common feature of both primary and secondary school lessons, despite policy and cultural differences between countries noted within cross-cultural research. All but one of four reviews examining small group work within science identified the USA and UK as the top two contributors (Bennett, Lubben, Hogarth, & Campbell, 2004; Bennett, Lubben, Hogarth, Campbell, & Robinson, 2005; Hogarth, Bennett, Campbell, Lubben, & Robinson, 2005; Lubben, Bennett, Hogarth, & Robinson, 2005). This changed only when Bennett and colleagues (2005) addressed the effects of small group work on secondary aged pupils' (11-18) understanding of science, when the USA remained in its topmost position (8 studies) but the UK produced the fewest examples (1 study). The small number of studies (19) that were included within the 2005 review, in comparison to papers contributing to the other reviews (89 studies, Bennett, et al., 2004), (94 studies, Hogarth, et al., 2005) and (63 studies, Lubben, et al., 2005), emphasise the paucity of studies examining secondary education.

A variety of group work methods and approaches have been identified within classrooms at all levels of education (Baines, Blatchford, & Kutnick, 2003; Galton, Hargreaves, Wall, & Comber, 1999b; Lou, Abrami, Spence, Poulsen, Chambers, & d' Apollonia, 1996). Indeed the term "group" is itself ambiguous; in addition to small group work, whole-class teaching has been incorporated into the parameters of what can be classed as a grouping method (Blatchford, Kutnick, & Baines, 1999; Kutnick, Sebba, Blatchford, Galton, Thorp, MacIntyre, & Berdondini, 2005b; Smith, Hardman, Wall, & Mroz, 2004); yet these settings and the opportunity for interaction they offer to pupils could not be more dissimilar. In effect, a tripartite distinction, common to schools in the UK and other countries, helps differentiate between the most frequent teaching and learning classroom arrangements (Alexander, 2000; Galton, et al., 1999b). A separation is evident between whole-class teaching (where a teacher engages with an entire class – in effect the "group"- and is the most frequent form of interaction that occurs between teacher and pupil), small group work (where the consensus amongst sources suggests as few as two and as many as six pupils work as a subgroup within a classroom on a shared task) and individual learning.

A large-scale cross-cultural study that endeavoured to help explain practices underlying effective teaching relied on the tripartite distinction (Reynolds & Farrell, 1996; Teddlie & Reynolds, 2000). Recognition was given to approaches such as maximising teaching time, employing productive group work, and demonstrating and using best teaching practices within classrooms. Related research reports that groups are effective in reviewing and practising material when part of whole-class teaching (Muijs & Reynolds, 2001, 2002, 2005). Group work is therefore presented as best restricted to a limited period and content, and followed by some form of plenary. However, neither evidence nor explanation is provided to substantiate this argument. The recommendation that group work be restricted to revision contrasts both with teachers' own reports of group work being used for a range of purposes (Kutnick, Blatchford, Clark, MacIntyre, & Baines, 2005a; MacQuarrie, 2006), and experimental research demonstrating its success in promoting pupils' attainment within complicated tasks, such as making connections between conflicting knowledge (Howe, Tolmie, Thurston, Topping, Christie, Livingston, Jessiman, & Donaldson, 2007; Thurston, Topping, Christie, Donaldson, Howe, Jessiman, Livingston, & Tolmie, 2008b). It has to be questioned whether the switch from whole-class teaching to group work and then back to whole-class methods is feasible, as it most likely requires specific management and skill. During whole-class instruction pupils typically spend long periods listening and receiving information from their teacher, making it uncertain whether teachers could facilitate a shift between the two approaches. Considering the breadth of the research (nine countries including the USA and UK were involved) that contributed to this guidance, the overly simplistic conclusions regarding group work are surprising and lack precise indication of how an effective teacher utilises group work.

In the chapters that follow it will become clear not only that guidance is rarely made available to teachers about how can they organise group work for it to be effective, but also that as research continues to demonstrate that group work can be a productive classroom teaching strategy, the understanding of such features becomes increasingly important (Baines, Blatchford, & Chowne, 2007; Blatchford, Baines, Rubie-Davies, Bassett, & Chowne, 2006; Gillies, 2003b; Howe, et al., 2007). Given the limited attention given to group work within educational guidelines – noted within recent group work research (Blatchford, Kutnick, & Baines, 2003; Howe, et al., 2007) - it is clear that further study is needed which both examines the nature of group work within education and aims to specify elements that support the nature of productive interaction.

1.1 Grouping at the school level

To put group work into context, the academic environment in which groups operate must be considered. Under guidance from education authorities, School Boards, Parent councils and national initiatives, schools make strategic decisions to arrange pupils into classes and thereby shape the parameters of grouping. Small groups used for teaching and learning can be contrasted with grouping taking place at the school level that involves the placement or allocation of pupils across classrooms. Although marked differences separate them, both forms can be arranged to be homogeneous or heterogeneous employing a similar set of criteria, which is a source of confusion within literature and research. To alleviate potential confusion the following chapters, where relevant, explain the nature of classrooms in which small groups operate (where relevant) prior to considering how such criteria influence small group work.

1.2 Ability grouping

Ability or pupils' attainment is frequently used as a grouping criterion at the school level: classrooms can be categorised as homogeneous – where pupils are set in subjects according to their ability – or heterogeneous where ability is allowed to vary more or less at random.

Setting, where pupils were organised by ability in either all or some of their classes, was common within primary and secondary schools in the mid twentieth century (Boaler, 1997). This practice was largely abandoned in the 1960's throughout Scotland (Harlen & Malcolm, 1999), yet in 1996 Her Majesty's Inspectors of Education presented six principles relating to the organisation of pupils, for example, recommending that secondary schools make greater use (in comparison with primary schools) of attainment groups in all subjects (Scottish Office Education and Industry Department, 1996). However these principles are vague, and critics point out inconsistencies within the document (2003). The 1996 report does well to highlight that ability grouping does not provide consistent benefits for all pupils. This conclusion is supported by multiple research reviews conducted over two decades (Gregory, 1984; Harlen & Malcolm, 1999; Ireson & Hallam, 1999; Lou, et al., 1996; Slavin, 1987a, 1990), and experimental studies (Ireson, Hallam, & Hurley, 2005; Linchevski & Kutscher, 1998; Venkatakrishnan & Wiliam, 2003). The report argues that either set or mixed ability grouping used at the school level would be appropriate for use within education if "effectively" employed.

What substantiates this comment, particularly as effective techniques have yet to be clearly identified, is obscure. Therefore, the 1996 report has described different formats of grouping relevant to education but avoided detailing practices that teachers ought to employ. Teachers' confusion regarding the interpretation of the report and its wider implications - for example how grouping at a school level affects classroom group work (2003) - indicates that varied approaches might occur within secondary schools.

Any understanding held by teachers is confounded by the finding that ability grouping and attainment vary in relation to specific curriculum subjects, further complicating the interpretation of benefits stemming from the use of ability grouping (Burris, Heubert, & Levin, 2006; Harlen & Malcolm, 1999; Ireson, et al., 2005; Linchevski & Kutscher, 1998; Reid, Clunies-Ross, Goacher, & Vile, 1981). Harlen and Malcolm (1999) reviewed the implications of ability grouping in Mathematics, Science and English subject areas. Mathematics alone benefited from ability grouping when teaching materials were adapted in relation to the ability grouping of the classroom. Ireson et al. (2005) considered pupils' prior attainment in relation to their experience of ability grouping and current academic achievement, within Mathematics, Science and English subjects. Key Stage 3, involving pupils aged between 11 and 14, and Key Stage 4 involving 14 to 16 year olds were considered. Only high attaining pupils at Key Stage 3 were found to benefit from ability grouping in Mathematics, lower attaining pupils performed better within mixed ability classes, repeating results previously identified within research (Lou, et al., 1996). At Key Stage 4, mixed ability science classes benefited higher attaining pupils, where lower attaining pupils demonstrated greater academic gains in classes grouped by ability.

The introduction of an accelerated mathematics curriculum within heterogeneous classes led to an increase in the academic achievement of all pupils (Burris, et al., 2006), thus avoiding the discrepancy notable in previous research where progress by lower achievers was at the cost of higher achievers. Thus, with sufficient planning mixed ability classrooms can provide similar learning and growth opportunities for all learners, indicating that broader strategies can lead to more universal benefits. Whitburn (2001) agrees and provides strong evidence that mixed ability teaching can be used effectively with all learners and reports comparable attainment gains when pupils from mathematics mixed ability classes were compared with classes grouped by ability. Within mathematics the use of partial processes, where schools use their discretion to use ability grouping in particular subjects, is indicative of practice responding to research findings and sets mathematics apart as a separate entity, in contrast to science and English where ability grouping has been reported as less effectual.

1.2.1 Implications for group work

Whether schools apply some form of ability grouping will have implications for how small group work unfolds within classrooms. It would be naïve to suggest that setting classes leads to a homogeneous learning group. Even within set classrooms, pupils will demonstrate a range of attainments and different ideas. Thus, it is more relevant for the purposes of defining the parameters of group work as a teaching and learning approach to examine what teachers do when they compose groups within classrooms.

Lou and colleagues (1996) compared pupils working together, who had been structured to form single or mixed ability small groups within classrooms. Lower ability pupils were found to achieve the greatest benefit from heterogeneous small groups, whereas medium ability pupils seemed to learn significantly more from participating in homogeneous small groups. High ability pupils on the other hand appear to perform similarly within mixed and single ability small groups – this apparent inconsistency with a conclusion noted earlier that the effects of ability grouping at the school level varied as a function of teaching subjects (Ireson, et al., 2005) helps to illustrate that a clear division exists between groups used for teaching and learning arranged to be homo- or heterogeneous and the use of such criteria at the whole-class level. Although in an earlier review, Webb (1989) presents evidence that conflicts with the conclusions made by Lou and colleagues, Webb focused on pupils' explanations, indicating that within group dialogue needs to be evaluated in order to depict the nature of interaction. Recent findings support Lou and colleagues (Hallam & Ireson, 2007; Hallam, Ireson, Lister, Chaudhury, & Davies, 2003), and it seems that these studies, including both reviews, acknowledge that academic gains from group work relate both to pupils' own ability level and their experience of ability grouping.

Considering the findings of research conducted thus far mixed-ability forms of small group work are consistently supported by studies investigating educational contexts (Gillies, 2003b; Johnson, Johnson, & Stanne, 2001; Wilkinson & Fung, 2002). The diversity of such groups is thought to encourage a greater volume of peer interaction as different learners with different ideas and capabilities can stimulate the group to work consistently and lead to a reduction in teacher-led interaction. Heterogeneous small groups also avoid numerous disadvantages associated with ability grouping occurring at classroom level (Harlen & Malcolm, 1999). These include the reinforcement of social class division, lowered expectation of those pupils allocated to groupings defined as less able, inconsistencies in allocation of pupils to ability groups (Boyd, 2007; Smith & Sutherland, 2003) and pupil anxiety in relation to setting (Hallam & Ireson, 2007).

Thus, there is a clear division between ability being used to arrange classes at a school level or to create small groups of pupils within lessons. A variety of approaches needs to be considered and ability is clearly a factor that defines group work in education at both the school and small group level.

1.3 Age

Schools also have age at their disposal when arranging classes in schools. Unlike ability, mixed-age classes are rarely implemented as a means of boosting attainment (Wilson, 2003). Composites are adopted when schools need to meet targets relating to class size (Eurydice, 2009; Howe, et al., 2007), for example, when over or under population is a problem within primary and secondary education. The exception relates to developing countries where the roll out of education programmes aiming to include all children means that composite arrangements may be more commonplace (Mulryan-Kyne, 2007). During the final two years of secondary education, non-compulsory education suggests additional reasons for placing pupils of varying ages in a single class. Composite classes may be created to accommodate pupils who delayed their choice of a teaching subject until their final school year, or pupils who repeat examinations within a specific teaching subject. Generally, it is the responsibility of the head teacher to manage classroom arrangements, and their overwhelmingly negative attitude towards composite classes (Wilson, 2003) would suggest its uptake only occurs when no alternative is available.

1.3.1 Implications for group work

Arrangement of small groups within composite classes presents an interesting dilemma – creating cross-age groups effectively engineers a specific working environment that may require specialist understanding – in contrast, restricting pupils to work in groups with their same age pupils (within a composite class) may require teachers to differentiate the learning materials they distribute to groups.

One example of cross-age group work is peer tutoring, which tends to be geared towards specific objectives. Interaction typically occurs between an older pupil (more expert) and a younger (novice) peer (Topping & Ehly, 1998). Learning within peer tutoring results from joint activity (Damon, 1984), when one individual supports another's learning and in doing so it is argued supports their own understanding. Much research has focused on the mechanisms involved with the use of peer tutoring in relation to Mathematics (Robinson, Schofield, & Steers-Wentzell, 2005; Topping, Campbell, Douglas, & Smith, 2003), Science (Topping, Peter, Stephen, & Whale, 2004) and non-curricular topics (Fuchs, Fuchs, & Kazdan, 1999; Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006; Gumpel & Frank, 1999; Heron, Welsch, & Goddard, 2003; McKinstery & Topping, 2003; Topping & Bryce, 2004). Partly because peer tutoring involves a highly specialised form of interaction, it is likely to vary in the quality of peer engagement it provides (Damon & Phelps, 1989). Research has noted that when pupils acts as tutors they find it difficult to follow their tutor role (Ellis & Rogoff, 1982; Gauvain & Rogoff, 1989) and when effective, gains are most evident for tutors rather than tutees (King, 1998; Topping, 1987). Since such tutoring regularly occurs as additional instruction, supplementary to content taught within lessons, it may be that peer tutoring is less frequently utilised within authentic classrooms and consequently less relevant to the current research.

1.4 Group Size

Although the previous paragraph argues that peer tutoring involving a pair of learners (dyad) is likely to be separate from group work, this is due to its function rather than the number of pupils who interact. Within educational contexts, other than peer tutoring formats, there is little (if any) evidence to separate dyads from larger groups. As noted at the outset of this chapter group size refers to the precise dimensions of a group and could equally refer to a dyad, as to groups of ten pupils or more.

Class size has been observed to influence the shape of grouping practices used within lessons (Blatchford, 2003; Blatchford, Baines, Kutnick, & Martin, 2001a; Blatchford, Russell, Bassett, Brown, & Martin, 2007; Rice, 1999). The Class size and Pupil Adult Ratio (CSPAR) project found that in classes of over 25 pupils, groups of 7-10 pupils were relatively more likely, whereas in classes of fewer than 25 groups of 11 or more occurred relatively frequently. This relates to the findings that more whole-class teaching occurred in small classes (Blatchford, et al., 2001a). However, the use of large groups conflicted with teacher beliefs that large groups have a negative effect on teaching quality, and pupils' contribution. The majority of the research points out that within larger classes teachers report reductions in the variety of instructional strategies used, yet observations reveal little change in teachers' behaviour (Hargreaves, Galton, & Pell, 1998; Hattie, 2002; Pedder, 2006).

1.4.1 *Implications for group work*

Lou and colleagues (1996) examined group size specifically in relation to educational contexts. Small groups (3-4), when compared with medium (5-7), large (8-10) and ungrouped lessons, appeared to provide optimal conditions for learning. Large groups were the only forms of grouping not to demonstrate any distinct advantages in comparison with ungrouped lessons. Kutnick et al., (2005b) within their literature review support this definition of large and small group sizes, and acknowledge that dyad working arrangements include group work and are not restricted to asymmetric or unequal forms of interaction (e.g. peer tutoring). They thus provide support for the definition of small groups (between two and six pupils) utilised within the thesis.

Gillies (2003b) reviewed five studies and presented an alternative argument in support of small groups. She argued that small groups are sufficient in that they maintain group diversity but their small scale makes it more likely that all group members will contribute. In turn this will help reduce undesirable behaviours such as social loafing – also known as the free rider effect - where groups members allow their more active peers to participate and complete the tasks on their behalf (Arterberry, Cain, & Chopko, 2007; North, Linley, & Hargreaves, 2000).

Research has adopted these parameters and small groups have been relied on within a long term group work programme (Baines, et al., 2007), collaborative group work (Howe, et al., 2007; Maloney & Simon, 2006; Saleh, Lazonder, & de Jong, 2007) and cooperative group work (Gillies, 2002b, 2003a; Gillies & Ashman, 2003; Hanze & Berger, 2007;

Stamovlasis, Dimos, & Tsaparlis, 2006) – see Section 2.1 for a discussion of these group work categories.

As noted at the beginning of this Chapter the nature of working arrangements can be separated into three separate forms – whole-class, group work and individual working. Clearly defined parameters facilitates the recognition of small groups' structure within classrooms and research output acknowledges pairs working together to achieve a shared goal to be no different from three or four pupils experiencing similar interaction. Yet whether teachers and pupils share this belief and conceptualise working with a partner as a form of group work is uncertain, and suggests an additional line of investigation to be included in the studies to follow.

1.5 Gender

Gender can function at the school level, and can influence the composition of small groups, and will be considered in this order. Arguments made to support the introduction of single sex education commonly cite pupils' enhanced engagement with the learning material or refer to anticipated reductions in classroom disruptions (Jackson, 2002; Lee & Bryk, 1986; Mael, 1998; Martino & Meyenn, 2002). Jackson (2002) notes that gender is most commonly linked to reform based initiatives, which show varying trends within different countries. The case study of a school where single-sex education has continued since the 1970s exemplifies this (Warrington & Younger, 2001; Younger & Warrington, 2002), as do the findings of a review considering examples from UK secondary schools (Younger & Warrington, 2006). However, the likelihood of the objectives of an initiative becoming integrated with those held by the whole school has to be questioned. Concerns stem from the lack of explanation given within the 2006 review as to how school and initiative (particularly conflicting) aims can be aligned and as to why teachers held negative views having been involved in the instruction of single-sex classes (Gray & Wilson, 2006).

Gender, however, can also unwittingly contribute to the make-up of a classroom without decisions being made by educational stakeholders. Most pupils during their secondary education select a set of subjects (in addition to the core curriculum) they wish to study, and clear patterns have been evident regarding the proportions of male and female choosing to study specific subjects (Francis, 2000; Howe, 1997). Both these arguments suggest that gender requires consideration within the bounds of this research as implementation of gender-targeted strategies (whether it is to create single-sex classes or encourage female pupils to remain in science) has implications for the use of small group work in such classes.

Returning to small groups, studies have examined whether single-sex groups or groups composed to have equal (balanced) or unequal (majority) numbers of male and female pupils are preferred. A wealth of studies have considered pupils' learning and interaction in relation to gender and are of particular relevance as the research has been dominated by studies of pupils aged ten years and above (1997). Research has investigated how different structures influence pupils' interaction by focusing on behaviour and group dialogue (as will become clear throughout these introductory chapters, behaviour and dialogue are key indicators of a groups' productivity).

Recent research relating to technology has challenged initial findings of boys' superior performance in computer based tasks (Barbieri & Light, 1992). A greater number of published studies fails to find differences (Howe, 1997; Sutton, 1991; Underwood & Underwood, 1998; Underwood, Underwood, & Wood, 2000) and shows mixed groups equalling the performance (in terms of academic achievements and interaction) of single sex groups. Research has also documented that boys dominate control of the materials available to the small group both when tasks are computer based (Barbieri & Light, 1992; Littleton, Light, Joiner, & Messer, 1992) and when they involve practical work in science (Conwell, Griffin, & Algozzine, 1993). Such dominance has been found to be resented by female pupils following participation in mixed gender groups, but Howe (1997) argues that such resentment is not necessarily exhibited during interaction. Underwood and colleagues (2000) suggest that when group members offer positive support and integrate other pupils' suggestions with their own or the groups' ideas, any lingering repercussions may be lessened.

Research examining help seeking and giving has demonstrated differences in male and female pupil behaviour within small groups. High-level explanations to others during group work have been positively related to achievement and lower-level explanations negatively related to achievement (Webb, 1989). Boys receive a greater volume of high-level explanations in mixed gender groups, as girls are more likely to respond to help-seeking behaviours (Conwell, Griffin, & Algozzine, 1993; Webb, 1984a) and girls target their explanations towards boys (Lee, 1993; Webb, 1984a). In contrast, boys in majority girl groups provide inadequate feedback to girls' help-seeking requests (Webb, 1984), and when girls seek help in majority boy groups they are largely ignored, with boys' focusing on their same sex peers (Lee, 1993; Webb, 1984a). Lee develops this point and argues that girls in mixed sex groups receive more help generally, suggesting that males may comply more frequently with requests for help in mixed groups.

Tolmie and Howe (1993) found that the gender composition of dyads also influenced how task based conflict was managed. Pupils tended to withdraw from the discussion when mixed-sex pairs disagreed; in contrast similar forms of conflict encouraged discussion within same-sex pairs. It follows that mixed groups showed impoverished dialogue (in comparison to that produced by single sex groups) but both mixed and single sex groups showed equivalent learning. The relatively prolonged nature of discussion within same sex groups is supported by other findings (Lee, 1993; Underwood, Mccaffrey, & Underwood, 1990). Yet, male pairs and female pairs show marked differences in their approaches to discussion, for example male pairs evaluated each others' contributions to promote understanding of the task, whereas female pairs looked for similarities between contributions (Tolmie & Howe, 1993). Therefore, the gender composition of groups need not have consequences for pupils' academic achievements but can exert an observable influence on task-related discussion and pupil behaviour within small groups.

To sum up, much of the research examining the gender construction of small groups has remained inconclusive with few clear findings emerging (Smith-Lovin & Brody, 1989; Webb, 1984). Cohen (1994) suggests that findings may not bear scrutiny in authentic classrooms where pupils are acquainted with one another, therefore group work research may have the most to offer to situations requiring clarification. One view shared by Cohen (1994) and Underwood and colleagues (2000) in relation to gender and group work is that preparing pupils prior to group work is fundamental. Conditions leading to productive interaction may only be feasible once such behaviours have been explained or demonstrated to pupils and may help overcome any discrepancies in pupils' behaviour that stem from the gender composition of their group. Thus, two points are apparent for the doctoral research that follows– the conditions surrounding the use of small group work need to be ascertained (in particular whether and how pupils are prepared for group work) and examination of interaction in small groups ought to take account of pupils' gender.

1.6 Friendship

As a group composition variable, pupils' friendship with their peers has received limited attention despite evidence that given a free choice, pupils are more likely to work in small groups with peers they consider to be friends, and that such opportunities may be more frequent within secondary education where teachers are content for friends to be seated in close proximity (Blatchford, Kutnick, Clark, MacIntyre, & Baines, 2001b). Underwood (2003) and Kutnick and Kington (2005) report that research varies in what it explains about the effects of friendship groupings, with some research reporting academic or social benefits (Azmitia & Montgomery, 1993; Miell & MacDonald, 2001; Newcomb & Bagwell, 1995; Strough & Meegan, 2001; Strough, Swenson, & Cheng, 2001; Zajac & Hartup, 1997), which contrasts with studies reporting little or no difference when comparisons were made with other teaching formats (Berndt, Perry, & Miller, 1988; Souvignier & Kronenberger, 2007).

Friendship based small groups may be preferred by pupils as a level of rapport will have already been established. However, such rapport may mean that high-achieving groups work rapidly and efficiently to adequately complete the task and then engage in social or off task behaviours. Such groups may fail to interact fully with the task and immediately move to off task behaviour or approach the task individually; groups involving friendships may make it easy to fall back on pre-determined roles with some members contributing complete answers resulting in constrained and limited discussion (Arterberry, et al., 2007). In both cases, close monitoring by teachers would be required.

A further limitation of friendship based small groups relates to social desirability - behaving in a manner according to those who surround us (Chiu & Khoo, 2003). Within such groups pupils may disagree or contribute less to discussions and in so doing allow inaccuracies to continue (Arterberry, et al., 2007). Chiu and Khoo argue that this is particularly likely within groups composed of female adolescents. Although, friendship may potentially be more influential than other grouping characteristics interaction within friendship groups is likely to be restricted by the relationships between group members (Blatchford, et al., 2001b). This is supported by research that reports how friendships are typified not just by similarities in gender and ability (Aboud & Mendelson, 1996) but also by related thoughts, behaviour or attitudes. This indicates that groups based on friendship may be too alike and reduce opportunities for alternative perspectives to be introduced within discussion. When such social pressures directly influence the discussion, they influence the output of the group in relation to its task and this may help explain the inconsistent findings within such research.

The lack of systematic findings regarding small group work and pupil friendship is not surprising. How studies determine friendship-based groups as opposed to acquaintance-based groups must be looked at with interest, for example is a single instance of two pupils reciprocating each other's nomination as a friend sufficient? If so, can an acquaintance group ever remain an acquaintance group? It may be that such interaction encourages acquaintances to evaluate each other as friends, thereby changing the status of their relationship. These and the other considerations indicate that findings from such comparisons may be less relevant for investigations conducted in authentic classrooms where pupils are familiar with each other.

Although such research is intrinsically complicated due to the complexity of classroom-based relationships and their measurement (Chiu & Khoo, 2003; Van Rossem & Vermande, 2004), nonetheless a measure of peer relationship ought to be included within the current research. It is clear that sociometric methods that require pupils to nominate their friends may underestimate the intricacy of peer relationships, particularly in relation to pupils who may have limited or no relationships with their peers. Indeed this may be exacerbated in secondary education as pupils interact with different peers in different teaching subjects, leading to an extended network of relationships. Hence a rating measure that presumes pupils are at least acquainted with their classroom peers acknowledges the presence of an extended network (at least at the classroom level) and may be the most accurate method of examining peer relationships within secondary education, allowing a clearer depiction of the environment in which small group work takes place.

1.7 Teachers' use of group composition variables

How teachers arrange groups and what they use to inform their decision can help demonstrate what value teachers assign to the variables of ability, gender and friendship, as well as describing the parameters likely to influence pupils' experience of small group work. Teachers place most emphasis on ability, behaviour and gender when deciding the composition of small groups (Daniels & Shumow, 2003; Pollard, 2000). Secondary teachers have reported that they assign pupils to groups more often than they allow pupils to group themselves (Blatchford, et al., 2001b). As teachers dominate such decisions, pupils may regularly work within groups balanced regarding ability and gender but not the friendship of its members. That teachers set aside their awareness of peer relationships perhaps strengthens the point made earlier that friendship may not operate as research suggests within educational contexts. If pupils are disruptive alternative seating arrangements are sought, if not pupils may remain with whomever they are seated with and as mentioned earlier secondary teachers are content for friends to be seated in close proximity (Blatchford, et al., 2001b).

Science teachers report considering a range of factors when constructing small groups but primarily their decisions regarding group work are informed by the availability of equipment (Kutnick, et al., 2005a; 2005b). However, whether the purpose of such grouping relates to an intention for actual group work or for groups to act as a means to share resources, therefore resembling a "by-product", remains ambiguous (Howe & Tolmie, 2003). Galton (1999b) claims that groups having been created for purposes other than specific learning objectives are likely to be ineffective by reducing the quality of discussion and work occurring within groups. Therefore grouping pupils in relation to the availability of equipment is likely to lead to ineffective group work.

Overall, teachers' actions, in particular the strategies they adopt to construct groups, are likely to influence the outcome of small group work, particularly pupils' learning and the enjoyment of peer engagement. This emphasises the need for appropriate classroom conditions to be established and used by teachers when group work is used as an instructional strategy (Coultas, 2007) and signals the need to develop understanding of what actually takes place within secondary classrooms, a central tenet of this doctoral research.

1.7.1 Temporal nature of group work

The discussion of group work so far has assumed that groups are relatively permanent in their composition, whereas in reality small groups may be temporary or specific to particular classroom contexts (Baron, Kerr, & Miller, 1992; Sweet & Michaelsen, 2007). Pupil absence is among the daily challenges a teacher has to consider, which by itself can necessitate the need to manipulate teaching and learning arrangements. Similarly, whether teachers assign pupils to groups on a temporary or permanent basis will also influence group work. Research has considered permanent groups, when pupils work regularly or repeatedly with the same peers (Baines, et al., 2007; Layne, Jules, Kutnick, & Layne, 2008; Staples, 2007) whereas few details regarding how and when teachers use temporary groups are available. Neither Lou et al. (1996), nor Bennett et al. (2004; 2005) included studies that lasted only one session in their reviews. What characteristics, if any, teachers include in their consideration of the composition of temporary groups, remains to be identified. On the other hand, it could be that such temporary groups refer to the less frequent occasions when pupils arrange their own groups, where working with friends appears to be the most influential characteristic (Kutnick, et al., 2005b) rather than strategic selection operating as a function of pupils' social or academic status. Interaction between peers has been found to vary in relation to the temporary or permanent nature of the group (Sweet & Michaelsen, 2007), suggesting that within educational contexts the potential benefits of group work may relate to whether temporary or permanent groups are used within classrooms.

Knowledge of secondary teachers' strategies to implement and use small groups invites investigation. The use of these structures in classrooms will influence pupils' experience of group work, and potentially pupils' relationships with their peers. Thus, where relevant, these factors will be incorporated in the studies to follow. Knowledge of the specific criteria that define group work within educational contexts can be contrasted with the parameters proposed for group work within specific theoretical perspectives, examined in the subsequent chapter.

Chapter 2

Theory, research and policy recommendations that support best practice

Group work and peer interaction have regularly been identified as a means of motivating pupils to communicate, develop social skills and progress academically (De Lisi, 2002; MacQuarrie, 2006; Weber & Hertel, 2007). However, there is a need to classify what supports group work practices within educational contexts, and informs "best practice" - evidence based teaching approaches and methodologies. The previous chapter examined structures that shape small groups used in classrooms. Throughout this chapter (and for the remainder of the thesis) small group work is elucidated in part by making comparisons with whole-class teaching. This chapter focuses on the processes that underlie best practice with references to the parameters outlined in research evidence and policy and reports whether teachers emulate such practice when they use small groups within their classrooms.

2.1 Categories of group work

Much of the literature examining group work differentiates between collaborative and cooperative formats. Yet commonly agreed definitions are inadequate or vague (Resta & Laferriere, 2007; Underwood, et al., 2000). Few precise details are available regarding how interaction within collaborative groups differs from cooperative groups, particularly as collaboration has been demonstrated within cooperative group work (Gillies & Ashman, 1996; Underwood, et al., 2000), and collaboration has been included within the sampling criteria of a meta-analysis examining cooperative group work (Roseth, Johnson, & Johnson, 2008).

A recent conceptualisation of collaborative group work states that " learners are typically supposed to construct knowledge by working on complex problems together, including individually contributing to solving the problem, partaking in discussion of the individual contributions and arriving at joint solutions" (Weinberger, Stegmann, & Fischer, 2007). However, this does little to clarify how collaboration ought to be separated from cooperative group work. The description utilised by Weinberger et al. surely refers to the type of genuine interaction that occurs in groups (and indeed is the focus of this research). In fact attempts to separate the two formats typically involve a specific cooperative group work approach (*Jigsaw*) where each group member is responsible for a separate aspect, whose sum completes the task assigned to the group (Foot & Howe, 1998), thus failing to recognise the diverse approaches encapsulated by cooperative learning (whose underpinning will be considered shortly). The application of group work in educational contexts has almost certainly been encouraged by Johnson and Johnson's "*Learning Together"* framework and as such deserves specific attention. Recently, Howe (2010) presents a broader explanation, noting that symmetric (where peers are equally involved in interaction) and asymmetric (where interaction involves a greater degree of assistance, e.g. peer tutoring) forms of group work can be sensibly integrated and conceptualised as a cooperative mode (as opposed to conventional teaching) operating within educational contexts. The overlap between these terms suggests that for the purpose of the thesis it would be more fruitful to study aspects of theoretical perspectives contributing to productive group work rather than focus on the labels assigned to such interaction.

2.2 Theoretical perspectives

A brief introduction to Piagetian and Vygotskian theory will be presented, followed by an overview of the principles underlying cooperative learning. Each has received wide acclaim for the volume of research they inspired and their contribution to the theoretical basis of group work. Within each section, the different perspectives are examined to detail their implications for productive structures of interaction. All are in agreement regarding the feature of groups, which encourages learning (Alexander, 2000; Howe & Mercer, 2007; Mercer & Littleton, 2007b). Dialogue occurring within groups forms the basis of interaction (Damon & Phelps, 1989), and is dependent upon task engagement when peers introduce new ideas (Damon, 1984). This mechanism that is argued to be responsible for growth is addressed in each section.

2.2.1 Piaget

Piaget proposed that children's understanding of the world involves the active participation of the learner leading to the formation of internal schemes containing conceptual knowledge (Tudge & Rogoff, 1999). Equilibration describes the resolution of disharmony between the processes of assimilation (incoming information categorised in relation to pre-existing schemes) and accommodation (modification of pre-existing schemes to cope with the specific properties of incoming information). Resolution of such cognitive conflict leads to changes in knowledge held prior to incompatible perspectives being encountered (Furth, 1981). Piaget centralised the role of individual development following exposure to cognitive conflict (Tudge & Rogoff, 1999) with equilibration occurring at a personal level. Communication with others is a significant element of Piagetian theory, interaction provides the stimuli for change; however selfregulation depends on a child's abilities to resolve discrepancies between their schemes and newly acquired information (Tudge & Rogoff, 1999).

Piaget (1962) argued that peer interaction provided optimum conditions for cognitive conflict to occur, as it demands that pupils explain, elaborate, and defend their ideas thereby exposing their differences. Group work seems a particularly appropriate form of peer interaction as the social processes and ideas it presents are likely to be absent when an individual works on a problem alone (Brown & Palincsar, 1989) and within educational contexts this is one of many explanations for why pupils are grouped together (Gabriele & Montecinos, 2001; Gillies, 2002a; Webb, Troper, & Fall, 1995). Clearer parameters for group work come from Piaget's argument that dialogue exposing differing perspectives can only occur when peers are grouped in terms of equal power relations, that is they are similar in terms of their relationships with each other (Gauvain & Rogoff, 1989; Inhelder, 1958). Within a group setting, peers are less threatened by each other, facilitating discussion that may include coordination of perspectives. Piaget also attributed importance to the environment within which children work (Cornelius & Herrenkohl, 2004; De Lisi, 2002; Palincsar & Herrenkohl, 2002). Interaction functioning within a supportive atmosphere encourages children to respond more openly and welcome their peers' contributions. Such research suggests that mutual respect must be integrated to the classroom climate, as opportunities for learning are optimised when it is established (De Lisi, 2002; DeVries, 2000).

The cognitive strategies (how pupils rationalise their thinking) used by groups have also been considered in terms of Piagetian theory. Small groups' superior performance on a task in comparison to matched controls who worked individually (Doise, Mugny, &

Perret-Clermont, 1975, 1976) have been interpreted in line with Piagetian thinking, that the specific coordination of perspectives and ideas occurred rather than one individual tutoring the other (Damon, 1984). Psaltis and Duveen (2006, 2007) and Murray (1983) report that when discussion and explanation featured during interaction, greater progress was evident. Such skills were utilised by pupils to deal with discrepancies between group members' conflicting beliefs. Groups possessing incompatible strategies were more likely to retain gains - in comparison to groups sharing compatible strategies - as their interaction style supported the characteristics of peer interaction presented by Piaget. Other studies (Gabriele, 2007; Webb, et al., 1995) reported consistent findings, but signalled, in connection with Piagetian theory, group members' readiness to contribute related to the climate of the group regarding interaction.

Children experience two forms of relationships, those with their peers, and those with their parents or guardians. Peer relations have been found to be qualitatively different from adult-child relations (Hunter & Youniss, 1982). Parent-child relationships are asymmetrical as the adult guides and influences the interaction more so than the child (Hunter & Youniss, 1982; von Salisch, 2001). Piagetian reasoning puts forward that interaction with others of equal status (age, ability and other criteria) motivates pupils to engage with their peers' beliefs. Peer relations, in contrast to adult-child relations, can be characterised by factors such as cooperation, reciprocity, and mutuality, which contribute directly to social development and learning. Therefore, cognitive conflict does not depend on asymmetrical relationships. Pellegrini (1992) demonstrated that the achievement of primary aged pupils in their first year of school, could be predicted by their interactions with adults and peers. Adult interactions were a negative predictor, whereas peer interaction was a positive predictor, suggesting that at an early level of education the differing nature of pupils' relationships can influence learning, also supporting Piagetian theory. Howe (2010) explains that, according to Piaget, views originating from teachers or adults would be integrated without question within pupils' thinking, such is the relationship pupils have with authority figures. During group work, teacher explanations would therefore retain more influence than justifications developed by groups. Consequently, rather than the two forms becoming integrated, information derived from the teacher may lead the group as teachers' contributions have higher status than pupils'. This suggests the teachers' role needs to be carefully planned in relation to both their behaviour during group work and their implementation of group work.

2.2.2 Vygotsky

Vygotsky argued that interaction is fundamental to cognition, guiding and shaping what is learnt (Damon, 1984). Children incorporate elements of interaction into their knowledge, stimulating learning in the present and future, having lasting effects that continue to mould learning. Yet Vygotsky, in contrast to Piaget, focused on adult-child interaction arguing that such interaction is necessary for children's development. Interaction according to Vygotsky only contributes to learning when it involves individuals with differing knowledge levels (Mercer & Littleton, 2007d). Despite few specifics being given regarding the instructional strategies supported by Vygotskian theory, multiple interpretations have been presented (DeVries, 2000).

Matusov (1998) identifies two models of development in relation to Vygotskian theory which examine the processes on which interaction is based (Daniels, 2001). Both accept that group interaction is essential for learning but differ in their interpretation of interaction and how its socio-cultural nature benefits learning. The internalisation model explains that interaction enables development and individuals can use skills learned from one activity elsewhere. In contrast, Matusov argues that the participation model is superior as it encompasses both joint and solo activity, and ties skills to the social context of the activity. This encompasses situated learning, which identifies learning as a continuing set of relations with one's world, as detailed by Lave and Wenger (1991). Skills therefore have meaning only in relation to the social environment or the contexts of specific tasks (Dakers, 2005). The differences between the models, their relative positions regarding Vygotskian theory and how they can be used to interpret group interaction are still being debated and help establish a basis for ideas central to Vygotskyian theory (Arievitch & Stetsenko, 2000; Carpendale & Lewis, 2004; Dakers, 2005; Pressick-Kilborn, Sainsbury, & Walker, 2005).

Vygotsky (1962) argued that two types of concepts form the basis of conceptual knowledge. Scientific concepts develop from classroom based teaching and interaction, whereas spontaneous concepts emerge from experiential learning occurring outside the classroom (Daniels, 2007). By contrasting differing perspectives and making rationalisations the relationship between everyday thinking and scientific concepts can be developed. Proposals of such practice have been included within varied sources (HM Inspectors of Schools, 1999; Laurillard, 2002; Learning and Teaching Scotland, 2004; Millar, Leach, & Osborne, 2000; Scottish Executive, 2001, 2006b), indicating that recognition - either at an explicit or implicit level – is taking place of factors stemming from theoretical perspectives.

One aspect that has received prominent status is the "zone of proximal development" (ZPD). Vygotsky argued that the development of cognition relies upon productive experiences within it (Wood & Wood, 1996). ZPD is the conceptual space comparing what a child is capable of individually and what they are able to achieve with assistance, thus pupils' current level of performance can be compared with their learning potential (Kozulin, 2003). Such potential can only be achieved with external support provided through "scaffolding" during social interaction with an expert (Wood, Bruner, & Ross, 1976). Scaffolding concisely describes the relationship between pupil and teacher. Within this process the expert guides pupils' learning; however this is not straightforward as assistance given during scaffolding will vary in relation to the task type, and pupils' prior knowledge (Plumert & Nichols-Whitehead, 1996). Despite Vygotskian-inspired practice describing teacher behaviour as a form of interaction, scaffolding was not originally conceived as a teaching approach (2002), therefore whether this form of interaction is feasible within classrooms is worth investigating.

Factors relating to assistance given during scaffolding processes have been widely examined (Choi, Land, & Turgeon, 2005; Palincsar, 1998; Philips & Tolmie, 2007; Wood, et al., 1976; Wood & Wood, 1996) and research continues to evolve within educational contexts (1991). Research interpreting the ZPD within educational contexts has indicated that it is more difficult to engineer than initially conceived (Wood & Wood, 1996). Bliss, Askew and Macrae (1996) noted that primary teachers encountered problems when attempting to scaffold pupils' knowledge, arguing that subject specific knowledge was the root of teachers' difficulty. As secondary teachers are required to be adept within a subject they may encounter less difficulty when attempting to make connections between scientific and everyday understanding epitomising ZPD type interaction (Chaiklin, 2003). Daniels (2007) adds that Newman, Griffin and Cole (1989) propose the basis of such interaction follows from teachers' skill and subject knowledge, enabling teachers to engage with pupils' ideas rather than provide a template on which pupils base their work. Findings from Philips and Tolmie (2007) are consistent. They reported that pupils (6-8 years) receiving specific assistance– high-level explanation coupled with demonstration of a problem being solved – made more accurate and rapid problem solving attempts. Therefore, the type of provision and the structure of scaffolding will influence what develops following interaction. Peer tutoring is also interpreted as a form of scaffolding, yet misgivings reported within Chapter 1 regarding the impractical nature and difficulties associated with peer tutoring - as it typically occurs away from lessons - further reduces the likelihood of scaffolding operating in education.

The paucity of examples of scaffolding interaction in authentic classrooms make it difficult to determine teachers' role whilst pupils work in groups other than that they ought to refrain from interrupting pupils and be supportive to them. The theoretical perspectives of both Piaget and Vygotsky signal that teachers are important to relation to the classroom environment yet the literature encountered thus far appears to undervalue teachers' role in relation to group work, providing little insight as to how group work can be successfully introduced to classrooms. The problems of attempting scaffolding within education may make an alternate explanation more appropriate. Daniels (2001) suggests that multiple "absent" tutors, who differ in their advice and support may function within an individuals' ZPD. Daniels also indicates that peer interaction has enduring consequences, for example ideas originally proposed within group discussion could be later recalled in addressing a different task. Research shows that academic and social benefits derived from group interaction can have delayed onsets and be long lasting (Gillies, 2000, 2002b; Howe, McWilliam, & Cross, 2005). Clearly, the interpretation of ZPD within educational contexts is intricate, but perhaps there is some suggestion that the teachers' classroom role may need to function at a broader level.

2.2.2.1 Dialogue

Within this section, Piagetian and Vygotskian content will be considered separately and in tandem, in order to elucidate their outlook on dialogue during group work. Piaget and Vygotsky appear to have contrasting perspectives regarding dialogue. The label "Transactive dialogue" was coined (Berkowitz, Gibbs, & Broughton, 1980) to describe talk where reasoning to resolve disagreement contributed to knowledge formation. Such dialogue would be descriptive, involving comparisons of one's own beliefs with that proposed by another (Kruger & Tomasello, 1986). Such peer engagement is argued to support the development of mental representations that contribute to schemes and studies report that group work (formed using principles encountered in Chapter 1) can facilitate such reasoning (Howe & McWilliam, 2006; Tolmie, Topping, Christie, Donaldson, Howe, Jessiman, Livingston, & Thurston, 2010).

Dialogue has also been classified as a "tool", through which learning is encouraged and promoted (Mercer & Littleton, 2007b). A central tenet of Vygotskian thinking considers children's development to be governed by language acquisition (Mercer & Littleton, 2007d). Although the concept of mediation is prominent within Vygotsky's developmental framework, Wertsch (2007) points out that its definition is vague, leading to different interpretations. In the current context mediation may be best considered as the elements - generally people or objects (Kozulin, 2003) - which individuals may use to aid their interpretation of the world.

Research incorporating elements from either theory suggests apparent incompatibilities should not govern how theory is related to teaching. Howe, Tolmie, Duchak-Tanner and

Rattray (2000) considered how conceptual and procedural knowledge in science can be acquired. Conceptual knowledge, following Piagetian theory, relates to the mental representations we have of experiences or ideas. However, procedural knowledge – the comprehension of how something requires action to be achieved or performed - requires action and can be based on direct experience and typically requires expert guidance most likely in the form defined by Vygotsky, which contrasts with the requirements of Piagetian theory. Howe et al. (2000) found that achieving consensus during discussion of conceptual and procedural matters allowed incompatibilities between group and expert guidance to be overcome; by integrating conceptual and procedural matters. These findings demonstrate that small groups can add value to classroom learning particularly when discussion supports conceptual understanding and development (Howe & Tolmie, 2003). Conflicting perspectives between the theories have stimulated research into their application in education, and the findings suggest that elements from each theory can be complementary in the context of group work.

Both theories, however, support the idea that joint prediction and interpretation relates to children's engagement with information. Research incorporating such approaches (Howe, Tolmie, Greer, & Mackenzie, 1995; Rojas-Drummond & Mercer, 2003) finds that engagement in a group setting has been demonstrated from joint on-task action. Such engagement is found to come from joint decisions made using agreement from all group members when each member contributes to the formation of predictions, interpretations or outcomes. Consensus is achieved through the explanations of individual group members who defend their beliefs and argue why their position ought to be the one accepted by the group. Engagement can therefore support the comprehension of information and enhance the extent to which material can be highlighted and learned from.

Consensus does not appear to be a requirement when pupils interact, although it has been found to enhance what can be gained from participation when expert intervention needs to be co-ordinated with novice dialogue, (Howe & Tolmie, 2003). Howe and Tolmie also find that their research illustrates that minor changes regarding group arrangements and task completion influence academic gains acquired through group work. Joint agreements concerning predictions and interpretations enable pupils to comprehend the content of group work without relying on external help (Howe, et al., 2000; Rojas-Drummond & Mercer, 2003).

The wealth of research arising from the foregoing theoretical perspectives has contributed to the implementation of group work interventions within schools (Johnson & Johnson, 2002; Littleton, Mercer, Dawes, Wegerif, Rowe, & Sams, 2005; Shayer, 1999; Wegerif, Linares, Rojas-Drummond, Mercer, & Velez, 2005). Research examining theoretical perspectives began to study curriculum subjects from 1990 onwards (Howe, et al., 2007) and initially focused on science. Recent investigations have broadened to include English, Geography and Mathematics (Alexander, 2008; Baines, Rubie-Davies, & Blatchford, 2009b; Dawes, English, Holmwood, Giles, & Mercer, 2005; Hardman, 2008; Mercer & Sams, 2006). The comparable effectiveness of these interventions indicates that group work can be tailored to different subjects – such findings indicate that awareness of factors (such as those encountered in Chapter 1) is advantageous and can lead to productive interaction taking place in classrooms.

2.2.3 Cooperative Learning

Cooperative learning features regularly within UK classrooms (Martin, 2007; Scottish Executive, 2003), leading to heightened awareness within the teaching population

(MacQuarrie, 2006) and the numerous methods derived for classroom use cited by a meta-analysis help explain such findings (Johnson, et al., 2001). Cooperative learning developed from consideration of whether individuals working in groups demonstrate competitive or cooperative behaviours. The juxtaposition of these terms by Johnson and Johnson (2005) using social interdependence theory forms the basis for their cooperative group work approach. Johnson and Johnson's *Learning Together* framework includes a vast number of group work forms developed for classroom use that range from peer tutoring to collaborative activity. Its general underpinning principle is that each individual is influenced by the actions of the group, and, once five conditions are established, an optimal environment for group work is provided.

Positive interdependence is the first condition, which leads to promotive interaction, where mutual help, assistance and trust are established within groups. Positive interdependence relates to cooperative behaviours, and will only occur when each individual within a group shares the belief that individual aims and group aims are achieved in tandem. In contrast, competitive formats involve negative interdependence where one's own aims can only be achieved by competing against group members at the expense of both group and others' goals. Cooperative groups founded on positive interdependence would exhibit supportive behaviours, where each member is equally eager to promote their own and their peers' goals. The third aspect relates to individual accountability, where each member has shared responsibility for assessing each others' contributions. The fourth condition examines the use of appropriate social skills – the sharing of responsibility such as leadership, making decisions, and using productive means of communication. The final element refers to group processing, where the group and its members takes responsibility to raise and discuss how well they are achieving their individual and group goals. These five elements form the basis of the "*Learning Together*" approach (Johnson & Johnson, 2005; Johnson, et al., 2001), which has been well received and used widely within research (Johnson & Johnson, 2009).

Slavin (1983) agreed with Johnson and Johnson, arguing that cooperative rather than competitive group work was preferable. However, Slavin's concept of cooperation is different from that within the "*Learning Together*" approach. Slavin (1980) argued that cooperative learning should be conceptualised in relation to classroom motivation. This motivational perspective (Slavin, 1987c) focuses upon the reward structures, which exist within groups. Cooperative groups ought to receive joint rewards, contingent on the group product which Slavin (1996) argues ties each individual to supporting the groups' aims. Slavin's main argument is that groups motivated to work together to achieve a group product, conditional on group effort, is more practical in relation to classrooms (see Slavin, 1987b). When cooperative groups are established within classrooms, the inherently competitive nature of the classroom changes if individuals work together within a group receive a reward for the group product.

Slavin's (1987c) argument rests on a number of principles. He suggests that factors contributing to higher order thinking are less likely to occur within classrooms than their preponderance in research would suggest and proposes that group rewards and individual accountability are more likely contributors to group work. Individual accountability is similar to that identified within the "*Learning Together*" approach. Accountability allows for any situation, which may disrupt interactions within groups, to be overcome and combined with group rewards encourages group members to focus on the group aim. Johnson and Johnson (2009) have incorporated the role of rewards within their positive interdependence framework, yet Cohen (1994) reports misgivings noting that the inclusion of rewards may inadvertently introduce negative interdependence to what may be otherwise productive interaction and may provoke inter-group competition, particularly problematic within a classroom environment. Others (Chizhik, 1999; Howe, 2010; Hoy & Tschannen-Moran, 1999) support the assertion made by Cohen that research should move on from this debate and consider the nature of tasks. Cohen argues that only “true group tasks” are likely to be so stimulating that external rewards are not required. The intrinsic nature of such tasks means they do not have a clear immediate answer thereby encouraging high-level group interaction (Chizhik, 1999) supported by its members who provide different skills (Abrami, 2009).,

The concept of individual accountability referred to by Johnson and Johnson and Slavin may help explain the support within education for cooperative group work. Teachers often perceive cooperative group work approaches as ensuring the involvement of all learners and therefore providing equal opportunities for academic growth. The motivational perspective argues that group based rewards provides the incentive to individual group members to contribute (Slavin, 1996). Of course, this is contingent on group members viewing group work as being productive – so pupils’ perception of group work is likely to be an important factor regarding classroom interaction. Slavin explains that specifics regarding classroom interaction and its relationship with motivation depend on the specifics of the cooperative approach employed. Similarly Johnson and colleagues (2005; 2001) argue the incorporation of individual accountability is imperative, citing its relevance in relation to how pupils in groups set about completing tasks. The diverse range of approaches stemming from the theoretical frameworks of both Johnson and Johnson and Slavin have been the subject of a number of reviews comparing research findings, leading to cooperative groups being recognised as an important contributor to the variety of instructional practices available to teachers (Cohen, 1994; Gillies & Ashman, 2003).

To help clarify the contribution of these perspectives research reviews will be examined. Comparison of cooperative learning with individual or competitive based group behaviours have consistently reported that cooperative formats lead to the greatest increases in academic achievements (Johnson & Johnson, 1974; Johnson, et al., 2001; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981; Roseth, et al., 2008). Roseth and colleagues' (2008) review is particularly interesting as it considers secondary aged pupils between 12-15 years of age, demonstrating that cooperative methods can boost academic performance within this educational level.

Johnson, Johnson and Stanne (2001) identify 158 articles relating to eight methods within their meta analysis (*Learning Together, Teams-Games-Tournament (TGT), Group Investigation, Constructive Controversy, Jigsaw, Student Teams and Academic Divisions (STAD) Complex Instruction, Team Accelerated Instruction (TAI), Cooperative Learning Structures, Cooperative Integrated Reading and Composition*); the sheer number of articles reveals the interest in cooperative group work approaches suited to education. Of these 158 articles 66% were conducted in primary schools (combining the categories of elementary and middle school cited in the article as pupils ranged between 3-9 years of age), 11% were conducted in high schools (10-12 years of age), and 23% were conducted in post-secondary and adult settings.

Johnson, Johnson and Stanne argue that teachers could be confident about the effectiveness of any of the eight approaches. However, they found that *Learning Together* and *constructive controversy* (both exhibit characteristics evocative of the Piagetian approach) provided the greater academic gains (in this order), when compared with competitive learning, individualistic learning and their order remained unchanged when the eight methods were ranked according to the volume of research identified for each approach.

The eight methods were also ranked indicating whether a method was more conceptual or direct in its approach (Johnson, et al., 2001). Direct approaches are initially easier to learn, representing well-defined approaches used for specific learning objectives. Conceptual approaches require more time for them to be used effectively. However, Johnson, Johnson and Stanne argue that conceptual methods have more value both for pupil and teacher, as they are highly flexible, providing a "template" for future lessons (both *Learning Together* and *constructive controversy* were rated as conceptual methods). Gillies and Ashman (2003) report this conclusion to be of considerable value, as it demonstrates the flexibility of cooperative methods in relation to education. Whether teachers who implement these methods recognise the disparity between the two approaches is uncertain. Further interpretation of Johnson, Johnson and Stanne's argument suggests that teachers' manipulation of direct approaches may render these approaches less effective. Teachers' imperfect understanding of factors contributing to productive interaction may constrain such approaches.

Sharan (1980) classifies five cooperative learning approaches as peer tutoring (*Jigsaw, TGT, STAD*) or group investigative approaches (*Learning Together, Small Group*

Teaching Method). Evidently, Johnson, Johnson and Stanne (2001) and Sharan (1980) have evaluated cooperative methodology differently. Johnson, Johnson and Stanne classify approaches according to users' difficulty, whereas Sharan examines different approaches, identifies similarities and categorises them using two classifications (peer tutoring and group investigative approach). Sharan's approach also contrasts with Johnson, Johnson and Stanne's argument that the eight identified methods of cooperative learning are effective since their diversity suggests their flexibility for use in different circumstances. Both Sharan and Johnson, Johnson and Stanne agree that the *Learning Together* approach – classified by Sharan as a group investigative method - supports pupils' academic achievement.

Research evaluating cooperative learning has progressed from refining methods to comparing group work with other forms of teaching (Bennett, et al., 2004; Lou, et al., 1996). Cooperative groups generally obtain greater scores when compared with other teaching formats with consistent findings being reported from different teaching years and subjects, including comparisons between groups and whole-class teaching (Doymus, Simsek, & Karacop, 2007; Lou, et al., 1996; Shachar & Sharan, 1994). A small scale study reported tentative findings as secondary pupils in heterogeneous small cooperative groups who received meta-cognitive training had the greatest academic gains in comparison to different forms of instruction (Kramarski, 2004; Kramarski & Mevarech, 2003). Even when additional achievement gains are not reported (Hanze & Berger, 2007) pupils with low self-concept were found to benefit from cooperative group work in comparison to those taught via whole-class methods. Similar findings have been reported within research reviews (Ginsburg-Block, et al., 2006; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003).

Chapter 1 suggested that specific structures can be used to shape groups and may be key to their effectiveness. Suggestions regarding group composition stemming from the meta-analysis conducted by Lou and colleagues (1996) have been repeatedly incorporated within studies successful in identifying academic gains. The varied nature of group work approaches arising from cooperative learning theory indicates that the use of specific types of tasks based on suggestions by Lou and colleagues (1996) and Cohen (1994) contributes to the research outcomes.

Gillies (2003b) proposed that certain conditions should be established in classrooms to ensure productive group work. These include paying attention to the composition of classroom groups and providing groups with opportunities to practise and develop specific skills prior to group work commencing. The latter might include modelling of procedures, behaviour, discussion and explanation with importance being assigned to equal participation. Gillies suggests that teachers familiar to pupils ought to introduce group work, signalling the importance of these conditions to group work, as such initial experience contributes to the expectations held between pupils and their teacher. Gillies and colleagues refer to groups who receive such support as "structured" and compare their effectiveness with unstructured groups who receive equal time with the resources to be used within groups, but no formal instruction or specific skill development. Gillies and Ashman (1998) used problem solving social studies activities with primary pupils and found structured groups displaying more cooperative behaviours and providing more forms of helping behaviours than unstructured groups. Consistent findings have been reported (Ashman & Gillies, 1997; Gillies, 2000, 2003b; Gillies & Ashman, 1998; Terwel, Gillies, van den Eeden, & Hoek, 2001). Such outcomes are not limited to the short term, as research identified comparable results one year (Gillies, 2002b; Terwel, et al., 2001) and even two years later (Gillies, 2002b). Therefore, when groups follow specific guidelines regarding their composition and their introduction to classrooms, both the short and long-term effects of pupils' interactions are evident.

A range of factors contributes to group work and the interaction that children experience. Theory and research that detail the parameters of group work within education have been examined. The remainder of this chapter will move to the details of classroom observation and policy, examining whether group work that takes place in classrooms can achieve the standard demonstrated by research.

2.3 Classroom observation research

Observational research helps explain how teachers utilise groups, reporting what actually happens, detailing what methods teachers rely upon and whether the use of groups in education is in line with the principles useful for arranging groups (see Chapter 1) and perspectives stemming from relevant theories noted in earlier sections within this Chapter.

2.3.1 Overview of relevant studies

A number of studies have involved observation of the teaching and learning strategies and classroom interaction occurring within lessons (Alexander, 2000; Blatchford, et al., 1999; Blatchford, et al., 2001b; Galton, et al., 1999b; Roth, Druker, Garnier, Lemmens, Chen, Kawanaka, Rasmussen, Trubacova, Warvi, Okamoto, Gonzales, Stigler, & Gallimore, 2006). Such studies adopt a naturalistic approach, providing some grounds for crediting their research, which is accepted as representing an accurate picture of pupil and teacher behaviour during lessons. In this regard, specific well-sampled projects will be considered and supported by teacher and pupil responses to surveys (Assessment of Achievement Programme, 2002, 2003, 2005; Baines, et al., 2003; MacQuarrie, 2006; Roth, et al., 2006).

The observation and classroom learning evaluation (ORACLE) project (1975-80) was the first UK large scale systematic observation study. It was replicated between 1995 and 1998 and both projects were co-directed by Professor Maurice Galton (Galton, et al., 1999b; Galton, Simon, & Croll, 1980). The research focused on classrooms within the last two years of primary school and the first year of secondary (equivalent to the last three years of Scottish primary education). The study considered numerous classroom processes, including the frequency of particular classroom structures and detailed evaluation of teacher and pupil interactions. Such research is unique in its content, the volume of data collected and the fact that the researchers returned and employed the same research methods twenty years later, leading to an exceptional body of work.

A cross-cultural study focusing on primary education in five countries (England, France, Russia, India and USA) by Professor Robin Alexander (2000) embraced the diversity that culture presents, and society and its traditions were fundamental to the research as evident in its title “Culture and Pedagogy: International Comparisons in Primary Education”.

The Third International Mathematics and Science Study (TIMSS) video study included observation of lessons from Australia, the Czech Republic, Japan, the Netherlands, and the United States. A large scale mapping study of primary and secondary classrooms collected both observation and questionnaire data (Blatchford, et al., 1999; Blatchford, et al., 2001b). Similarly, the assessment of achievement programme (AAP) collected data from both pupils and teachers during the 1980s to 2004, being replaced by the Scottish Survey of Achievement (SSA) in 2005. Originally, only English, Mathematics and Science subjects were considered, but surveys have extended to include "Social Subjects" and other relevant themes within the Scottish curriculum such as "core skills". These surveys aim to profile pupils' learning and incorporate a number of questions that assess pupils' experience of different teaching approaches, including group work.

2.3.2 Primary classrooms during group work

Alexander (2000) argues that two approaches summarise primary teaching: Central European (classroom based pedagogy) and Anglo American (group or individual based pedagogy). The physical appearance of classrooms observed supports this distinction. Classrooms within the USA and England most regularly seat pupils in groups. French and Russian pupils are regularly seated in pairs and individually, Howe (2010) notes that extremely large class sizes and the preponderance of individual pupil seating is sufficient to explain why India, despite its British colonial history, aligns with France and Russia. The seating arrangement of pupils is clearly a contributory component of classroom interaction, and varies within the different countries leading to separate classifications of the teaching and learning mechanisms. Within Central European lessons interaction is public, highly structured and involves the class. In contrast, during Anglo American lessons, interaction was frequently informal, less structured and conversations were peer based. Pupils' interaction and discourse therefore varies within the different forms of pedagogy and relates to the forms of organisation occurring within the classroom. Equally, the organisation of pupils within a classroom, particularly within primary education (Galton, et al., 1999b), allows pupils to sit in pairs, groups or individually. A much-cited criticism of classroom group work (Alexander, Rose, & Woodhead, 1992; Blatchford, et al., 1999; Blatchford, et al., 2001b; Galton, et al., 1999b) shows that although pupils are seated in formats that support interaction, group work will not automatically follow.

This distinction has been supported by research that compares primary education within European countries. Osborn found that groups were used as an organisational method rather than a learning enhancement strategy (2001, 2003), when the frequency of group work in primary schools within England (and Denmark) and its infrequency in France was compared. Osborn (2003) noted that Denmark’s educational policy focuses on collaboration in contrast to England’s emphasis on differentiation and France’s on universalism. It follows that group work was most frequent in Denmark, and lowest in France where it is attributed less value. England appeared somewhere in the middle, where group work is used frequently with a range of other teaching and learning methods. The separation between group work as a teaching approach and an organisational approach is blurred, and even Ofsted (2003) did not distinguish between the two possible uses. As stated in Chapter 1, the importance of being able to distinguish between the intentions used to create and manage groups must be recognised in both policy and research. Arranging pupils into groups with the aim of providing opportunities for collaboration is fundamentally different from the arrangement of pupils that facilitates teaching. There is evidently a difference between the intentions to establish effective learning through group work or whether interaction in groups is an after-effect of a classroom seating arrangement.

Alexander et al. (1992) talked about "fitness for purpose" when describing the choice of methods in relation to appropriate tasks being allocated. This clearly relates to the use of group work being inappropriate when pupils are assigned work that can be completed individually and reinforces the concept of "true group tasks" (Cohen, 1994). Galton (1999b) reports that incompatible seating and working arrangements are common practice within primary classrooms. Attempts to separate learning and organisational approaches and explain the importance of the separation have not been successful. When group work occurs as an after-effect any interaction that follows will influence pupils' enjoyment and perception of group work - teachers' sole attention to seating arrangement may make it a dull and unproductive experience. In contrast, when group work is used for learning teachers may utilise supportive language and behaviours, create a positive welcoming environment, where pupil contributions are encouraged and thus reflect aspects of the theories discussed earlier.

Moving to studies that focused solely on UK primary classrooms Galton and colleagues (1999b) reported that the organisation of the classroom is related to pupils' task engagement. This project evaluated both the location where pupils were seated but additionally with whom pupils worked. It recognised that pupils can be seated in groups for both organisational purposes and learning activities within classrooms. Blatchford et al. (1999) in their mapping study also relied on the distinction between groups used for learning in contrast with groups used as a classroom organisational method, indicating that teachers continue to use such methods, as did the assessment of achievement survey as pupils and teachers were asked whether groups were used as a learning activity or as a form of classroom organisation. All of these sources indicate that pupils experience small group work in both formats. Of particular interest is the finding that small group work is the principal form of classroom organisation within UK primary schools, but is used less frequently as a learning activity. This demonstrates that primary pupils are frequently seated in groups, but neither suggests that interaction is supported by teachers because they have seated pupils in groups nor implies that effective group work follows from such seating arrangements.

Hastings and Schwiseo's (1995) review of classroom seating supported this conclusion and flagged the distinction between pupils working in groups and pupils sitting in groups. They argued that incompatibilities between tasks and seating arrangements have been found to have implications for pupils' attention to task and their on task behaviour. Both Galton and colleagues (1999b) and Hastings and Schwiseo (1995) found pupil task engagement was associated with pupils working individually and seated in rows. The possibility that particular seating arrangements will be associated with a greater volume of on-task behaviour is problematic. On-task behaviour is at best a crude indicator of pupils' actual classroom behaviour (Hastings & Schwieso, 1995). Secondly, learning is a social process and demands that pupils interact with their peers and teacher in a variety of task and non-task fashions; however, Hastings and Schwieso point out that alternative measures were not incorporated within the publications they reviewed. Crude observations of pupil on- or off-task behaviour do not adequately represent group interaction and this has been recognised within recent research (Baines, et al., 2003; Blatchford, et al., 2001b; Howe, et al., 2007; Topping, Thurston, Tolmie, Christie, Murray, & Karagiannidou, 2007). There is little doubt that a similar approach ought to be incorporated in future studies, it is clear that observational schedules utilised within the thesis ought to incorporate possible inconsistencies in pupils' behaviour evident within group work lessons.

2.3.3 Secondary classrooms during group work

In contrast to the wealth of research available regarding primary education, studies investigating secondary education are scarce both in terms of experimental and naturalistic research. Only recently have secondary schools been examined with studies incorporating group work within their observation or questionnaire based research (Baines, et al., 2003; Blatchford, et al., 2001b; Hargreaves & Galton, 2002; MacQuarrie, 2006; Topping, et al., 2007), which limits what can be said regarding differences between primary and secondary use of group work.

Observation (Blatchford, et al., 2001b; Roth, et al., 2006) and surveys (Assessment of Achievement Programme, 2002, 2003, 2005; MacQuarrie, 2006; Scottish Survey of Achievement, 2006, 2007) indicate that small groups are used for learning but feature in tandem with a range of other teaching and learning methods. Secondary pupils appear to be seated within classrooms in a variety of formats, but work individually for most of a lesson, irrespective of their seating arrangements. Blatchford and colleagues (2001b) claim that as pupil age increases so does the proportion of time spent working alone.

A survey of Mathematics, English, Modern Languages, History and Science teachers, which the author conducted for her MSc, suggested a number of findings relevant to this research (MacQuarrie, 2006). It indicated that, in the first and third years of secondary education, small group work is especially likely in Science and English classrooms (thus providing parameters for Study 1, whose methods are presented in Chapter 3). Given that large scale studies have tended to focus on Mathematics or Science, with limited research considering literacy (Assessment of Achievement Programme, 2003; Blatchford, et al., 2001b; Rice, 1999; Scottish Survey of Achievement, 2006; Whitburn, 2001), the inclusion of English lessons would be surprising, if it were not for evidence stemming from teacher reports indicating extensive use of group work in that context. The survey also found that teachers report moderate use of the incompatible seating and working arrangements within science and English classrooms (2006), originally noted as a feature of primary classrooms (1999b).

Additional outcomes such as pupils' attitudes to group work and teaching subject are informative in explaining potential gains achieved through involvement in group work. Lou and colleagues (1996) attempted to tease out the influence of different forms of grouping regarding these outcomes and report a positive relationship between grouping and pupils' attitude to teaching subject but note that their interpretation was constrained due to the small number of studies that examined such measures.

Other reviews of research have indicated that gains in attainment (typically included within investigations utilising group work) are seen in tandem with associated improvement in pupils' motivation and attitudes (Johnson, Johnson, & Taylor, 1993; Johnson, Johnson, & Tauer, 1979; Sharan, 1980). Yet little of such evidence stems from UK contexts. Exceptionally though, Pell and colleagues (2007) examined secondary pupils' attitudes to group work and attitudes to teaching subjects over the course of a two-year investigation. The use of a longitudinal group work intervention was found to maintain pupils' initial positive perception of group work, despite attitudes towards specific subjects decreasing. Pell and colleagues also reported a positive relationship between pupils' beliefs regarding group work and their perspectives regarding their teaching subjects and more generally their education. Clearly, it would be of considerable interest to investigate such outcomes in a naturalistic context, particularly as Pell and colleagues report experimental findings, where pupil behaviour in groups was productive. However, as noted previously interaction in groups in naturalistic settings may be based on ineffective practice. For example, pupils who do not enjoy a teaching subject may behave differently when presented with opportunities for interaction within that subject – pupils could be withdrawn and appear reluctant to interact, or alternatively opt to work alone but remain seated in the group therefore avoiding teacher attention. Therefore, conclusions based on classroom observation can be supported with the use of supplementary measures indicating that the nature of classroom interaction can be assessed more accurately when pupils' attitudes are examined (in addition to the measure of peer relationships suggested in Chapter 1). Thus, to fully assess and detail the nature of group interaction, multiple measures ought to be included in Study 1 and 2.

2.4 Dialogue during classroom interaction

As seen in the discussion of the different theoretical perspectives dialogue has played a central role when the nature of group work is being examined. Improvements in research methodology have allowed investigations to focus on pupil interaction and dialogue. Research evidence such as that obtained from the TIMSS video study (Roth, et al., 2006) provides overwhelming confirmation that discussion features within secondary science lessons, as pupils were found to be involved in 81% of discussions during whole-class lessons. Pupils' understanding comes largely from their interaction and discourse with their peers and teachers, therefore such "talk" (Alexander, 2000, p. 355) has particular importance during group work.

Evaluation of the dialogue used during group work can help detect problems that pupils encounter and demonstrate how errors or miscomprehension is managed within groups. Within collaborative groups, which depend upon mutual interaction and continued renegotiations of meaning (Mercer & Littleton, 2007e), dialogue is central when pupils' representational knowledge is used to create groups whose members hold conflicting perspectives (Howe et al., 2000; Howe et al., 1995; Pine & Messer, 1998). Such group interaction provides support for the forms of group interaction advocated by the theoretical perspectives discussed earlier.

Much criticism has focused on group work discussion observed within naturalistic classrooms. Even within classrooms, which regularly use group work as an instructional strategy, pupils' dialogue is argued to be ineffective in relation to the task if it is focused at a low level or is unrelated to the task (Galton, et al., 1999b). Similar arguments have been made regarding unproductive dialogue following a large scale study of primary school pupils' (8 – 10 years of age) talk during small groups' interaction at computers within classrooms (Wegerif, 1997).

Some explanation regarding the low level of talk observed within groups interacting in authentic classrooms could come from the interpretation that pupils constrain themselves during interaction, allowing teachers to provide the majority of input (Alexander, 2006). Therefore, pupils and teachers constrain their behaviour according to the roles they typically adopt (during whole-class teaching) where pupils focus their attention on the teacher expecting information, described by Howe (2010) as the "performance" mode operating within classrooms. Observation of classroom interaction within research has made clear that there is an assumption that pupils can converse at length leading to productive interaction (Blatchford, et al., 2006). However, whether pupils are capable of achieving such interaction in the face of barriers to learning such as teachers' management of transitions between standard whole-class teaching and group work has not been verified. Both teachers and pupils will most likely need to acclimatise to the new classroom dynamic supportive of productive interaction where pupils' contributions are welcomed and teachers encourage such interaction. It follows, that evaluation of such interaction is a line of investigation to be evaluated throughout the research conducted as part of this thesis.

When pupils are working in groups, they are provided with an ideal opportunity to discuss and challenge each others' ideas and support their learning. However, lessons geared towards whole-class teaching could provide similar opportunities for interaction, particularly as small groups are less frequently used in secondary education relative to primary education (Baines, et al., 2003). Fewer opportunities for interaction may suggest that pupils will make more spontaneous attempts to engage with their peers. This heightens the need to examine the context of the classroom – considering whether the learning environment is primed for group work and whether pupils are prepped prior to group work, understood through behaviour made by teachers before and after group work. Therefore, care must be taken when interpreting classroom interaction – teacher supported interaction may be different from that which occurs spontaneously.

2.4.1 Overview of relevant studies

A number of projects examining group work and pupil interaction while conducting research in genuine classrooms also provide information about dialogue and add to the studies cited in Section 2.3.1. An increase in research that utilises interaction in groups has followed from the evident divide between experimental groups' superior performance in contrast with that achieved by classroom groups (Wood & O'Malley, 1996).

An approach based on theory and developed for schools is "CASE" or cognitive acceleration through science education. The approach has also been applied to mathematics education - CAME. Originally developed for pupils aged 11 to 14 years it has been expanded to include the final years of primary school. Peer interaction is given priority in CASE activities, complementing the curriculum taught in schools. Although such an approach consumes a proportion of the teaching time and requires commitment from teachers and schools involved, the benefits generalise to other academic subjects (Adey, Robertson, & Venville, 2002; Adey & Shayer, 1993, 1994) and are visible both in the short and long term. This approach exemplifies a method suited to classroom interaction and is an example of what is available to local authorities and schools aiming to improve peer interaction and pupils' academic achievements.

Two projects that implemented interventions within primary schools are particularly relevant as they consider group work to be an indispensible component of teachers' instructional strategies. The SPRinG project (Social Pedagogic Research into Group work) was conducted in England with pupils aged 5-14, followed by a partial replication with pupils aged 9-12 in Scotland (SCOTSPRinG). Both demonstrated that conditions for productive group work could be established within primary school science lessons (Baines, et al., 2007; Howe, et al., 2007; Thurston, et al., 2008b) and other subject areas (Blatchford, et al., 2006; Blatchford, Galton, Kutnick, & Baines, 2005). Their relational approach to group work - which encompasses many of the principles of cooperative learning integral to the "*Learning Together*" approach (Howe, 2010) - emphasises the inclusion of both teachers and pupils within interactions, but stipulates that pupils must be given sufficient time to develop the skills necessary for group interaction. Increases were evident in pupils' academic achievements (Baines, et al., 2007; Howe, et al., 2007; Thurston, et al., 2008b) and encouraging findings were obtained regarding changes in pupil behaviours during interaction with their peers (Baines, et al., 2009b; Blatchford, et al., 2006).

Mercer and colleagues (Littleton, et al., 2005; Mercer & Littleton, 2007e; Wegerif, et al., 2005) established the "*Thinking together*" approach. It has been successfully applied to Key Stage 1 (pupils aged between 5 and 7), Key Stage 2 (7 to 11), Key Stage 3 (11 to 14) and rolled out within international educational contexts (Rojas-Drummond & Mercer, 2003; Rojas-Drummond, Mercer, & Dabrowski, 2001; Rojas-Drummond, Perez, Velez, Gomez, & Mendoza, 2003; Wegerif, et al., 2005). This approach emphasises the importance of communication and provides pupils with skills they can use during peer interaction but are equally relevant when pupils work individually.

2.4.2 Dialogue observed within classroom based research

These projects have considered the impact of group work on pupils' discussions and particular forms of dialogue have been demonstrated as having greater potential for learning when pupils are involved in group work (Barnes & Todd, 1977; Littleton, et al., 2005; Mercer, Dawes, Wegerif, & Sams, 2004).

Solicited helping behaviours, where an individual receives help having asked for it, are argued to be fundamental for encouraging group activity and maintaining on task behaviour (Terwel, et al., 2001). These include explanations, which have been consistently identified as helping both the provider and recipient (Webb, 1982, 1991; Webb & Mastergeorge, 2003a); and which provide opportunities for group members to align their learning and knowledge as a consequence of helping (Gillies, 2002b; Oortwijn, Boekaerts, Vedder, & Fortuin, 2008).

Giving and receiving explanations supports social and academic benefits gained within group interaction (Webb, 1989; Webb & Mastergeorge, 2003b). Individuals' awareness of their peers' comprehension is raised leading to appropriate explanations being given. As a consequence pupils may ask for assistance from their group rather than their teacher (2003). This could indicate why both giving and receiving explanations are important to pupils' comprehension, academic development and group interaction. Webb (1989) reported that giving high level explanations was positively related to achievement; their production encouraged reorganisation of knowledge for the pupil producing the explanation and the recipient. Low-level explanations – defined by the absence of a coherent and developed answer - may enable pupils to propose an answer but reduce the likelihood of consequent higher order thinking.

Likewise, Mercer and colleagues have described that "exploratory talk" where peers provide explanations and constructively support others' ideas, and shown that it is an important feature of productive group discussions (Mercer, et al., 2004; Mercer & Littleton, 2007a). Further support for the advantageous nature of these features of dialogue came from the SCOTSPRinG project, where such features were directly related to increases in pupils' academic achievement (Howe, et al., 2007). There are tentative findings that suggest pupils' classroom relations and the environment in which groups interact contribute to these findings (Christie, Tolmie, Thurston, Howe, & Topping, 2009;

Tolmie, et al., 2010). Such learning approaches have benefits both for pupils' participation within group work but can also support what pupils can achieve when working alone (Mercer & Littleton, 2007c). Studies have also shown that academic benefits are not restricted to the subject area, in which skills were originally developed (Adey & Shayer, 1993; Baines et al., 2007; Shayer, 1999a).

These projects evaluating group work provide strong evidence that group work can feature regularly within educational contexts and that peer interaction can involve higher order thinking as evidenced by group dialogue. Research has clearly established that giving explanations and seeking assistance are productive forms of dialogue, so these will be key variables in the observations of classroom interaction in the studies to follow.

The specific conditions outlined by such research are related to potential gains following from participation in group work. Such conditions are important, as minute changes to the parameters within which small groups operate have been observed to have powerful consequences for the benefits derived from group work. This has particular resonance for classroom contexts where group work is regularly used as a teaching and learning approach (Howe & Tolmie, 2003).

Research may determine optimal conditions regarding pupils' learning within groups. Whether such circumstances are relevant within everyday lessons can only be accurately determined when the context in which teachers currently utilise group work is incorporated, and when methods have been tested within educational environments. In this respect effective group work approaches may not be easily established for secondary education, as few studies accurately portray classroom interaction within group work educational contexts.

So far, the discussion of classroom dialogue has examined how pupils talk during group interaction. Yet to comprehend the role of small groups within educational contexts, teachers' dialogue within classrooms needs to be considered. As noted at the outset of Chapter 1, the most common form of classroom interaction occurs during whole-class teaching, which allows a teacher to engage simultaneously with the entire class. Question and answer sessions typify teacher-pupil interaction during whole-class teaching, and have been labelled the "IRF exchange" (Sinclair & Coulthard, 1975); where teachers initiate material (I), pupils respond (R), and teachers provide feedback (F). Teachers' use of questioning reveals two forms - open and closed questions, closed questions typically suppose a single response. In contrast, open questions typically achieve multiple responses, perhaps sourced from different pupils. The nature of the open question, and cues elicited from teachers' behaviour (Alexander, 2000), indicate that pupils may volunteer extended explanation of their answer, generally not seen in response to closed questions. Thus, the type of question influences pupils' responses, which in turn influences the extent to which feedback is present within lessons (Tharp & Gallimore, 1991). Howe (2010) notes the condensed form of IRF structure, where feedback is tacitly implied, or commentary following pupil contributions emphasises and repeats pupils' statements rather than providing explicit commentary on it.

Tharp and Gallimore note such behaviour follows a frequent pattern, "Recitation Script". They describe the use of a series of questions seeking predictable and obvious answers. Although having a pre-determined answer in mind would seem to be a shortcoming, Edwards and Mercer (1987) introduced the term "cued elicitation" to explain teachers' questioning strategies. They describe how teachers draw attention to content that pupils should attend to, signalling what they want to see in pupils' answers. Such behaviour is argued to encourage pupil participation (Hardman, 2008). Even if increases in pupil participation were found, that teacher dialogue (within whole-class scenarios) is geared towards identifying the correct response in relation to the learning objective (2006), would suggest little overall change to the nature of classroom interaction. Such talk (of the IRF recitation type) following group work is likely to devalue the interaction and exchanges made during peer interaction. In particular, it seems likely that pupils will not be encouraged to interact within groups if such interaction is followed by correct answers being presented by their teacher where little value is given to their contribution.

Initiatives (aimed at primary and secondary schools within England) have either introduced new technologies (e.g. interactive white boards or IWBs) or "new thinking" (e.g. whole-class interactive teaching based on principles observed within Pacific Rim classrooms) and are helpful in describing teachers' practice as they note teachers' behaviour before and after the main part of a lesson. In general, such initiatives aim to change the nature of interaction within whole-class lessons, and agree that their approach should encourage pupil participation. Despite the profound claims associated with such initiatives, IRF structures have proved resistant to change (Mercer, 2007; Smith, Hardman, & Higgins, 2006, 2007). Primary teachers were able to emulate the pace of whole-class lessons observed within Pacific Rim classrooms; however the anticipated increase in opportunities available for pupils to ask questions did not follow (Burns & Myhill, 2004; English, Hargreaves, & Hislam, 2002; Smith, et al., 2004). Smith et al. (2006) observed primary schools' numeracy and literacy lessons using IWBs and reported a greater volume of open questions by teachers but this was not maintained following the first year of IWB use. Secondly, whole-class teaching occurred more often at the expense of group work and continued usage of IWB encouraged more shifts or moves during a lesson between whole-class and individual work (2006). Such changes in the classroom dynamic are significant considering that increases in the pace of a lesson appear to influence the variety of organisational strategies used by teachers and that group work relies on effective communication which requires a substantial proportion of class time (Cohen, 1994; Howe & Mercer, 2007; Kutnick, et al., 2005a; Mercer & Littleton, 2007b).

Clearly, that which is expressed within whole-class formats is characteristic of teachers' talk. Of course, any attempt to assess teachers' dialogue should feature questions. Considering that IRF structures are rooted in classroom interaction, to elucidate the nature of teachers' talk distinctive forms of dialogue may be more helpful and thus can be incorporated within the current research. Potential forms include how teachers aid the interpretation of material, including when teachers aim to stimulate pupils' thinking by making connections or provide an overview of the lesson during lesson introductions. Research has suggested that teachers are likely to model behaviours they deem desirable within pupil interaction (Webb, Franke, Ing, Chan, De, Freund, & Battey, 2008; Webb, Nemer, & Ing, 2006), hence forms of dialogue (for example explanations as seen earlier) could also feature within teachers' talk during whole-class teaching.

Changes noted regarding the classroom dynamic (teachers' attempts to alter their standard approach influenced the pace of lessons and the use of different teaching and learning arrangements), signals that a broader perspective that examines the classroom may prove valuable when the nature of group work within lessons is being examined. Hence, measures will be included within the studies to follow that help examine factors thought to influence the nature of interaction within classrooms.

So far, the emphasis has focused on the characteristics of groups within education. Chapter 1 explained that teachers make specific judgments regarding the teaching approaches they employ within classrooms. These can be further understood through examination of the regulations and frameworks presented regarding group work and teachers' practice at an international and UK level.

2.5 Guidance within international policy

Recalling that English and Science classes are the focus of this research (see Section 2.3.3 and Chapter 3), guidelines for each of these subjects will be considered in turn. Policy and documents providing recommendations for science teachers' practice (Eurydice, 2006) examined countries' regulations on which teachers establish their behaviour. The report studies both primary and secondary education and considers science as an integrated and a distinct discipline. Policy cited in the report (including the UK), vaguely speaks of teachers having "knowledge of different teaching approaches" (Eurydice, 2006, p. 14). The content of such "knowledge" can only be understood if material incorporated within teachers' initial training is considered. The report provides detail on the separate approaches undertaken in Scotland, England, Wales and Northern Ireland and notes that Scotland specifically makes "knowledge and background of the teaching and learning processes" compulsory. However, as little specific content can be identified regarding group work within initial teacher education guidelines, science teachers trained in Scotland are not likely to be more equipped than their counterparts trained elsewhere in the UK. Within the entire Eurydice (2006) report, group work is considered on only two occasions. The first acknowledges that science lessons utilise different teaching formats, including small groups and the second describes groups used during practical work in the laboratory. Perhaps the report should not be criticised regarding the lack of information regarding group work, rather the policy upon which the report is based, should receive such criticism.

Cross-cultural research examining components such as literacy or language (instruction regarding the native language of a country) typically relates to groups being used to encourage reading skills in primary schools (Eurydice, 2009), further overlooking the potential of interaction. The criticism that group work is ignored within policy documents relating to English and science cannot be restricted to European policy. A review of science education in Australia (Goodrum & Rennie, 2007) is constrained despite criticising current pedagogy for its lack of variety in teaching practises (Tytler, 2007). It does little to explain recommended formats. The review repeatedly states that science needs to be made more relevant to pupils. It argues that pupils' own interpretation of material is fundamental to this process yet a glaring omission is the failure to recognise group work as a mechanism able to encourage such change. Policy recommendations broadly indicate that teachers should employ a variety of teaching approaches, yet seldom emphasize the inclusion of group work within classrooms.

Recent commentary from experts within the field of science education (Osborne & Dillon, 2008) supports the conclusion that European policy avoids discussion of group work. The report states that inclusion of wide-ranging teaching practices as suggested in policy demand much larger changes in pedagogy than current policy admits. Such remarks concerning policy and teaching practices cannot easily be dismissed. Moreover, the report succinctly summarises one of the problems that teachers face: if teachers are expected to use effective group work within classrooms, they must be equipped with appropriate tools and guidance. Yet the vague statements offered as guidance make it more likely that teachers unintentionally use unproductive methods.

2.5.1 UK education policy and group work

Current UK education policy recognises the value of group work, describing group work as a feature of classrooms. The guidance available to teachers agrees that pupils should be provided with opportunities to experience a variety of teaching formats (Department for Education and Employment, 1999a, 1999b; Learning and Teaching Scotland, 2000a, 2000b; Scottish Office Education Department, 1991). Recommendations regarding first and second teaching years (Scottish Office Education and Industry Department, 1997) recognise that pupils encounter different teaching and learning formats but suggest that whole-class teaching should feature as a key contributor as it is associated with the declaration of learning purposes. Such instruction (described earlier in Section 2.3.3) necessitates active engagement with pupils about their learning and encompasses an efficient means of providing general introduction or explanations, or processes of probing pupils' knowledge. Thus within occasions when introduction and evaluation of information may be prominent, a greater volume of whole-class teaching may be evident at the beginning and end of lessons.

Recommendations guiding the teaching of environmental studies – which encompasses science (Learning and Teaching Scotland, 2000a) - are that once the learning objective and context of a lesson has been established the form of teaching arrangement used should relate to teacher judgment or preference. Such flexibility will be welcomed by teachers, as will the acknowledgement of small group work in relation to practical activities, reflecting statements presented in research (Cano, 2005), but generally such guidelines do little to guide their practice. Clearly, the criticism made earlier regarding international policy is also applicable to recommendations made by UK stakeholders. This is particularly problematic as Science has received a wealth of attention from group work research (Howe, et al., 2007).

The guidelines available to Scottish teachers regarding English language for pupils aged 5-14 (Scottish Office Education Department, 1991) indicate that group work ought to be a regular feature when discussion is integral to the learning objective and because interaction supports the four outcomes of listening, talking, reading and writing.

Policy produces guidance and recommendations advising what should happen within teaching. It provides scant detail regarding group work, with recommendations constraining its use to specific content but failing to comment further. The proposal that education should accommodate a variety of teaching and learning approaches is echoed by different policies indicating that group work is supported within both Science and English classrooms. The inclusion of detail regarding whole-class teaching demonstrates that policy documents are able to outline suitable teaching approaches, which begs the question why content regarding group work is so limited? Few if any, specific research findings have been detailed; recommendations are subsequently almost hypothetical. An explanation comes from the constrained association that is evident between research and policy. Hemsley-Brown and Sharp (2003) report that decision-making bodies, including policy makers, local authorities, and school boards, rarely use research findings to support the development of policy based decisions. There is an argument that limited access to research findings restricts the opportunities available to bodies responsible for policy recommendations to develop evidence based practice (Hillage, Pearson, Anderson, & Tamkin, 1998). Nevertheless Bolam (1994) concluded even when research findings are systematically made available, little impact is typically observed on either policy or on teachers' practice. In fact criticism made of educational research (Hargreaves, 1997; Tooley & Darby, 1998) contributed to government supported measures being established – including the Centre for Evidence Informed Policy and Practice in Education (EPPI centre), which aims to disseminate publications and research to make access easier for all interested parties. It remains to be seen how successful such measures are in contributing both to large- and small-scale policy and teaching decisions.

2.6 Context of secondary education

The increasing number of studies examining transition from primary to secondary education makes plain that transitional arrangements are necessary because of the stark contrast between the two environments (Braund & Hames, 2005; Hargreaves & Galton, 2002; Topping, et al., 2007). However, group work research has not acknowledged differences in the educational contexts that pupils face, or indeed the mental and physical challenges that adolescents endure during secondary education. The move from primary to secondary education reflects a shift in teachers' expectations regarding pupils' behaviour and their approach to learning. Additional challenges facing pupils relate to decisions regarding their own personal development during secondary education, including the completion of examinations and choosing their educational or training pathways following compulsory education.

Group work research needs to acknowledge that pupils within secondary education face a myriad of demands and challenges in accordance with their development. Neither have group work approaches been tailored to secondary education, meaning that effective and rewarding methods have not been available for teachers to include within the instructional strategies they use, nor have pupils had the opportunity to experience them. Indeed, this includes the lack of tasks (argued to be fundamental to group productivity) suitable for inclusion within projects investigating group work.

2.7 Overview of the current research

Given the scarcity of previous research, there is considerable potential gain from investigating group work within Scottish secondary schools. Such evidence should outline current teaching practice and detail characteristics of pupil and teacher interaction in relation to different teaching approaches. The lack of research does not automatically suggest untested practices are being used rather that their nature remains elusive.

As little research has focused exclusively on this age range, whether it is appropriate to use methods devised for primary aged children with secondary aged pupils is uncertain. If primary school methods are used with other populations, their impact on pupils' learning has not been established. The main opposition to using materials aimed at primary education relates to evidence which reports that minute changes in the approach pupils use during group work can severely reduce benefits following from participation (Howe & Tolmie, 2003). The construction of a successful and appropriate group work method is a complex process and a large component is the nature of the task used within groups. Merely swapping one task for another more difficult task is unlikely to result in effective group work, as other factors need to be included at the planning stage so that tasks contribute to pupils' experience of interaction and approximate the description of a "true group task" (Cohen, 1994).

It cannot be assumed that classrooms using groups will demonstrate uniform approaches to group work. Observation (Blatchford, et al., 2001b; Roth, et al., 2006) and self-report measures (Assessment of Achievement Programme, 2002, 2003, 2005; Scottish Survey of Achievement, 2006, 2007) involving secondary schools have made it apparent that small groups are used as a learning activity but feature in tandem with other teaching and learning approaches. Although secondary pupils appear to be seated in a variety of formats within classrooms, research (Baines, et al., 2003; Galton, et al., 1999b) suggests they may work individually within the greatest part of a lesson, irrespective of their seating arrangements. Thus, a primary aim of the thesis focused on investigating the nature of interaction, evaluating small groups in order to assess the parameters of interaction, and explore pupils responses when presented with opportunities to interact with their peers. The observation materials incorporated the distinction between different types of groups and were sufficiently flexible to allow classroom interaction to be recorded without regard to pupils' seating arrangements.

The few studies evaluating group work within secondary education limit the possibility of forming specific hypotheses about what takes place. One line of investigation relates to whether teachers distribute different tasks to groups. Indeed, guidance would appear to encourage such processes to accommodate different learning styles (Scottish Office Education and Industry Department, 1996). The first study in this thesis (Study 1) explores classroom behaviour by looking at the relationship between pupil behaviour and the form of instruction their teacher is using. For example, being seated in groups and assigned a group task does not necessarily lead to productive interaction (Barron, 2003; Oliveira & Sadler, 2008; Wegerif, 1997; Yetter, Gutkin, Saunders, Galloway, Sobansky, & Song, 2006).

Many studies which have examined pupils' talk recognise productive interaction as having greater potential for learning when pupils are engaged in group work (Barnes & Todd, 1977; Littleton, et al., 2005; Mercer, et al., 2004). For example, when pupils counter statements, such action not only stimulates the understanding shared by group members but also goes some way to solidify an individual's own beliefs and understanding. Similarly, reports that pupils who initially held opposing perspectives are able to reconcile their thinking when small group work is governed by specific conditions (Howe & Tolmie, 2003) indicates that the standard of interaction suggested by theory can be approached (Piaget, 1962). In light of the above, in order to quantify productive interaction, Study 1 will compare pupils' talk in relation to what type of class pupils were working in.

Secondary schools require in-depth observation of lessons to ascertain how and why group work is used and an evaluation of the approaches, mechanisms and methods relied upon by teachers. Both these lines of investigation form the major theme underpinning this thesis: to provide an overview of classroom interaction. To this end, this research is the first to use a systematic naturalistic observation procedure, combined with supplementary measures, within Scottish secondary schools, to observe both pupils and teachers during lessons. Thus, Study 1 aims to identify which characteristics of productive group work are currently utilised within authentic classrooms. Study 2 incorporates the findings of Study1 to develop a group work approach specifically aimed at secondary pupils.

Chapter 3

Study 1: Comparing group work and conventional lessons, exploring behaviour recorded during classroom observation, and examining participants' perceptions of groups.

This chapter is the first of three that will introduce and consider findings from the first investigation of this doctoral research, which involved collecting observational data within naturalistic classroom settings, and asking pupils and teachers within these classrooms to complete questionnaires. These findings will then be considered in relation to previous research and contribute to the development of a group work intervention aimed at improving practice (Study 2).

3.1 Rationale

Extensive research has evaluated the benefits of participation within group work for pupils, yet the implications of such studies cannot be assumed to be applicable across all sectors because most research has examined primary education. Secondary and primary classrooms are qualitatively different environments, both in terms of their organisation and the pupils who inhabit them. Therefore, approaches to group work ought to be founded upon environments pupils are trying to adapt to, easing their inclusion within the range of instructional approaches utilised by teachers. Their effectiveness should also be assessed by academic tests or otherwise. Contributing to the argument that secondary education is different is the fact that secondary aged pupils are adolescents; they are involved in a process of change, which at its core is a personal and individual experience.

The 5-14 guidelines and the Curriculum for Excellence outcomes and experience guidelines recognise the personal nature of adolescence. This implies that pupils who enjoy learning within one teaching subject may not be equally successful or have similar academic abilities within other subjects. Adolescent development and maturation are not uniform processes and different pupils will have different abilities and preferences towards different teaching subjects, which will influence the classroom environment. Accordingly, this research encompassed a measure to ascertain pupils' preferences regarding their schooling.

As research pertaining to secondary education is scarce, conducting a naturalistic, systematic observation of secondary classrooms is, at the very least, desirable. Moreover, programmes involving group work founded upon classroom observation have been successful, indicating the value of incorporating such knowledge (Baines, et al., 2007; Blatchford, et al., 2001b; Howe, et al., 2007). Thus, a study of secondary classrooms would be logical, both to portray the nature and use of group work within Scottish contexts and to help develop an intervention specifically aimed at secondary schools.

3.2 Outline of primary and secondary Scottish education

The introduction of the "Standards in Scotland's Schools Act" following devolution (Scottish Executive, 2000a), set out the guidelines for the free and compulsory schooling of all Scottish children between 5 and 16 years of age (Thurston & Topping, 2005). The Scottish Office Education Department (now the Scottish Government Education Department) developed a series of curriculum and assessment national guidelines covering the 5-14 curriculum, from the first year of primary school to the second year of secondary school. The third year of secondary education onwards is guided by regulations related to national qualifications – in Scotland these requirements and relevant support materials constitute a broadly agreed agenda.

In Scotland, pupils complete seven years at the primary level before moving into a minimum of four further years at secondary school (Thurston & Topping, 2005). The 5-14 programme incorporates stages reflecting children's development. In the first (S1) and second years (S2) of secondary, the 5-14 programme is followed. Within their second year pupils select seven or eight subjects they wish to study for the following two years (S3 and S4), in order to complete their Standard grade exams. Therefore, pupils' experiences within their first year at secondary school have important consequences for their attainment and selection of their own personal S3 curriculum. During the data collection undertaken for each of the studies that contribute to the thesis, "A Curriculum for Excellence", an integrated curriculum for pupils aged between 3 and 18 years (Scottish Executive, 2006a) was being developed (it has now been introduced) and is a priority for Scottish educational policy. Schools clearly wish to modernise and support their approaches to education. In fact, following the creation and maintenance of bodies such as the EPPI, more policy recommendations and guidance is likely to integrate research findings.

Curriculum guidelines in Scotland support teaching with examples of good practice. Schools within Scotland are not actually required to follow the guidelines, thereby potentially allowing much greater variability within secondary schools than might be expected in England. Scottish schools and local authorities are able to maintain flexibility (Learning and Teaching Scotland, 2003) by designing a customised curriculum utilising input from stakeholders, teachers, parents, in order to meet the schools' and local communities' expectations. Scottish schools are holistic in their approach to pupils' learning and development exemplified by the revision and updating of inclusion policies (HMIe, 2002, 2005). Moreover, this holism is mirrored in the role and approach undertaken by the Her Majesty's Inspectorate of Education (HMIe) in Scotland (HMIe, 2009a) and the philosophy of comprehensive education embedded in Scottish educational policy (Humes & Bryce, 2003).

In 2005 following a national debate on Education, the Scottish Executive introduced more flexibility within their curriculum, as the "age and stage" regulations regarding entrance to examinations in secondary education were abolished and replaced with guidance criteria. Pupils deemed by schools as having appropriate maturity and ability can complete exams and related coursework a year earlier. This new approach simplified how schools could enter pupils for examination (prior to the relaxation of regulations schools had to enter into a formal application process with the Scottish Qualification Authority – the national body responsible for almost all qualifications other than degrees). At the time of the present research, reports examining the uptake of the new approach were minimal and appear to suggest that within Scottish secondary schools only a minority were participating (Scottish Executive, 2004, p. 6). Therefore, in order to avoid inclusion of extraneous factors Study 1 specifically avoided schools where such regulations had been adopted. Therefore, only first year (S1) and third year (S3) classes within schools that did not implement a changed curriculum were selected for inclusion within the current research. This builds on teachers' reports cited in Section 2.3.3, of the previous chapter, that group work was found to be especially likely in first and third year Science and English classrooms (MacQuarrie, 2006).

3.3 Parameters of the first study

The main objective of this research was to provide a description of teachers and pupils' behaviour during lessons that make use of group work, allowing a comparison with conventional teaching. This objective was addressed by collecting a range of data including classroom observation of both pupils and teachers and questionnaires, which examined teacher and pupil beliefs regarding their teaching environment.

As noted earlier group work is especially likely in Science and English classes (MacQuarrie, 2006). The inclusion of English lessons would be surprising, if it were not for evidence stemming from teacher reports indicating extensive use of group work in that context. In general, the scarcity of research considering English lessons is itself surprising, when we consider that group work is related to classroom discussion and features repeatedly within an HMIE (2008a) guidance document exemplifying good practice. This further signals the value of conducting a systematic investigation into Science and English lessons that make use of group work.

Observation (Blatchford, et al., 2001b; Roth, et al., 2006) and self-report measures (Assessment of Achievement Programme, 2002, 2003, 2005; MacQuarrie, 2006; Scottish Survey of Achievement, 2006, 2007) involving secondary schools have made it apparent that small groups are used as a learning activity but feature in tandem with other teaching approaches. As secondary teachers were found to use groups as an organisational approach and learning technique, to ensure only instructional or learning based approaches were observed, group work lessons were identified in advance by teachers with reference to their lesson plan, rather than being labelled post-hoc by the researcher.

This approach avoided potential bias and further exemplified the naturalistic approach undertaken.

Research has demonstrated that secondary teachers require considerable support when arranging and establishing learning environments, which do not follow the traditional transmission model of teaching (de Kock, Sleegers, & Voeten, 2005). However, survey research (Blatchford, et al., 2001b) has found that the majority of teachers report not having received specific group work training. As Blatchford et al.'s sample included both experienced and newly trained teachers, the findings are particularly concerning. Thus, as teachers' beliefs and practices have been shown to be associated (Fang, 1996; Lotter, Harwood, & Bonner, 2007; Mulhall & Gunstone, 2008; Nespor, 1987), Study 1 included items that ascertained teachers' experience of training involving group work and examined teachers' beliefs regarding group work within the teacher questionnaire.

The small number of studies evaluating group work within secondary education limits the possibility of forming specific hypotheses about what takes place, Study 1 aimed to explore classroom behaviour and looked at the relationship between pupils' behaviour and the form of instruction their teacher was using. An objective of Study 1 was to document teacher behaviour prior to and following group interaction as the few studies that have considered teachers has focused solely on teacher-pupil interaction whilst pupils work in groups. The characteristics contributing to the diversity of classroom groups (outlined in Chapter 1 and 2) suggest it would be unwise to assume that uniform approaches to group work will be observed. Although secondary pupils appear to be seated in a variety of formats within classrooms, research (Baines, et al., 2003; Galton, et al., 1999b) suggests they may work individually within the greatest part of a lesson, irrespective of their seating arrangements. The observation materials incorporated the distinction between different types of groups and were sufficiently flexible to allow classroom interaction to be recorded independent of pupils' seating arrangements. For example, being seated as groups and assigned a group task does not necessarily lead to productive interaction (Barron, 2003; Oliveira & Sadler, 2008; Wegerif, 1997; Yetter, et al., 2006). Whether teachers distribute different tasks to different groups is of interest since guidance would appear to encourage such processes (Scottish Office Education and Industry Department, 1996). This is primarily to accommodate different learning styles and the diverse nature of the class to help to address pupils' individual needs (Simpson, 1997). Consequently, the observation materials included categories that could succinctly record whether different tasks were assigned to different groups.

Although class size has received a lot of research attention, inconsistent findings regarding the relationship between overall size and organisation of classroom groups - which was introduced in Chapter 1 - makes it difficult to specify predictions. Rather we know in advance that class size overall may differ due to policy decisions - English classes potentially can have a maximum of 33 pupils whereas Science is restricted to 20 pupils (Scottish Negotiating Committee for Teachers, 2007) –but it is unclear whether this will encourage English teachers to utilise different strategies than Science teachers to accommodate a greater number of pupils.

Many studies recognise productive interaction partly by examining pupils' talk as particular forms of dialogue have been demonstrated as having greater potential for learning when pupils are engaged in group work (Barnes & Todd, 1977; Littleton, et al., 2005; Mercer, et al., 2004). For example when pupils counter statements such action not only stimulates the understanding shared by group members but also goes some way to solidify an individual's own beliefs and understanding. Similarly, reports that pupils who initially hold opposing perspectives are able to reconcile their thinking when small group work is governed by specific conditions (Howe & Tolmie, 2003) indicates that they are approaching the standard of interaction suggested by theory (Piaget, 1962). In light of the above Study 1 compares pupils' dialogue in relation to what type of class pupils were working in.

Two studies examining teachers' perspectives regarding group work within secondary schools provide evidence to suggest teachers restrain their use of small group work to the middle of lessons, preferring to utilise individual or whole-class method during the introduction and conclusion of lessons (Kutnick, et al., 2005a; MacQuarrie, 2006). Accordingly, pupil observation was recorded during the middle of lessons whereas teachers were observed at the introduction and conclusions of lessons. These studies tentatively indicate relationships between different teaching approaches and learning purposes – whether teachers rely upon the same methods to implement group work was examined within Study 1. Hence, an additional variable of interest was included to consider this within Study 1 - topic stage denotes whether observation (of either pupils or teachers) was recorded at the beginning, middle or end of a topic.

3.3.1 Questionnaire measures

When combined with classroom observation, the inclusion of attitudinal data and other supplementary measures makes for a comprehensive approach. Their inclusion will help identify which factors (if any) contribute to the nature of group work. Despite a wealth of research that has examined pupils' attitudes towards teaching subjects, frequently investigations are inadequate or flawed (Osborne, Simon, & Collins, 2003; Reid, 2006). Nevertheless a subset of studies where accurate measurement techniques have been employed have reported that gender is a likely explanatory variable, particularly within Science where male pupils frequently report more positive beliefs than female pupils (Osborne, et al., 2003; Reid & Skryabina, 2003). In the context of the current study, pupils' responses to questionnaires had two main functions. As mentioned within Chapter 2 pupils' behaviour in class ought to be examined in tandem with their attitudes to the teaching subject. Secondly, pupils' responses can be a useful barometer regarding the classroom environment and are helpful in allowing comparison of teacher and pupil perspectives. For example, teachers may report that they regularly use groups but pupils state that they often sit in groups but fail to work as groups; such conflicting evidence may suggest that teachers' practices are not as effective as they could be and point towards teachers not being aware of the problem. This suggests that observation measures ought to be sufficiently detailed to note the varied forms of pupil classroom behaviour and that the collection of attitudinal data requires precise techniques to support the classroom observation data. A measure of peer relationships will also help examine the nature of the classroom environment and indirectly help to assess group members' readiness to contribute to group discussion (based on the Piagetian belief that equal power relations contribute to productive interaction).

Method:

3.4 Design:

Study 1 employed a naturalistic observation approach within S1 and S3 English and Science secondary classrooms. Within each lesson, both teachers and pupils were observed. However, separate designs are appropriate as different materials were used to record different stages of the lessons. For pupils; a five-way between-subjects design incorporated lesson type (group work or conventional lessons), teaching subject (Science or English), gender (male or female), topic stage (beginning, middle or end) and teaching year (S1 or S3). For teachers; a six-way mixed design incorporated a within-subjects factor of lesson stage where teachers were observed both at the introduction and conclusion of lessons and between-subjects factors – lesson type (group work or conventional lessons), teaching subject (Science or English), gender (male or female), topic stage (beginning, middle or end) and teaching year (S1or S3). Difficulties encountered during data collection meant that topic stage was treated as a between-subjects factor, as three observations per participating class was not always feasible. For example if a class provided two observations of group work lessons, but an additional observation of group work was not feasible, then a third observation of the class occasionally took place within a conventional lesson.

3.5 Participants:

It was considered important to conduct research in a variety of schools and observe lessons within different topic areas. Participants attended or taught within eight secondary schools located in five local authorities in west central Scotland, and these schools varied in their percentage of free school meal entitlement (FSE), a measure of family income and socio-economic status, which is displayed in Table 3.1 below. As Study 1 took place over two school years, FSE school entitlement is reported as the mean of each school's reported 2007 and 2008 values. Three schools were based within the 10-15% entitlement band, which approximates the Scottish average for secondary schools. The average has remained within this entitlement band over the last five years – see Figure 3.1 (Scottish Executive, 2008). The five remaining schools were equally distributed within the other levels of entitlement. In total the eight participating schools had an average FSE of 16.0.

Table 3.1

Frequency of schools in relation to their free school meal entitlement band

FSE band	Number of Schools	Number of Classes
0-5%	1	2
5-10%	1	4
10-15%	3	8
15-20%	1	2
30-35%	1	4
30-40%	1	3
TOTAL	8	23

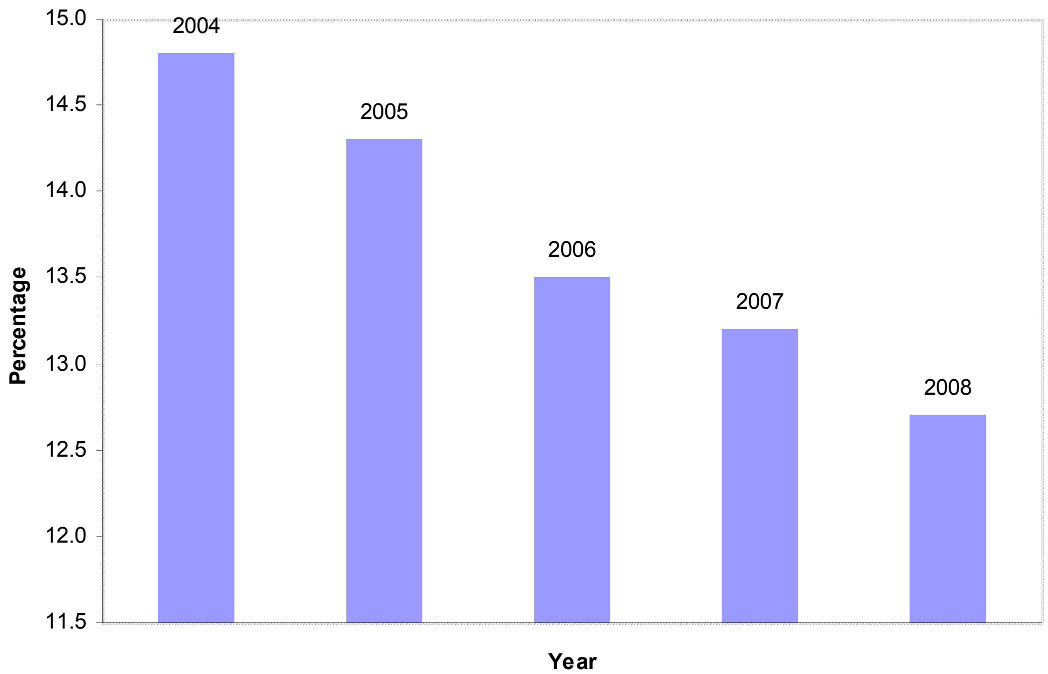


Figure 3.1 Mean proportion of Scottish secondary pupils registered for free school meals

3.5.1 Recruitment of participants

Research conducted within Study 1 was in accordance with the British Psychological Society's Code of Ethical Conduct. Further ethical approval was obtained from the University of Strathclyde Psychology Department and local authorities prior to schools being contacted individually. Schools were then approached via letter, email, and telephone, to solicit their participation (Appendix 1). It was clearly explained that even when schools in general agreed to participate, in no way were specific teachers obliged to take part. Teachers volunteered on the understanding that when observation was recorded within group work lessons, a different teacher content to have similar observations recorded within conventional lessons would also be sought. Parental consent for pupil participation was obtained via letters sent home from the schools. Measures given to pupils were distributed with envelopes, diminishing any concerns regarding anonymity. It was indicated clearly that participation was voluntary, via, for instance, completion of a consent form.

3.5.2 Teacher Sampling

Both teachers and pupils from S1 or S3, Science or English classes within five local authorities participated. An overview of participating classes and their teachers' details appear within Table 3.2. First year classrooms were observed in the spring and summer terms of a teaching year, followed by third year observations occurring mid-way through the autumn term and concluding prior to the schools' Christmas break. Such a separation was necessary as teachers indicated that, due to curriculum pressures, conducting observations within third year classrooms would not be practical or welcomed in either teaching subject during the spring and summer terms. In general, a greater number of Science teachers were willing to participate. This is partly explained as Science is separated into component disciplines during the third year of Secondary education. Thus third year Science involved recording observation in two sets of classes – chemistry and physics – effectively doubling the volume of data recorded within third year Science teaching

Table 3.2
Overview of participating teachers

	Science		English	
	S1	S3	S1	S3
Male	4	2	1	0
Female	4	7	4	4
Total	8	9	5	4

Note: Values enclosed in parentheses represent percentages. S1 = First year, S3 = Third year.

Of the 26 participating teachers, 13 (50%) returned completed questionnaires.

3.5.3 Pupil Sampling

Contextual factors influenced the number of pupils observed within each classroom. Science classrooms are restricted to a maximum of 20 pupils for health and safety reasons, whereas guidelines regarding class size within English lessons are more flexible (Scottish Negotiating Committee for Teachers, 2007). The mean number of pupils observed per class was computed by dividing the total number of pupils observed with the number of lessons observed for each teaching subject, giving separate descriptives for Science (M = 13) and English (M = 15) classrooms.

3.6 Materials:

A lesson context sheet (Appendix 2) was completed prior to each lesson and re-evaluated following the observations within the lesson. It facilitated the general layout of the classroom to be detailed in a classroom map allowing conventional lessons and structured group work lessons to be directly compared. The lesson context sheet included a table that enabled specific activities to be noted to indicate the general range of activities, and the materials and organisation methods employed during lessons. Similarly, the number of transitions observed during lessons were recorded onto the lesson context sheet. A transition can be considered a shift coordinated by the teacher that occurs during lessons and helps explain the rate and pace of lessons. Transitions were coded both when they were reactionary – changing the type of working arrangement to improve pupils concentration on a task - or planned - where a teachers gains the attention of the classroom in order to progress with the lesson. A visual representation of the classroom observation is presented in Figure 3.2

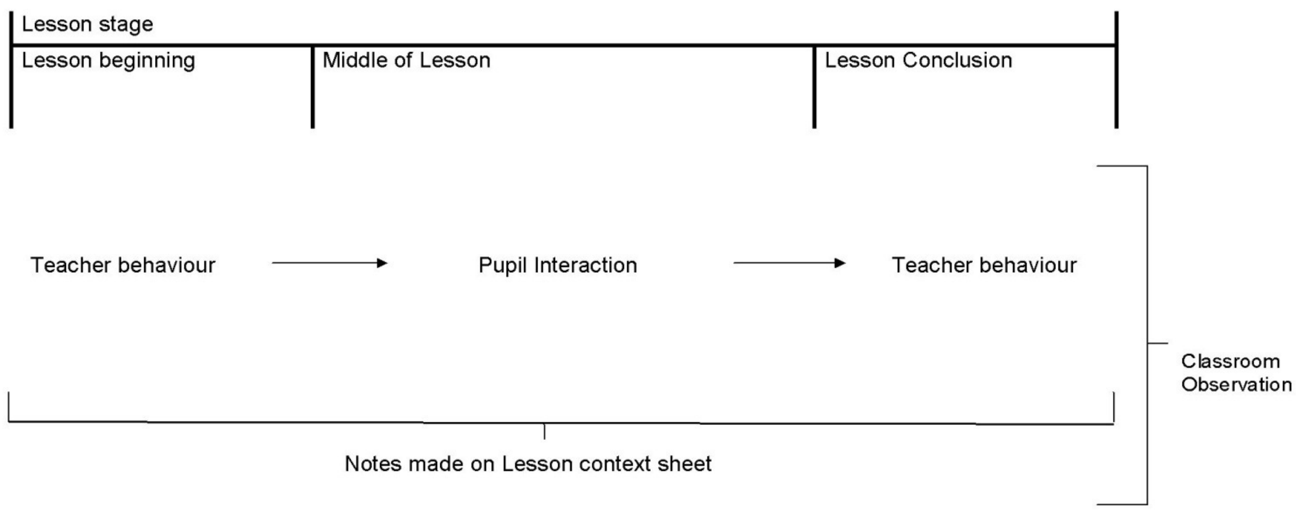


Figure 3.2 Visual representative of observation sequence used in both types of lesson

3.6.1 *Observation Grids*

The observational data for Study 1 were coded during classroom lessons and collected solely by the main researcher; therefore appropriate reliability checks of the observation methodology were made beforehand. In vivo coding of actual lessons, with two observers being present in the same classroom, would have been impractical; instead video recordings of lessons situated within conventional classrooms were used. The researcher and an observer trained for this purpose coded the recordings independently and inter-rater reliability of the observation grids was determined. This constitutes the final column in the teacher and pupils observation overview tables (Tables 3.3 and 3.4). Inter-rater agreement over teacher observations was computed using Cohen's Kappa, whereas Intraclass correlation coefficients (McGraw & Wong, 1996) were more appropriate for use with the interval pupil data. Agreement ranging between 0.61 and 0.8 can be considered substantial (Landis & Koch, 1977), although more recently Wragg (1999) has advised caution when interpreting findings, which are based on reliabilities below 0.7 agreement. In all cases, the reliability values of each of the categories within Tables 3.3 and 3.4 exceeded 0.7. The contents of the materials used within Study 1 are outlined below; information regarding their development is presented separately following this section.

3.6.2 *Teacher Observation*

Observation grids (Appendix 3) were used to observe teachers within lessons. The observation categories and how they were coded are presented below. The first section contained six descriptive statements, focusing on the lesson content. The second section included four measures used to aid interpretation of material, for example, whether the teacher used a pupil plenary, made specific links to other lessons, gave feedback to pupils and whether the lesson's purpose was made explicit. As research has indicated that teachers are likely to model behaviours they deem desirable within pupil interaction (Webb, et al., 2008; Webb, et al., 2006), the final section contained nine particular dialogue concepts demonstrated within the SCOTSPRinG project (Howe, et al., 2007) which related to the quality and content of an interaction.

Within each classroom, the teacher was observed on two occasions; one grid was completed to record the introduction of a lesson and another its conclusion. The beginning of a lesson encompasses pupils' arrival at the class and generally a number of classroom management behaviours, during which the lesson context sheet was completed. In contrast, the lesson introduction documents teachers' attempts to talk about the content of the lesson that pupils are about to participate in.

Behaviours exhibited by teachers were recorded once within each observation window (a detailed explanation of the systematic nature of observation is outlined within the procedure section). Multiple coding that recorded the frequency of behaviour within an observation category would have required the researcher to distinguish between the boundaries of one explanatory statement and the next and could not be reliably assessed within a single observation window. A solitary statement made by a teacher, regarded by pupils to hold a position of authority and to be knowledgeable, is argued to be sufficient to stimulate pupils' thinking. A count of the behaviours exhibited by teachers was therefore considered to be sufficient to provide an adequate volume of data for analysis and act as a baseline based on the expectation that teachers will repeat and rephrase information to ensure effective communication (Zwiers, 2008; Zwozdiak-Myers & Capel, 2008). As a result, the contents of the observations grids were summed, which created overall frequencies for each teacher within the different observation categories.

Table 3.3

Overview of observation categories used to record teacher behaviour

Categories		Inter-rater reliability values
1) *Descriptive Statements*		
Connections made	Relevant to material/stimulate pupils' thinking.	.81
Develop ideas	Promote/broaden understanding.	.86
Consolidate	Reiteration of statements.	.82
Evaluate	Reason material more explicitly.	.90
Revise	Rework material already expressed.	.80
Summarise	Reduce material/concepts further.	.83
2) *Lesson and Material Interpretation*		
Pupil plenary	Pupils point out differences in opinion or experiences and used to share group output.	.86
Link to other lessons	Explicit connections made. Links can be regarding any content.	.78
Feedback to pupils	Used to correct/evaluate or to support meaningful learning.	.88
Lesson Purpose Detailed	Expectations of teacher and pupil roles or descriptions of lesson content. Teachers tend to stress learning objectives.	.88
3) *Dialogue*		
Instructions	Detail given regarding specific actions to be carried out. (Tend to focus on process knowledge).	.75
Explanation	Clarification given to detail/help interpret something.	.90
Disagree	Teachers signal inconsistencies in pupil reasoning.	1.0
Resolution	Teachers involved/exemplify how to address misconceptions.	.83
Q&Awc	Questions posed to whole-class.	.73
Q&Aindi	Questions posed to specific individuals.	.88
Other	Not covered/inaudible.	n/a

3.6.3 *Pupil Observation*

The second observation grid was completed when pupils were observed and contained five sections (Appendix 4). The observation categories and their coding are presented in Table 3.4. The first section considered the social context of pupil and teacher interaction. The first, second and third sections complemented each other and identified whether pupils were instructed to work as groups or otherwise, and whether pupils completed tasks as individuals, groups or as part of a whole-class. The fourth section considered whether pupils were actively focused on completing tasks or not, and the final section focused on the dialogue produced by pupils during lessons, based on the dialogue concepts from the SCOTSPRinG project (Howe, et al., 2007). These five sections allowed the exact interactive nature of a lesson to be evaluated.

Sections one to four within the pupil observation grid employed mutually exclusive coding during each observation window. Behaviours that had the longest duration within each observation window were recorded – for example, a pupil could interact with a group for two-thirds of an observation window then switch to working alone, in this instance, the group interaction would be recorded. The contents of each observation grid were summed, so that frequencies within each observation category were computed and used within the analysis. This approach was used previously within the SPRinG group work intervention and the SCOTSPRinG research (Baines, et al., 2007; Howe, et al., 2007; Thurston, et al., 2008b).

The final section focused on the dialogue produced by pupils during lessons. In accordance with the approach undertaken by previous SCOTSPRinG research multiple dialogue behaviours could have been coded within each observation window (Howe, et al., 2007; Thurston, et al., 2008b). A similar approach was used by the recent SCOTSPRinG transition project (Topping, Thurston, Tolmie, Christie, Murray, & Karagiannidou, 2008), providing support for the belief that dialogue behaviours from secondary pupils need to be coded in this manner. The author's piloting of the original seven categories from the SCOTSPRinG project (Howe, et al., 2007) revealed she could not reliably record them in genuine secondary classrooms. As a result, four concepts based on the original categories were more appropriate.

Unlike the approach undertaken by the SPRinG and SCOTSPRinG research, specific pupils were not focused upon repeatedly within each classroom. The pilot study established that within a study of this scale, involving a number of different schools, classrooms and lesson types, pupil absence would be severely detrimental to data collection. Therefore, observing a variety of pupils during each classroom observation was more appropriate to the aims of this research.

Table 3.4

Overview of observation categories used to record pupil behaviour

Categories		Inter-rater reliability values
1) *Pupil Interaction*	Examples of Behaviour	
No Interaction	Working alone.	.87
Interaction with nearby Pupils	Working with others seated close by.	.97
Interaction with further away pupils	Working with others seated far away.	.94
2) *Teacher Presence*		
Teacher Present	Teacher present.	.88
Teacher Interaction	Teacher engaged with pupil.	1.0
3) *Task and Classroom Organisation*		
Different individual tasks	Pupils assigned different tasks.	1.0
Identical individual tasks	Pupils assigned the same task.	.92
Different group tasks	Groups assigned different tasks.	.77
Identical group tasks	Groups assigned the same task.	1.0
Whole-Class	Teacher leading the whole-class.	.87
Whole-class interaction	Pupils and teachers involved in whole-class interaction.	1.0
4) *Task Activity*		
On task behaviour	Engaged with task.	.98
Classroom preparation	Classroom preparation	.77
Not engaged with task	Not engaged with task.	.80
5) Dialogue		
Inform	Give explanation.	.78
Ask	Seeking help, direct questions.	.81
Resolve	Examines others' accounts. May point out inconsistencies.	.84
Other	Not covered /inaudible.	.94

3.6.4 Questionnaire measures:

A teacher questionnaire (Appendix 5) included ten questions focused on teachers' beliefs regarding group work and participants responded using five-point Likert scales. A table listed nine forms of teaching approach and asked teachers to report how often they would incorporate such methods within lessons by selecting one of five responses. These sections combine to provide additional information, supporting observations taken within classrooms.

The pupil questionnaire included a number of different items. A summary is presented in Table 3.5 and complete measures are available in Appendix 6. Although a single questionnaire was issued to pupils, separate sections were presented, which were identical in content, but worded according to whether they asked questions about Science or English teaching. The classroom environment scale investigated pupils' beliefs with six items, each probed the opportunities given to pupils to express their ideas and how teachers manage such interaction.

Measures examined pupils' attitudes, self-perceptions and experiences within teaching subjects. Two measures were adapted from Reid and Skryabina (2002, 2003) which examined pupils' attitudes and self-perceptions within each subject. Questions evaluating pupils' attitudes and self-perceptions employed a semantic differential format (Osgood, Suci, & Tannenbaum, 1971) where phrases of opposing meaning are positioned at both ends of a six-point scale. Analyses were conducted on pupils' responses to the individual items composing the measure and pupils' mean attitude scores, which were arrived at by summing across their responses to the individual items.

Pupils' experiences of different forms of teaching within either teaching subject were evaluated within two tables, which were both presented in similar formats asking pupils to choose one of five responses. For the purposes of the questionnaire it cannot be assumed that pupils adopt the conceptualisation of small groups that was outlined in Chapters 1 and 2, which included dyads. It follows therefore that separate questions ought to be presented regarding working with a partner and working in groups. Seven items focused on the frequency of different teaching approaches as experienced by pupils, pupils' views regarding specific teaching approaches were investigated using three items, followed by a single item noting their preferred teaching approach. The wording used in these items was based on the Assessment of Achievement pupil questionnaire (Assessment of Achievement Programme, 2003, 2005).

A sociometric measure asked pupils to evaluate their relationships with all pupils named on the class list in which they were observed. Pupils rated their peers by choosing one of five possible responses, using a Likert scale, with 1 - representing a positive rating - to 5 – representing a negative rating; examples of ratings were placed at each end and at the neutral point of the scale. Peer rating methods are suitable for the ages being tested, and in this instance are preferable to nomination approaches, where pupils are asked to list or nominate pupils within their lessons according to set preferences. Ratings provide interval rather than nominal data, allowing each pupil's sociometric score to be calculated based on their peers' rating. Mean scores were computed to establish whether pupils who experience different types of lessons have different social experiences or perceive their peers differently. This score provided an indicator of their degree of acceptance within a particular classroom, in addition to the frequencies of positive and negative ratings.

A subset of pupils who were observed during lessons completed the questionnaire. Within the 26 participating classes, teachers of four classes objected to the inclusion of the sociometric measure, teachers of a further six classes objected to the completion of any self-report measures. Therefore, within the remaining 16 participating classes, a sample balanced by gender was obtained as 169 (54% male) pupils responded to the questionnaire and 137 (51% male) pupils completed the sociometric measure. Irrespective of whether pupils were observed in Science or English, all pupils responded to questions concerning Science and English lessons. This allowed a larger sample of data to be collected and encouraged pupils to complete each section of the questionnaire systematically.

Table 3.5

Summary of measures included in the pupil questionnaire

List of measures	Completed by pupils from both subjects and teaching years	Total Possible Score	Number of items
Classroom environment	✓	-	6
Attitude to Subject	✓	42	7
Self-perception in relation to Subject	✓	48	8
Frequency of different teaching approaches	✓	-	7
Pupils' views regarding specific teaching approaches	✓	-	3
Pupils' preferred teaching approach	✓	-	1
Sociometric	✓	-	Related to class size

3.6.4.1 Pilot Study

A pilot study was conducted within 6 classrooms, which supported the development of the observation methodology and measures included within the questionnaires. The pilot also ensured that categories within the observation grids were suited to classroom environments and reflected an accurate portrayal of lesson activity. This was considered particularly important for the content of the teachers' observation grids, as little research has systematically observed teachers at the beginning and conclusion of lessons. The pilot confirmed the suitability of using dialogue elements taken from the SCOTSPRinG research within the observation grids. In particular, testing of the observation methodology made it clear that four concise dialogue elements, rather than the original seven used in SCOTSPRinG, were more suited to observing pupils within the different types of lessons and teaching subjects in this study. Pilot work also revealed that separate grid sections to record each pupil's work and task arrangements were essential. As a result of the wide-ranging teaching approaches observed within conventional lessons, all observation and questionnaires were tested in both types of lesson, both teaching years and both subject areas.

3.6.5 Reliability analysis of sub scales within the pupil questionnaire.

The internal reliability of the two main sub-scales was found to be greater than Cronbach's threshold of $\alpha = 0.7$ in all cases indicating high internal reliability. Table 3.6 provides a summary of these measures, including the alpha values specific to each measure.

Table 3.6

Findings of reliability analysis conducted on pupil questionnaires

Scale	Items comprising each measure	Cronbach's α
Pupils' attitudes towards Science	I like/dislike lessons Interesting/dull lessons Easy/difficult lessons	.90
Pupils' attitudes towards English	I'd like to spend more time/less time on them Enjoying/dull lessons Important/unimportant lessons Important/unimportant for other school subjects	.78
Pupils' perception of self within Science	I feel I am coping/not coping well I am enjoying/not enjoying the subject I find it very easy/very hard	.83
Pupils' perception of self within English	I am obtaining/not obtaining a lot of new skills I am enjoying/ I dislike practical work I like/I dislike the teacher It is definitely/definitely not "my" subject Relevant/not relevant to getting a good job	.78

The level of agreement apparent regarding either subject indicates that the scales are reliable and can therefore be used to ascertain pupils' opinions. As a consequence, the results also provide further support for the research conducted by Skryabina (2000) and the findings reported within Reid and Skryabina (2002, 2003). Questions relating to pupils' experiences of different teaching approaches were not assessed using reliability statistics, as they were not developed to be a comprehensive one-dimensional scale; rather they can be used to further explain the approaches experienced by pupils within the different types of lessons.

3.7 Procedure:

Within each lesson or observation period, a lesson context sheet, teacher observations, and pupil observations were collected. The type of lesson (group work or conventional) and topic stage (whether lessons were consistent with the beginning, middle or end of a teaching topic) were identified by teachers and recorded onto the lesson context sheet. Completion of the lesson context sheet prior to the onset of the lesson (for example when pupils were entering the classroom), provided descriptive information regarding the exact nature of the classroom to be observed. During the lesson when the class moved onto another activity – for example from whole-class to individual based work - precise observations were made onto the lesson context sheet regarding this. Resources used within the classroom, and the arrangement of pupils were detailed on a classroom map.

3.7.1 Naturalistic systematic observations

Observation incorporated a naturalistic approach, where the observer coded lessons in vivo, but did not interrupt, alter or add to classroom interaction. Systematic observations utilised a time-sampling procedure, facilitated by the use of a grid, with rows corresponding to observation windows and columns to observation categories. Observation windows allowed for preparation, observation and recording of information. Teachers were observed on two occasions, at the beginning and end of lessons. Each of the eight windows that constituted a single teacher observation grid approximated 60 seconds.

Eight consecutive windows also constituted one complete observation grid per pupil, but each window lasted 15 seconds in total. Each pupil was observed once within each classroom visit. A specific sampling technique was employed: one pupil per group was observed, each successive observation would attend to a different group, and whenever possible operate a selection process based on pupils' gender – observation of a male pupil would be followed by the observation of a female pupil. Contextual factors and the variable nature of lessons influenced the number of pupils observed within each classroom, for example pupil observation was only recorded when pupils were engaged with their classroom task, consequently a predetermined number of pupil observations could not be met.

Chapter 4

Study 1 results: nature and use of group work

The results are presented in two chapters. Both incorporate multiple forms of data so that a comprehensive picture of group work within Science and English lessons can be developed. Chapter 4 sets out the nature and use of group work and conventional lessons, incorporating both pupil and teacher observation, coupled with their views regarding particular teaching approaches. Whether pupils and teachers show corresponding or conflicting understanding (in their responses to questionnaires) will add to what is known regarding the conditions provided for small group work within authentic classrooms. The subsequent chapter examines measures investigating pupil perceptions in relation to specific classroom influences. Specific measures consider the classroom environment, attitudes and self-perception of a specific teaching subject. Peer relationships are explored using sociometric techniques. Two-tailed tests are used throughout and each section has a corresponding discussion section. The contents of the chapters are brought together in the general discussion, which considers the broader perspective and implications of the findings.

Table 4.1 displays the number of pupil observations according to the type of lesson, teaching subject, teaching year, gender and topic stage. An important aspect of the research was to maintain a naturalistic approach when conducting data collection. It is obvious that more Science pupils were observed within conventional lessons, in comparison with English pupils and a significant chi-square goodness of fit test supported this (X^2 (1) = 52.49, $p < .01$). This reflects the difficulty in researching two distinct teaching subjects and teaching years, and indicates that group work is a regular occurrence within Science teaching. When observations recorded in English and Science were looked at more closely, it is clear that similar numbers of observations were recorded within group work lessons, and the discrepancy lies with observations recorded within conventional lessons. This may indicate that English teachers were more hesitant during observations recorded within conventional lessons as fewer opportunities were available for data collection. Generally, irrespective of teaching subject, significantly more group work lessons were observed than conventional lessons (X^2 (1) = 43.06, $p < .01$).

Similarly when teaching year was explored, more third year pupils were observed in comparison with first year pupils, and a significant chi square was found (X^2 (1) = 24.69, $p < .01$). This finding is less of a concern as within third year two sets of classes – chemistry and physics – were categorised as Science (in comparison with first year combined science lessons). This effectively doubles the volume of observations recorded of third year science teaching. The numbers of pupils observed were similar with regards to gender (X^2 (1) = 1.57, ns) and topic stage (X^2 (2) = .44, ns).

Table 4.1

Sampling statistics of pupil observations in relation to variables of interest

		Lesson Type		Gender		Topic stage		
		C	G	Male	Female	Introduction	Middle	Conclusion
Science	S1	107 (40.1)	59 (13.6)	85 (25.7)	81 (22.3)	49 (21)	44 (18.5)	73 (32.6)
	S3	121 (46.4)	156 (35.9)	129 (38.9)	148 (40.1)	93 (39.9)	109 (45.8)	75 (33.5)
English	S1	14 (5.4)	102 (23.5)	50 (15.1)	66 (18.1)	48 (20.6)	27 (11.3)	41 (18.3)
	S3	19 (7.3)	117 (26.9)	67 (2.2)	69 (18.9)	43 (18.5)	58 (24.3)	35 (15.6)
Total		261 (100)	434 (100)	331 (100)	364 (100)	233 (100)	238 (100)	224 (100)

Note: Values enclosed in parentheses represent percentages. S1 = First year, S3 = Third year. C = Conventional, G = Group work.

The overview of the sample in Table 4.1 means that clear guarantees of representativeness are beyond the scope of Study 1. Rather the sample was intended to outline the main features of current grouping practice within English and Science first and third year classrooms, providing an overview of classroom behaviour and help to inform the intervention stage of this research.

4.1 Cluster analysis of pupil observation data

The size and varied nature of the data set presented a challenge for most forms of analysis – largely based on assumptions relating to the underlying distribution of the data. One method that does not require strict assumptions to be held is cluster analysis (Norusis, 2009). The term "cluster analysis" refers to a number of different approaches that can group data into clusters, allowing the underlying structure of data to be understood.

4.1.1 An overview of two-step cluster analysis

Two-step cluster analysis was used as it can automatically identify the appropriate number of clusters within a dataset. The label "two steps" stems from the fact that the data set is initially "pre-clustered" into many small sub-clusters, and then analysed, which involves clustering these sub-clusters (Norusis, 2009).

Although two-step clustering is a relatively new method in comparison with other cluster analysis techniques, it has marked advantages. A cluster solution is provided, which explains how clusters were agglomerated to create the final number of clusters in relation to the data set that is used. In contrast, other cluster analysis approaches necessitate a priori decisions regarding the final number of clusters (K means clustering), or else a posteriori decisions are made based on interpretations of the cluster analysis output (Hierarchical clustering) (Everitt, Landau, & Leese, 1993). These decision-making processes relate to some of the "well known problems" identified by Bacher, Wenzig and Vogler (2004), who provide moderate support for the two-step clustering method within statistical computing programs, such as SPSS. Norusis (2009, p. 280) adopts a more liberal view and explains that although "ideal" conditions are recommended for the use of two-step clustering, it is reasonably robust when used with suitable data sets. Two-step clustering is particularly appropriate as it can analyse categorical data and also responds well to large data sets (the data set of pupil observations is in excess of 600), which other cluster analysis methods may find problematic.

Two-step clustering produces various outputs to help with interpretation. These will be explained and relevant information provided regarding their interpretation and their use within the results. The first table within the output produced by SPSS displays a summary of the auto-clustering procedure, and summarises how the decision regarding the final number of clusters was computed. The clustering criterion is computed for each potential number of clusters. In general, smaller criterion values indicate better models. However, there are problems: the clustering criterion will continue to decrease as the number of pre-clusters is agglomerated to create fewer clusters within the auto clustering procedure (Bacher, et al., 2004). Yet improvement in the cluster solution, as measured by the criterion change, is not worth the increased complexity of the cluster model, as a smaller number of highly complex individualised clusters will be created. SPSS will always determine the "best" cluster solution to have the smallest clustering criterion. However, this weakness can be overcome by considering in detail the contents of the auto-clustering summary. In such situations, changes in the clustering criterion and changes in associated measures can be reviewed to determine the "best" cluster solution and compared with the results of the auto-clustering procedure. In brief, a good solution can be checked by assessing the values of the Ratio of Criterion Changes and the Ratio of Distance Measures, these statistics being calculated by comparing the current number of clusters with the previous number of clusters. A good solution will report an increase in the Ratio of Criterion Changes and the Ratio of Distance Measures as the number of clusters decreases. These checking procedures are adhered to within the following analysis.

The next item within the output contains the cluster distribution table, which details the frequencies within each cluster. It reports the number of cases assigned to clusters and identifies any excluded cases within the analysis. The cluster frequency table summarises the size and shape of the clusters determined within the analysis. The "by variable" importance charts are produced with a separate chart for each cluster. These charts explain which variables contribute to the composition of each cluster. Finally, a cluster membership variable is computed and can be analysed to specify the precise composition of each cluster. However, the clearest approach to reporting findings from a two-step cluster analysis does not follow the order of the output given by SPSS, as illustrated above. Rather the clustering solution ought to be evaluated using the independent variables to determine its contents as an initial step. The observation categories also feature within variable importance plots, supported by the knowledge of what independent variables contribute to the cluster solution. These figures are themselves made interpretable by considering the profiles of each observation category within each cluster. The results of two-step cluster analysis considering pupil observation using this approach are evaluated within the following section.

4.1.2 *Two Cluster Solution*

The auto-clustering procedure highlighted two main groups within the data set, which are presented within Table 4.2. Indeed both clusters are of a reasonable size, 58.6% within the first cluster and 41.4% within the second cluster, suggesting that each cluster has an adequate number of cases for the cluster to be meaningfully interpreted. As indicated in the table, missing data in two cases led to their exclusion.

Table 4.2
Cluster Distribution

Cluster	n	% of Total
1	406	58.4
2	287	41.3
Combined	693	99.7
Excluded cases	2	.3%

The clustering criterion reported within the auto clustering solution, dramatically increases in the stage prior to two and three clusters, creating a change in the ratio of criterion changes of 563.67 (from 9138.20 to 9701.88) and an increase in the ratio of distance measures of 2.06 (from 1.17 to 3.23). Therefore, a three-cluster solution was also computed and is presented within Appendix 7; however, comparisons of the two and three cluster solutions indicated that the two-cluster solution was preferable based on the values presented in the auto-clustering table and the contribution of observation categories to each potential cluster. Indeed, the cluster distribution suggests that the clear division evident between the two almost equally weighted clusters is the most appropriate cluster solution.

The cluster membership of each case within the analysis can also be evaluated with regard to each independent variable, to help evaluate their contribution to the groups within the data and further interpret the contents of the two clusters. The cluster membership for each case within the two-cluster solution was cross-tabulated with each of the independent variables: lesson type, teaching subject, gender, topic stage, and teaching year. The strength and significance of the X^2 relationship can be evaluated with nominal measures. Cramer's V is most appropriate, as unlike Phi and the contingency coefficient, it is not constrained by table size (Howell, 1997). This value can be squared to obtain proportional reduction in error in predicting the value of one variable based on the value of the other variable.

Observations were arranged in separate clusters according to lesson type (X^2 (1) = 195.76, $p < .01$, Cramer's V = .53). 24.8% of conventional lessons were grouped within the first cluster, in contrast with 78.9% of group work lessons. The second cluster in contrast had 75.1% of conventional lessons, with the remaining 21.1% group work lessons. The inclusion of lesson type during the clustering process meant that a 28.2% reduction in error was observed regarding allocation of items to the clusters. A relationship was also found between the cluster membership of each case and teaching subject (X^2 (1) = 55.25, $p < .01$, Cramer's V = .28). The first cluster had 48.1% of Science lessons and 77% of English lessons, whereas the second cluster had 51.9% of Science lessons and 23% of English lessons. When the teaching subject was also taken into account when clusters were being grouped, it led to a further 8% reduction in error regarding allocation of items to the clusters. Therefore, the discrepancy noted regarding the smaller volume of English conventional lessons has been accommodated within the clustering process and is reflected in this finding.

Analysis of the remaining independent variables of gender, topic stage and teaching year were not found to contribute significantly to the interpretation of the two clusters, reported within Table 4.3. Had the variable of topic stage, with three levels, been an important contributor or had this variable been reported in previous research as influential, an alternative method such as log linear analysis may have been suitable. However, cross tabulation is preferable when the independent variables being investigated have two levels (Sheskin, 2004).

Table 4.3

Analysis of cluster content in relation to variables of interest

Cluster proportion	Gender		Topic stage			Year	
	Male	Female	I	M	C	S1	S3
C1 %	60.8	56.6	56	56.1	63.8	62.4	56
C2 %	39.2	43.4	44	43.9	36.2	37.6	44
X^2 Equation	X^2 (1) = 1.25, *ns*		X^2 (2) = 3.76, *ns*			X^2 (1) = 2.87, *ns*	

Note: I=Introduction, M=Middle, C=Conclusion. S1 = First year, S3 =Third year.

Therefore, two of the original five, independent variables help explain the content of the two clusters. Both variables, type of lesson and teaching subject, will be included within the remaining analysis of the pupil measures.

The composition of each cluster can be evaluated by examining variable importance plots, which place variables on the Y axis in descending order relative to their contribution within a cluster. The dashed vertical lines within the figures represent critical values (defined by the clustering process), which must be exceeded to reach statistical significance. Therefore, variables regarded as key contributors to the cluster formation process can be clearly identified by examining these figures. The X axis plots chi-square values, and larger values indicate that the distribution of a variable within a cluster is different from its overall distribution (Norusis, 2009). Comparison of the variable importance plots for each cluster indicates that ten variables were crucial to the construction of the first cluster, and twelve variables were involved within the second (see Figures 4.1 and 4.2). The order of presentation of the ten variables significant within the first cluster was repeated within the plot of the second cluster, which reported an additional two significant variables – groups using different tasks and pupils involved in classroom preparation. Within the second graph each of the variables had a higher rating on the X axis than in the first, indicating that their distribution varied to a greater extent.

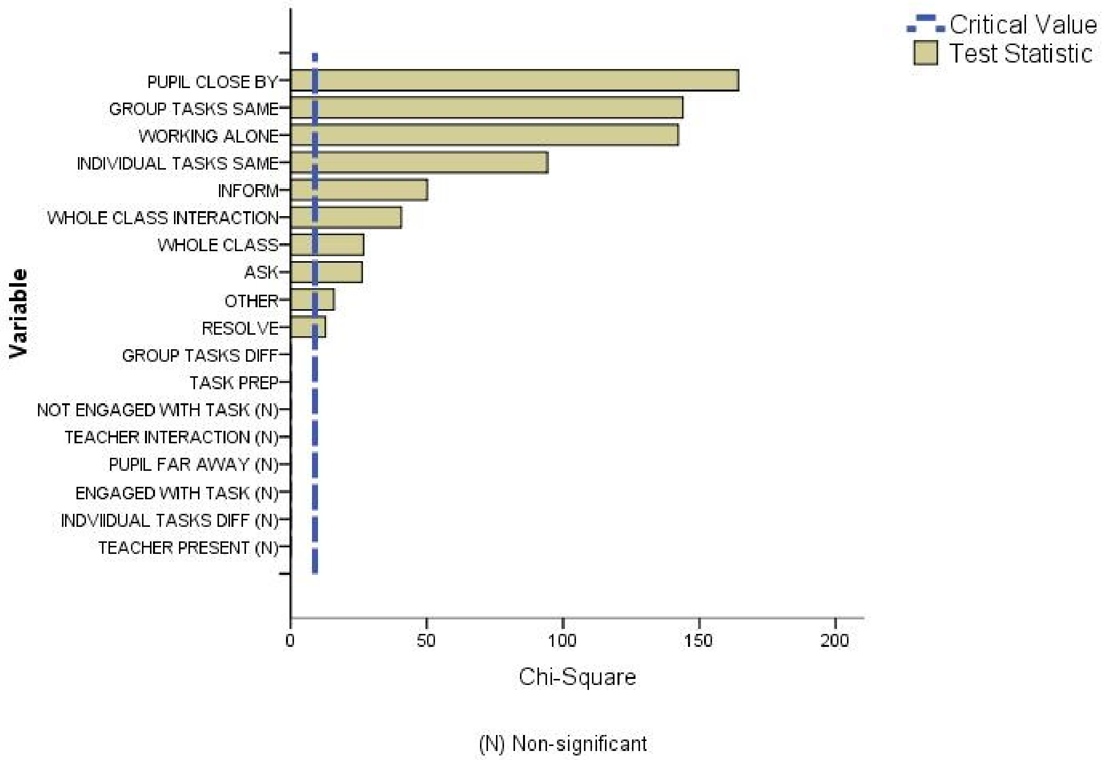


Figure 4.1 Plot of observation categories, which contributed to the first cluster

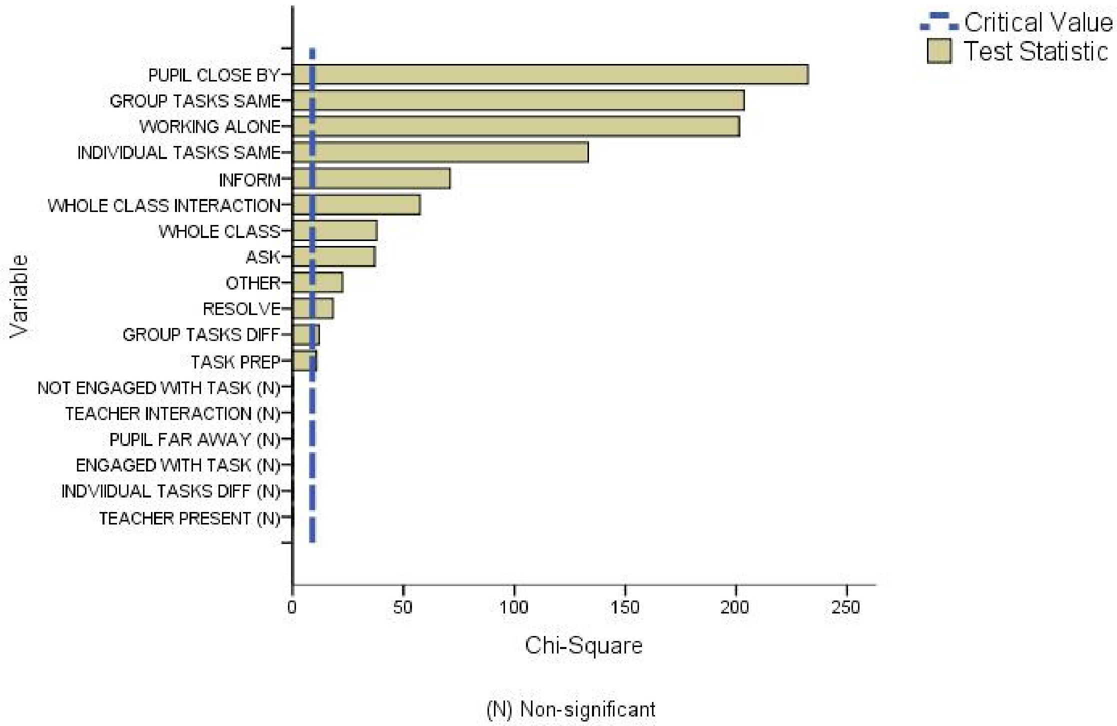


Figure 4.2 Plot of observation categories, which contributed to the second cluster

The analysis of cluster membership indicated that the first cluster is predominantly group work based and the second cluster conventional lesson based. Therefore, the ten identical variables identified within Figure 4.1 and 4.2 contributed to the construction of both clusters. Items identified within the variable importance plots as significant contributors to the formation of the two clusters have been labelled within Table 4.4. The frequencies of each variable can be used to assess their contribution to either cluster.

Table 4.4

Cluster Frequency Profiles

	Variables	Cluster1	Cluster2
		Freq (%)	
Pupil interaction	Working alone	108 (27.8)*	280 (72.2)*
	Interaction with nearby pupils	405 (82.5)*	86 (17.5)*
	Interaction with further away pupils	62 (72.1)	24 (27.9)
Teacher presence	Teacher present	54 (67.5)	26 (32.5)
	Teacher interaction	136 (66.7)	68 (33.3)
Task and Classroom Organisation	Different individual tasks	1 (16.7)	5 (83.3)
	Identical individual tasks	2 (1.5)*	134 (98.5)*
	Different group tasks	43 (89.6)	5 (10.4)*
	Identical group tasks	359 (87.6)*	51 (12.4)*
	Whole-class	16 (18.6)*	70 (81.4)*
	Whole-class interaction	3 (4.2)*	69 (95.8)*
Task Activity	On task behaviour	372 (57.5)	275 (42.5)
	Classroom preparation	64 (81.0)	15 (19.0)*
	Not engaged with task	122 (67.4)	59 (32.6)
Dialogue	Inform	267 (79.9)*	67 (20.1)*
	Ask	175 (80.6)*	42 (19.4)*
	Resolve	115 (78.8)*	31 (21.2)*
	Other/inaudible	125 (80.1)*	31 (19.9)*

Note: Values enclosed in parentheses represent percentages. *exceeds critical value

4.1.3 Pupil interaction

When the pattern of significant findings regarding pupil interaction was considered, two of the three sub-categories significantly contributed to the formation of both clusters. Pupils within conventional lesson completed tasks by themselves (72.2%), in contrast with pupils observed within group work lessons who less frequently (27.8%) worked alone. Additionally, pupils were recorded interacting with peers seated in close proximity proportionally more often within the group work cluster (82.5%) than the conventional cluster (17.5%). Within both lesson types pupils' interaction with peers located further away was observed on far fewer occasions than the other categories, suggesting that pupils rarely engaged in this behaviour.

Although both teacher presence and teacher interaction appeared to be grouped to a greater extent within the group work cluster, they were not identified as significant contributors to the formation of either cluster. However, in comparison to other variables their frequencies were particularly low, indicating that teachers were rarely observed to be involved with pupils who were focused on actively completing tasks, either by themselves or whilst working as part of a group.

4.1.4 Task and classroom organisation

The divide between the two types of lesson was maintained when the task or learning context was evaluated. Within conventional lessons (cluster 2), the majority of pupils were observed to work on individual tasks, whereas within group work lessons (cluster 1) the majority worked in groups. Therefore, the divide between the two clusters is reflected in the structural and working arrangement of the two lesson types. Within both clusters, tasks of a similar nature were assigned to pupils working individually or in small groups. Only a small number of observations were made of tasks being differentiated within classrooms in either lesson type, as evident by low frequencies in both clusters. Indeed, while group tasks whose nature differed were identified as a key contributor to the formation of the second cluster, the penultimate position of this category indicates that it is of lesser importance (than variables included previously) as variables on the Y axis descend relative to their contribution to a cluster.

Whole-class organisation was identified as a variable contributing to the formation of the two clusters. It was predominant within the second cluster (81.4%) in comparison with the first cluster (18.6%). Whole-class interaction was also identified as a key variable for both clusters. Similarly, it too had a greater presence within the second cluster (95.8%) in comparison with the first (4.2%). The clearest description regarding the division between whole-class and whole-class interaction, can be expressed with an example – whole-class would have been recorded when a teacher lectured pupils in contrast to teachers involving pupil contributions within such talk. Therefore, this division concentrates on the teacher-pupil relationship rather than any formalised definition of whole-class teaching. In this regard, it is positive to note that teachers did incorporate pupils' contributions but tended to do so within conventional rather than group work lessons.

4.1.5 Task activity

Pupils were largely focused on completing tasks, with approximately equal proportions of on-task behaviour recorded within the group work (57.5%) and conventional (42.5%) clusters. This impression of task focus and task engagement was given further support through the data relating to off task behaviours, which indicated moderate occurrence in either cluster. Classroom preparation work was a significant factor only within the second cluster. The significant findings relate to unequal proportions of this category being allocated between the two clusters. Pupils engaged in classroom preparatory work more frequently within group work lessons (81%) than their counterparts within conventional lessons (19%). Therefore, when pupils worked in groups, an aspect of such arrangements included time dedicated to classroom preparation.

4.1.6 Dialogue

The final section of Table 4.4 makes it clear that a higher proportion of each dialogue category was evident within the group work cluster. Three of the four dialogue categories relate to behaviours known to be key to pupils' learning, therefore not only is it encouraging to detect such behaviour but also to observe their frequency during group work lessons. That such dialogue was observed during interaction makes clear that pupils were not merely seated as groups; rather they relished being given the opportunity to interact with their peers and did so in a productive manner.

4.2 Pupils' responses to questions evaluating the frequency of teaching approaches

Pupils were asked to report the frequency of different teaching approaches. Their beliefs regarding common teaching methods were ascertained through additional questions. Pupils' responses to questions regarding the frequency of different teaching approaches were obtained separately for the two teaching subjects, and significant findings will be reproduced following the same approach.

Of the items listed in Tables 4.5 and 4.6, pupils gave similar responses to six out of seven questions when answering questions relating to their English teaching, and five out of seven questions relating to the Science teaching. Pupils reported a wide range of teaching approaches being used within both teaching subjects and responses did not vary when data from pupils observed in group work or conventional lessons were compared. Working as a class, individually, in dyads and small groups were features of the classroom interaction that pupils experience. Pupils' responses to three items are of particular interest when inferring normative classroom teaching. Pupils' varied responses to items considering small groups being taught by their teacher and being seated in groups but completing work individually indicate that ineffectual practice did take place.

Table 4.5

Comparison of group work and conventional pupils' experiences of the different teaching approaches used within English lessons

English		n	During most lessons	Once or twice a week	Once or twice each term	Rarely	Not sure	Equation
With the whole-class being taught by the teacher	C	39	84.6	15.4	0	0	0	X^2 (3) = 3.79,
	G	132	84.1	9.1	0	5.3	1.5	*ns.*
In a small group being taught by the teacher	C	39	5.1	10.3	17.9	53.8	12.8	X^2 (4) = 4.98,
	G	131	1.5	23.7	14.5	45.8	14.5	*ns.*
Talking on your own with the teacher	C	39	17.9	20.5	15.4	35.9	10.3	X^2 (4) = 3.07,
	G	130	11.5	19.2	9.2	47.7	12.3	*ns.*
Working in a group on a shared task	C	38	5.3	23.7	21.1	31.6	18.4	X^2 (4) = 16.73,
	G	130	10.8	40.0	30.0	15.4	3.8	$p < .01$, V= .32
Working with a partner on a shared task	C	37	16.2	18.9	13.5	35.1	16.2	X^2 (4) = 8.07,
	G	128	14.8	35.9	18.0	25.8	5.5	*ns.*
Working quietly on your own	C	38	92.1	5.3	2.6	0	0	X^2 (4) = 6.54,
	G	132	75.0	18.2	1.5	3.0	2.3	*ns.*
Sitting in groups but working on your own on a task	C	38	28.9	7.9	13.2	34.2	15.8	X^2 (4) = 4.03,
	G	131	18.3	18.3	10.7	37.9	13.7	*ns.*

Note: C = Conventional, G = Group work

Table 4.6

Comparison of group work and conventional pupils' experiences of the different teaching approaches used within Science lessons

Science	N		During most lessons	Once or twice a week	Once or twice each term	Rarely	Not sure	Equation
With the whole-class being taught by the teacher	C	39	97.4	2.6	0	0	0	X^2 (4) = 8.83, *ns.*
	G	127	76.4	14.2	3.1	4.7	1.6	
In a small group being taught by the teacher	C	39	15.4	35.9	10.3	20.5	17.9	X^2 (4) = 6.25, *ns.*
	G	126	9.5	37.3	17.5	28.6	17.9	
Talking on your own with the teacher	C	39	10.3	20.5	15.4	38.5	15.4	X^2 (4) = .14, *ns.*
	G	127	10.2	18.1	15.0	15.7	40.9	
Working in a group on a shared task	C	39	48.7	41.0	2.6	5.1	2.6	X^2 (4) = 13.69, $p < .01$, V= .29
	G	128	21.9	44.5	13.3	14.8	5.5	
Working with a partner on a shared task	C	38	47.4	31.6	7.9	13.2	0	X^2 (4) = 4.13, *ns.*
	G	126	34.9	44.4	11.1	7.9	1.6	
Working quietly on your own	C	38	26.3	47.4	5.3	15.8	5.5	X^2 (4) = 5.71, *ns.*
	G	126	46.8	32.5	5.6	12.7	2.4	
Sitting in groups but working on your own on a task	C	39	69.2	10.3	7.7	7.7	5.1	X^2 (4) = 28.17, $p < .01$, V= .41
	G	126	23.8	2.6	11.1	33.3	11.1	

Note: C = Conventional, G = Group work

Pupils from conventional lessons reported being seated in groups but working alone much more frequently (69.2%) in Science than pupils within group work lessons (23.8%). Within English lessons, no differences were detected in pupils' responses according to the lesson type in which they were observed. A positive finding is that within Science, 33.3% of pupils working in group work lessons rarely experienced working alone whilst seated in a group. Pupil reports of similar experience within English lessons in both group work (38.9%) and conventional lessons (34.2%) support this.

Pupils reported moderate experience of being seated in small groups and being taught by the Science class teacher, with similar quantities of responses from conventional pupils (35.9%) and group work pupils (37.3%) selecting the category of “once or twice a week”. Whereas similar quantities of pupils from conventional (53.8%) and group work (45.8%) lessons reported rarely experiencing such a working arrangement when the same question was posed regarding English lessons. In both cases, no differences were detected in pupils’ responses when lesson type was considered.

A clear pattern is visible in pupils’ responses regarding “working in group on a shared task” within English lessons. Group work pupils more frequently experience such interaction once or twice a week (40%) in comparison to conventional pupils (23.7%). A more complicated pattern is visible in the spread of pupils’ responses regarding Science. Pupils from conventional lessons reported working in small groups during most lessons (48.7%) in comparison with 21.9% of group work pupils. The subsequent category of once or twice a week drew similar quantities of responses from conventional (41.0%) and group work pupils (44.5%). Yet it was the spread of responses given by group work pupils in the remaining categories that is unusual. A small proportion of conventional pupils reported infrequent (2.6%) or limited (5.1%) experience of such interaction in comparison with a higher proportion of responses from group work pupils regarding infrequent (13.3%) and rare interaction (14.3%). In contrast, when responses to working with a partner (considered within the thesis as a form of group work) are examined an equivalent set of responses was obtained.

4.3 Pupils' views regarding their experiences of different teaching approaches

Further evidence regarding the nature and use of group work comes from pupils' preferences and views investigated using four questions included within their questionnaire. Three questions asked pupils to indicate their agreement with statements describing three different teaching approaches. The fourth question asked pupils to indicate their preferred teaching approach. Pupils' responses to the first three questions are outlined in Table 4.7.

Table 4.7
Comparison of group work and conventional pupils' views regarding specific teaching approaches within English classes

English		N	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree	Equation
I really enjoy working as a whole-class with the teacher	C	39	23.1	30.8	33.3	10.3	2.6	X^2 (4) = 7.74, *ns.*
	G	131	14.5	55.7	22.1	5.3	2.3	
I like to work in groups with other pupils	C	39	48.7	38.5	10.3	0	2.6	X^2 (4) = 2.85, *ns.*
	G	131	37.4	44.3	13.7	3.1	1.5	
I like to work by myself	C	39	12.8	25.6	25.6	12.8	23.1	X^2 (4) = 6.41, *ns.*
	G	130	13.8	30.0	28.5	19.2	8.5	

Note: C = Conventional, G = Group work

Comparisons of responses to the two types of lesson - group work or conventional lessons - did not reveal any significant differences in pupils' evaluations regarding English classes. Whole-class work and group work received largely positive responses from pupils. In contrast, although pupils also reported frequently completing tasks individually, their responses did not demonstrate preference for this teaching approach within English lessons. Approximately similar proportions are presented across each of the five response categories indicating that pupils vary in their opinion when asked about completing tasks by themselves.

In an attempt to establish pupils' preference one question asked pupils to select one of four teaching approaches – the even spread of responses shows that equivalent numbers preferred group work and whole-class instruction within English lessons (see Table 4.8).

Table 4.8

Comparison of group work and conventional pupils' preferred teaching approach within English lessons

English		n	Group work	Individual work	Working with one other person	Working as a whole-class	Equation
How do you learn best within a lesson	C	39	33.3	20.5	12.8	33.3	X^2 (4) = 5.2, *ns*.
	G	132	36.4	9.8	18.2	31.1	

Note: C = Conventional, G = Group work

Table 4.9 outlines pupil responses to questions regarding their Science lessons

Table 4.9

Comparison of group work and conventional pupils' views regarding specific teaching approaches within Science classes

Science		N	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Equation
I enjoy working as a whole-class with the teacher	C	39	48.7	43.6	5.1	0	2.6	X^2 (4) = 16.91, $p < .01$, V = .32
	G	127	18.4	56.7	18.1	3.9	3.1	
I like to work in groups with other pupils	C	39	56.4	38.5	2.6	0	2.6	X^2 (4) = 9.72, $p < .05$, V = .24
	G	127	35.4	56.7	7.1	0.8	0	
I don't like it when I have to work by myself	C	39	30.8	30.8	28.2	5.1	5.1	X^2 (4) = 9.25, *ns.*
	G	127	15.0	26.8	30.7	22.8	4.7	

Note: C = Conventional, G = Group work

Pupils from conventional lessons gave mostly positive responses when describing whole-class work with their Science teacher. In contrast, a smaller proportion of pupils from group work lessons gave positive responses, and in general, the spread of their responses indicates a subset that was less positive about whole-class work in Science.

A greater proportion of responses within the strongly agree category (56.4%) were given by conventional pupils in comparison to group work pupils (35.4%) regarding the item "I like to work in groups with other pupils" in relation to Science lessons. The opposite pattern was detected regarding the subsequent category of agree, with a greater proportion of group work pupils (56.7%) reporting agreement with this category in comparison to conventional pupils (36.5%). Interestingly this trend led to another emerging pattern. A subset of pupils from conventional lessons indicated they strongly did not like to work in groups (2.6%); in contrast no pupils from group work lessons reported strong dislike. Yet caution must be exercised before concluding that pupils in group work lessons had more favourable views, as they gave a greater proportion of undecided responses (7.1%) than conventional pupils (2.6%) in relation to Science lessons.

In contrast to the approximately equal proportions present within each response category given by group work pupils, a greater number of pupils from conventional lessons did not like individual work, and agreed with the statement "I don't like it when I have to work by myself". The 22.8% of group work pupils who gave negative responses to individual work is clear from the responses given to the fourth question. Pupils from group work lessons were more accepting of individual work, with 12.9% opting for this category in comparison with 2.6% of pupils from conventional lessons. Table 4.10 shows that group work was the most favoured activity followed closely by working as a whole-class, and working in pairs. Individual work was the least favoured.

Table 4.10

Comparison of group work and conventional pupils preferred teaching approach within Science lessons

Science		n	Group work	Individual work	Working with one other person	Working as a whole-class	Equation
How do you learn best within a lesson	C	39	46.2	2.6	12.8	38.5	X^2 (4) = 9.60, $p < .05$, V = .24
	G	132	36.4	12.9	18.9	24.2	

Note: C = Conventional, G = Group work

4.3.1.1 Summary

The spread of responses given by pupils indicates their experience of different teaching approaches. In particular, their reports relating to group work and whole-class approaches supported the findings of the cluster analysis; that group work and whole-class teaching were regular features of classroom interaction. Similarly, these two approaches were most favoured by pupils when they explained the teaching approaches that supported their learning. However, a different pattern emerged regarding individual work. Despite the cluster analysis and pupils' responses to questions showing agreement that it was a frequent feature of conventional lessons, only a minority of pupils indicated that it allowed them to learn the most in comparison with other teaching approaches. Pupils' responses also verified that interaction on a one-to-one basis with their teacher was infrequent, irrespective of the type of lesson, supporting what was detailed within the cluster analysis.

Pupils' views regarding group work were generally positive, yet a small sample of pupils from conventional lessons remained dissatisfied. This could relate to pupils' experience of being seated in groups but working individually for a proportion of a lesson, evidenced by pupils' responses to questions examining the frequency of different teaching approaches. The findings of the cluster analysis suggest that pupils engage with tasks according to whether they are situated within group work or conventional lessons. Pupils were observed to be content to work within groups as they completed the same task but were also able to interact during whole-class teaching. So what is it that drives pupils to differentiate their behaviour? – that groups appear to be governed by principles nearing best practice or that pupils' enthusiasm for interaction and peer engagement motivates them to interact in groups? An alternative perspective relates to whether the variation in pupil behaviour could be attributed to differences in teachers' behaviours within these lessons thus observations of teachers were analysed.

4.4 Analysis of teacher observation data

Observations of teachers were analysed to help determine whether the variation in pupils' behaviour could be attributed to differences in teachers' behaviours. The nature of classrooms means a large number of pupils are present; however, each class is paired with one teacher, restricting the number of participating teachers making it equivalent to the number of participating classes (26). Table 4.11 reports the precise number of teacher observations collected.

Table 4.11

Descriptive statistics for observed teaching in relation to variables of interest

		Subject		Gender	
		Science	English	Male	Female
C	S1	20 (28.5)	4 (11.8)	12 (38.7)	12 (16.4)
	S3	18 (25.71)	0 (0)	10 (32.3)	8 (10.9)
G	S1	8 (11.43)	12 (35.3)	2 (6.5)	18 (24.7)
	S3	24 (34.29)	18 (52.9)	7 (22.5)	35 (47.9)
Total		70 (100)	70 (100)	34 (100)	31 (100)

		Topic stage			Lesson Stage	
		Introduction	Middle	Conclusion	Beginning	Conclusion
C	S1	8 (22.2)	4 (11.8)	12 (35.3)	12 (22.6)	12 (22.6)
	S3	8 (22.2)	6 (17.6)	4 (11.8)	10 (18.9)	10 (18.9)
G	S1	8 (22.2)	6 (17.6)	6 (17.6)	10 (18.9)	10 (18.9)
	S3	12 (33.3)	18 (52.9)	12 (35.3)	21 (39.6)	21 (39.6)
Total		36	36 (100)	34 (100)	34 (100)	52 (100)

Note: S1 = First year, S3= Third year. C = Conventional, G = Group work.

Equivalent numbers of observations were recorded at each stage of the lesson and topic. Significant chi square goodness of fit tests for teaching year (X^2 (1) = 4.92, $p < .05$) and subject (X^2 (1) = 22.23, $p < .01$) can be explained. As noted earlier, first year teaching involves general subjects, whereas third year science involves discrete science thereby doubling the number of observations collected in third year science lessons. In contrast, significant differences regarding gender (X^2 (1) = 32.33, $p < .01$), and lesson type (X^2 (1) = 13.0, $p < .01$) indicate difficulties in obtained balanced samples.

Comparisons of data recorded within the different lesson types are examined as analysis of the pupil observations revealed that pupils' interaction and behaviour varied within the different lesson types. However, to examine teachers' behaviour more fully it is imperative that additional variables of interest are considered. Analyses are presented separately by lesson type, and separate distributions are examined for group work and conventional lessons, rather than evaluating the overall distribution (Field, 2000). The frequencies of the 17 observation categories presented within teacher observation grids are shown in Table 4.12, and are outlined separately for group work and conventional lessons.

Table 4.12

Frequencies of observation categories used to record teacher behaviour

Categories	Conventional	Group work	Included in Analysis
Connections made	39	73	✓
Develop ideas	54	91	✓
Consolidate	30	60	✓
Evaluate	65	90	✓
Revise	38	51	✓
Summarise	9	12	×
Pupil plenary	21	55	✓
Link to past/future lessons	49	78	✓
Feedback to pupils	68	114	✓
Lesson purpose detailed	22	30	×
Instruction	86	147	✓
Explanation	78	129	✓
Disagree	13	21	×
Resolution	20	22	✓
Questions to whole-class	64	73	×
Questions to specific individuals	18	38	×
Specific questions	82	111	✓
Inaudible/Not applicable	4	6	×

Specific variables were observed more regularly within group work lessons than conventional lessons; feedback to pupils and explanations are two such examples. Two related variables Questions to whole-class and Questions to specific individuals were amalgamated to create Specific questions, as Questions to specific individuals was observed infrequently. Four variables were rarely observed: with such low frequencies they were not included in any additional analysis (Summarise, Lesson purpose detailed, Disagree and Inaudible). Excluded variables are indicated with a cross in the right-hand column of Table 4.12.

The results from a Shapiro Wilk test of normality, most suited to evaluating small data sets (Field, 2005), were computed for the remaining twelve variables and are presented separately for group work and conventional lessons. It is clear that many of the variables have significantly non-normal distributions (see Table 4.13).

Table 4.13

Tests of Normality applied to observation categories used to record teacher behaviour

	Conventional	Group work
	Statistic (df = 18)	Statistic (df = 34)
Connections made	.89	.81**
Develop ideas	.92	.83**
Consolidate	.89*	.84**
Evaluate	.96	.89**
Revise	.85**	.75**
Pupil plenary	.77**	.61**
Link to past/future lessons	.89*	.90**
Feedback to pupils	.95	.88**
Instruction	.92	.94
Explanation	.94	.94*
Resolution	.83**	.63**
Specific questions	.86**	.87**

Note: *$p < .05$. **$p < .01$

Three different transformations were applied to the data, with the aim of converting a non-normal distribution to a normal distribution. Commonly applied transformations for positively skewed data include square root, log and inverse methods. Scores within the negatively skewed variable are reversed, which effectively converts the variable to a positive skew, allowing similar treatment, following which its scores are reversed so they retain their original meaning. Table 4.14 reports the results of normality tests on these variables, according to whether the data were obtained from group work or conventional lessons and the three different types of transformations applied to the data.

Table 4.14

Tests of Normality on Transformed data

Categories	Conventional (df = 18)			Group work (df = 34)		
	1	2	3	1	2	3
Connections made	.92	.91	.80**	.89**	.92*	.79**
Develop ideas	.92	.89*	.77**	.76**	.63**	.33**
Consolidate	.91	.89*	.79**	.89**	.90**	.82**
Evaluate	.95	.89*	.69**	.95	.95	.79**
Revise	.90	.92	.83**	.81**	.82**	.76**
Pupil plenary	.78**	.77**	.74**	.75**	.84**	.82**
Link to past/future lessons	.89*	.84**	.66**	.94*	.93*	.79**
Feedback	.93	.87*	.66**	.95	.95	.77**
Instruction	.92	.88*	.67**	.98	.95	.72**
Explanation	.89*	.82**	.62**	.97	.95	.72**
Resolution	.85**	.84**	.79**	.67**	.69**	.68**
Specific questions	.87*	.86*	.77**	.93*	.94*	.80**

Note: 1 = Square root, 2 = Log, 3 = Inverse. $^{*}p < .05$, $^{**}p < .01$

The different transformations had little overall effect on the non-parametric nature of the data, evidenced by the significant normality tests. Unlike parametric statistics, non-parametric statistics make no assumptions regarding the normality distribution of the data. However, most nonparametric tests require that the variances within each population examined are equal or that homogeneity of variance is maintained (Sheskin, 2004). The non-significant homogeneity tests displayed within Table 4.15 demonstrate that equal variances were observed within group work and conventional lessons for all categories, with the exception of “Specific questions”. Figure 4.3 considers the underlying distribution of this variable in greater detail.

Table 4.15

Test of Homogeneity of Variances applied to observation categories used to record teaching behaviour

	Levene Statistic
Connections made:	1.09
Develop ideas	1.81
Consolidate	1.52
Evaluate	.04
Revise	.01
Pupil plenary	.67
Link to past/future lessons	.29
Feed back to pupils	.39
Instructions	1.12
Explanation	.67
Disagreement	.19
Resolution	.002
Specific questions	5.22*

Note: * $p < .05$

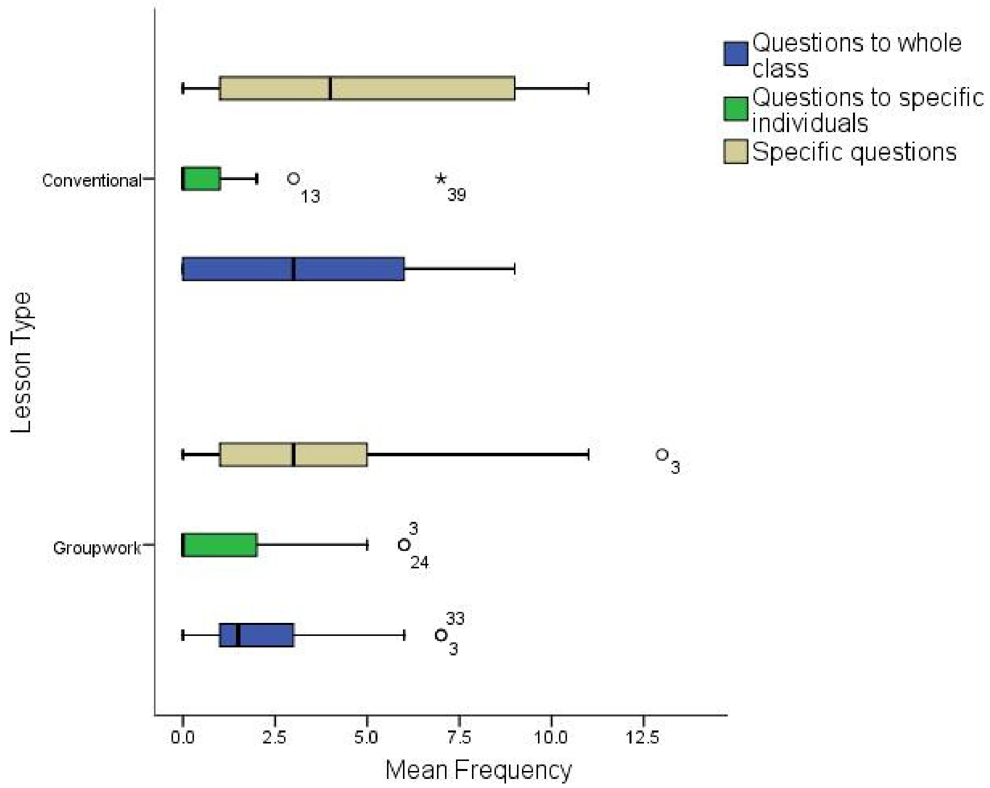


Figure 4.3 Comparison of the observation categories investigating teachers' questioning behaviour

Both original and agglomerated categories are presented in Figure 4.3. Teachers were infrequently observed to pose questions to specific pupils suggesting that this type of behaviour may not be widely used. In contrast, much greater variability can be seen in teachers' posing of questions to the whole-class, particularly within conventional lessons. Within group work lessons a number of outliers are evident, suggesting that specific teachers utilised classroom questions more frequently yet generally teachers within group work lessons appear to have posed fewer questions to the whole-class than they would do within conventional lessons. Therefore, these categories, which did not meet the homogeneity of variance assumption required for the majority of non-parametric statistics, including the agglomerated category, will not be considered further.

The eleven remaining observation categories were analysed using non-parametric statistics. As multiple two-tailed tests were conducted on the same data set, a Bonferroni corrected significance level was used. This conservative approach (Howell, 1997) reduces the likelihood of false significant findings and here replaces the normal p-value of .05 with a more stringent .004, used in relation to all analyses involving teacher observational data. A two independent samples test was used to compare teachers' behaviours within the different lesson types (group work or conventional) and teaching subjects (Science or English) separately for observations collected at the introduction and conclusion of lessons. The Kolmogorov Smirnov *Z* value will be reported as it is more suited to small sample sizes (Field, 2005; Sheskin, 2004).

Comparisons of teachers' behaviour at the introduction of lessons indicated that one finding was statistically significant and a second approached Bonferroni-adjusted significance. During lesson introductions, teachers within conventional lessons made more evaluative comments (Mdn = 5, IQR = 1.5) than teachers within group work lessons (Mdn = 2, IQR = 2), (Kolmogorov Smirnov $Z = 1.77$, $p < .004$, $r = .34$). Teachers within conventional lessons provided more feedback to pupils (Mdn = 6, IQR = 3.5) than teachers within group work lessons (Mdn = 2, IQR = 2.5), with this finding approaching corrected statistical significance (Kolmogorov Smirnov $Z = 1.49$, $p = .007$, $r = .29$).

One finding approached corrected significance when the teaching stage was considered. Teachers within third year classes gave more instructions during the introduction of a lesson (Mdn = 6.0, IQR = 5) than their counterparts within first year classes (Mdn = 3, IQR = 5) (Kolmogorov Smirnov $Z = 1.38$, $p = .02$, $r = .27$). There were no corrected statistically significant differences between teachers when the teaching subject was considered.

Analyses focused on lesson conclusions detected no significant differences between teachers' behaviour relating to whether observations were recorded within the different types of lessons, the teaching subjects or teaching years. By itself, this finding would appear to suggest that teachers do not vary in how they approach lesson conclusions, yet this is an unsatisfactory outcome when we consider their duration. Teachers within conventional lessons took more time to introduce lessons (Mdn = 6, IQR = 2), than to conclude lessons (Mdn = 4, IQR = 2), ($Z = -3.62$, *exact* $p < .004$, $r = -.78$). In contrast, time taken to introduce (Mdn = 6, IQR = 2.25) or conclude (Mdn = 5, IQR = 4) lessons did not vary within group work lessons ($Z = -1.87$, ns). Conventional teachers set aside more of the lesson to introducing material and had briefer concluding periods, whereas group work teachers appear to have approximately equal introductions and conclusions. Yet this should not imply that equivalent behaviours were observed at the outset of lessons as the analysis indicated moderate differences between teachers within group work and conventional lessons.

To probe teachers' behaviour further, the focus progressed to evaluating teachers' behaviour within lessons. Comparisons of teachers' behaviour were made between the introduction and conclusion of lessons using a Friedman test. Separate comparisons were computed for observations recorded within the different lesson types. Teachers' behaviour was found to vary when the observations recorded during the introduction and conclusion of lessons were compared, for both conventional (X^2 (10) = 81.51, p <.004) and group work (X^2 (10) = 96.38, p <.004) teachers. Follow-up analysis using Wilcoxon signed rank tests revealed that teachers' behaviour varied across specific variables within the different types of lessons (see Table 4.16).

Table 4.16

Comparison of teacher behaviour recorded during the introduction and conclusion of lessons, according to lesson type (IQR in parentheses)

	Category	Introduction	Conclusion	Equation
Conventional	Develop Pupils' ideas	5 (2.5)	2 (3)	$Z = -2.72, p < .004, r = -.91$
	Revision	3 (4)	1 (1.5)	$Z = -2.54, p = .008, r = -.85$
	Instruction	6 (5.5)	3 (4.5)	$Z = -2.54, p = .008, r = -.85$
Group work	Explanations	4 (5)	3 (2)	$Z = -2.55, p = .009, r = -.62$

Note. IQR – Inter-quartile range.

Within conventional lessons, teachers were observed to use statements related to developing pupils' ideas more frequently during lesson introductions than their conclusion. A number of findings approached significance. More revision occurred at the outset of lessons than at their conclusion. A greater number of instructions were also given during the introduction of a lesson than at its conclusion. Explanations featured in the introduction of group work lessons more than at their conclusion.

As few differences were observed when comparisons were made looking at teachers' behaviour within lessons, the remaining observation categories were plotted within Figure 4.4 to help give a general picture of the manner in which teachers approach the introduction and conclusions of lessons.

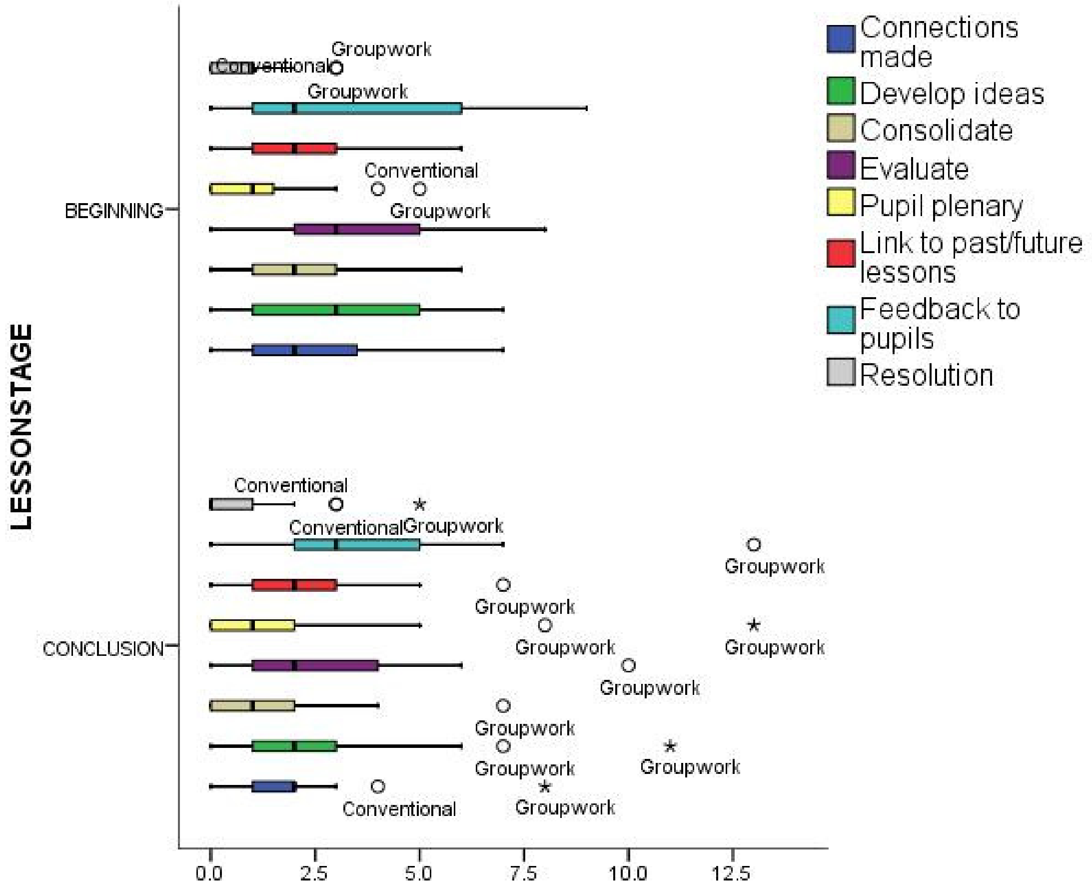


Figure 4.4 Comparison of observation categories used to record teaching behaviour within each lesson stage

The variation within each of the observation categories presented in Figure 4.4 helps clarify how teachers address pupils. During the lesson introduction teachers showed similar approaches when talking to pupils within group work or conventional lessons. Evaluative comments and giving feedback were common features of teachers' talk. In comparison, the outliers suggest that a number of teachers were able to include specific behaviours within lesson conclusions and more variance was observable. It is also reassuring to see that brief attempts were made to engage in a plenary session, indicating that teachers made attempts to pull together ideas from separate groups within their class. Aside from these minor indications, it is difficult to identify what efforts were made by teachers to incorporate what pupils were learning in groups with the academic purpose of the lesson and indeed relate it to the lesson in its entirety.

The final between-subjects variable of topic stage was analysed using a non-parametric Kruskal-Wallis test, which compared the medians of the observation categories across the three different topic stages. However, no significant differences were detected when the medians of the observation categories were compared at the different topic stages. Neither were significant differences detected when separate analyses were conducted, each of which included one of the independent variables of lesson type, teaching subject, and teaching year. Thus, teachers' efforts within lessons did not vary across the different stages of a topic.

Investigating teachers' behaviour indirectly by examining the number of transitions observed during lessons can help explore the rate and pace of lessons, clarifying the lack of conclusions within either lesson type. A transition can be considered as a shift coordinated by the teacher, in an attempt to move the focus of the lesson, perhaps onto a different working arrangement. Each transition, when observed, was recorded onto the lesson context sheet. The resulting frequency for each lesson was used within the analysis. The two independent samples test compared the number of transitions recorded within lessons according to teachers' lesson type (group work or conventional) and subject (Science or English), and the Kruskal-Wallis test (more than two independent samples) compared teachers' behaviour according to their training regarding group work.

The rate of transitions was not found to vary according to teaching subject ($Z = .82$, ns), type of lesson ($Z = .80$, ns), or the degree to which teachers had received group work training ($H (2) = 2.19$, ns). Descriptive statistics relating to the number of transitions recorded ($Mdn = 7$, $IQR = 2$) suggest that teachers have little time during such fast paced lessons to engage with pupils. Even within lessons where the smallest number of transitions was recorded it may have been difficult for teachers to incorporate pupils' ideas within the main objectives of lessons. The limited opportunities available to teachers may mean that such occasions focus on pupils' completion of tasks, rather than lead to an extended discussion. Therefore, frequent transitions are argued to make it less feasible for teachers to incorporate pupils' contributions.

The analysis of teachers' behaviour observed at the introduction and conclusion of lessons revealed that, with the exception of one significant finding, teachers were reasonably consistent in how they introduce lessons. The same cannot be stated regarding lesson conclusions, where teachers' behaviour was constrained by the shorter remaining lesson time available to them in which they could conclude lessons. Teachers employed a rapid pace with an equivalent number of transitions made during conventional and group work lessons. To add to the account of teacher behaviour within group work lessons, teachers' questionnaire responses examined their usage and views regarding different teaching approaches.

4.5 Teacher perspectives derived from questionnaire responses

Teacher reports regarding their usage of different teaching approaches can also be a useful barometer when exploring classroom interaction. As teachers showed few differences in their behaviour and approach to group work and conventional lessons, teachers' experience of group work training was considered to be more informative when interpreting teachers' beliefs. It may be that teachers lack skills to tailor their learning and teaching approach but are able to express insight regarding group work having experienced training. Teachers' responses were compared using inferential statistics (Fisher's exact test to account for small sample size), according to the respondents' teaching subject and whether or not they had experienced training regarding the use of classroom groups. Teachers' responses to questions, which aimed to profile the frequency of different teaching approaches, combine to create the first section below, followed by examination of teachers' views regarding teacher and pupil interaction whilst pupils worked in groups. Tables 4.17 and 4.18 detail the spread of responses given by teachers to a set of questions, which investigated the frequency of different teaching approaches.

Table 4.17

Frequency of teaching approaches according to English teachers

		n	Frequently %	Infrequently %
Teach the Whole-class	√	2	100	0
	X	4	100	0
Teach small groups	√	2	100	0
	X	4	66.7	33.3
Talk to individual pupils	√	2	100	0
	X	3	100	0
Allow pupils to work in a group on a shared task	√	2	100	0
	X	3	100	0
Pupils work with a partner on a shared task	√	2	100	0
	X	4	100	0
Teach pupils who are sitting and working individually	√	2	50.	50.
	X	3	33.3	66.7
Teach pupils seated in groups but work alone	√	2	50.	50.
	X	3	33.3	66.7
Cooperative group work	√	2	50.	50.
	X	4	75.	25.
Collaborative group work	√	2	50.	50.
	X	3	100	0

Note: √= have received some training, X= have not received any training. Dashes indicate the category did not meet test assumptions.

Table 4.18

Frequency of teaching approaches according to Science teachers

		n	Frequently %	Infrequently %
Teach the Whole-class	√	3	100	0
	X	4	100	0
Teach small groups	√	3	66.7	33.3
	X	4	100	0
Talk to individual pupils	√	3	100	0
	X	4	100	0
Allow pupils to work in a group on a shared task	√	3	100	0
	X	4	100	0
Pupils work with a partner on a shared task	√	3	100	0
	X	4	100	0
Teach pupils who are sitting and working individually	√	3	100	0
	X	4	75.	25.
Teach pupils seated in groups but work alone*	√	3	0	100
	X	4	100	0
Cooperative group work	√	3	66.7	33.3
	X	4	50.	50.
Collaborative group work	√	3	100	0
	X	4	100	0

Note: √= have received some training, X= have not received any training. $*p < .05$
Dashes indicate the category did not meet test assumptions.

When comparisons were made between responses given by English teachers, regarding the frequency of specific teaching approaches, according to whether or not they had received continued professional development or other training including group work, no significant differences were detected.

When we look at teachers' responses to items querying small groups (for example: "allow pupils to work in a group on a shared task, "pupils work with a partner on a shared task" and “teach small groups”) small groups were reported as being used frequently with similar proportions of responses being attributed to each category from teachers irrespective of whether they received training and this is true of both English and Science teachers.

A significant difference was detected and related to the incidence of pupils being seated in groups but completing tasks individually. Teachers who had not received training were adamant that a few times each week they used this incompatible seating and working arrangement; by contrast teachers who had received training were evidently reluctant to use the arrangement.

Findings of the cluster analysis and pupil reports indicated that teachers were rarely observed to interact with pupils in the main part of the lesson. Teachers’ responses to specific questionnaire items can help shed light on their behaviour, during the main part of lessons. Teachers who had received group work training reported that they were equally likely (33.3%) to interact with individual pupils within every lesson, a few times each week and once a week. In contrast, teachers who had not received training reported more frequent interaction with pupils, with all teachers (100%) agreeing that interaction occurred every lesson. In itself this finding does not present a clear answer rather it raises more questions – are teachers who had received training more aware of their role during group work? Or is it that training increases awareness of related issues such as the volume of teacher-pupil interaction occurring within lessons? To help elucidate teachers’ beliefs additional questions were posed.

When responding to the question “A teacher's presence during group work benefits the group”, teachers’ reported diverse opinions (see Figure 4.5 and 4.6). Of particular interest is that the number of teachers who reported receiving training indicated less agreement with this statement than their counterparts who had not received training. This finding is consistent with the reduced level of teacher interaction when pupils worked in groups as observed in group work classrooms and detailed within the cluster analysis. Yet caution must be exercised before concluding that teachers who reported receiving training held more favourable views, as they gave a greater proportion of undecided responses and did not report disagreement with the statement.

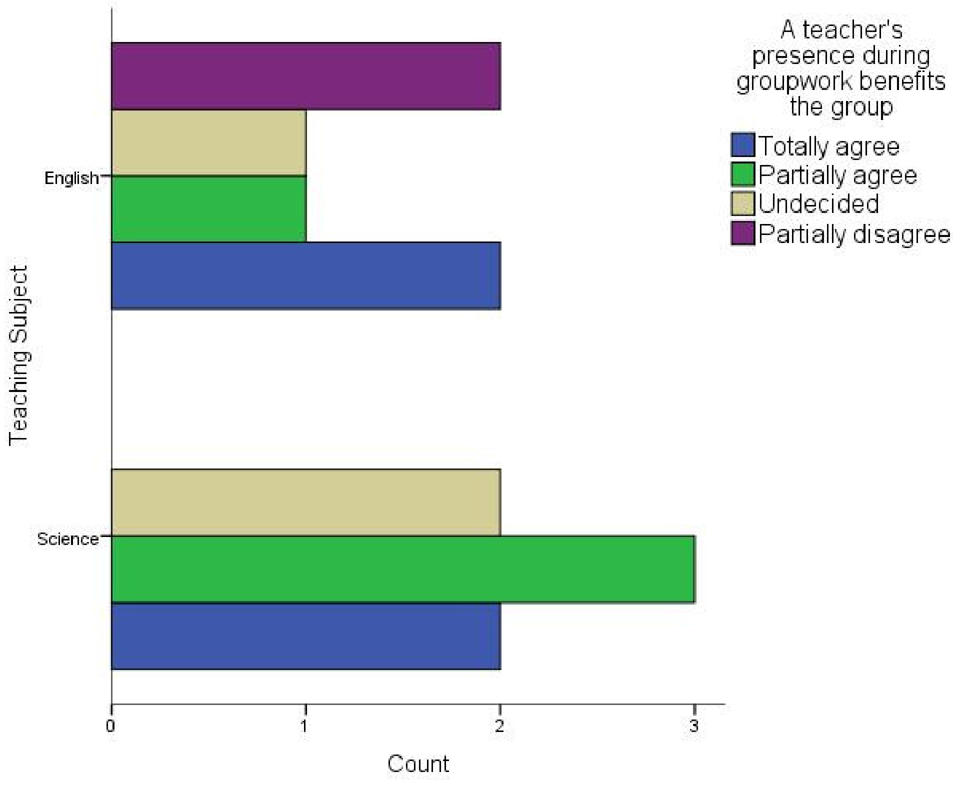


Figure 4.5 Comparison of English and Science teachers’ responses to the item investigating “a teacher’s presence during group work benefits the group”

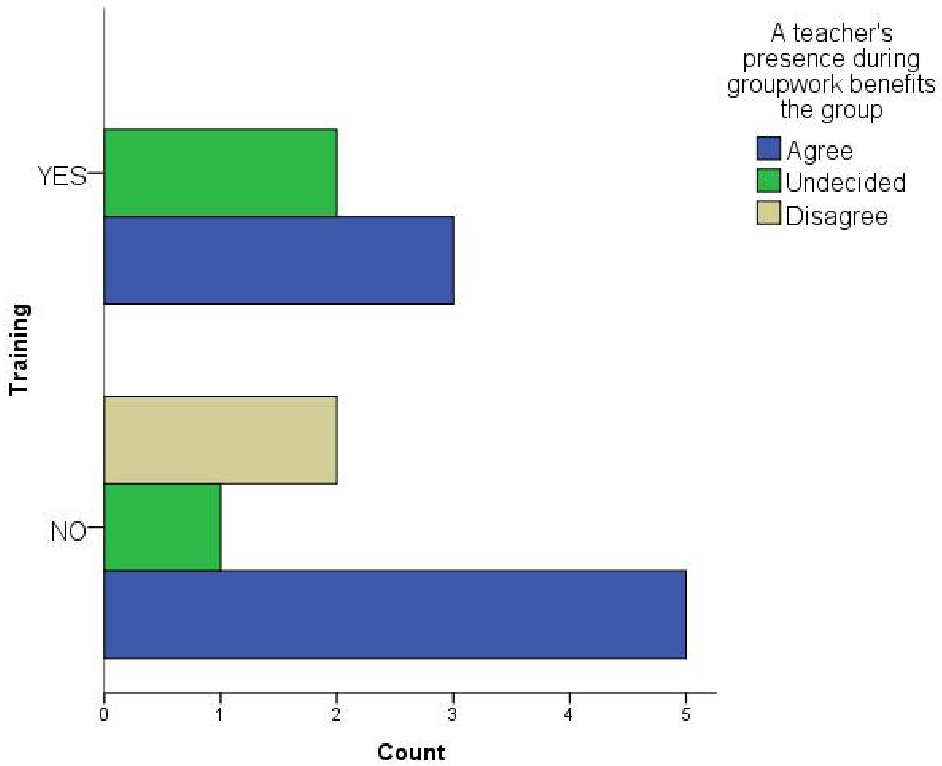


Figure 4.6 Comparison of trained and non-trained teachers' responses to the item investigating "a teacher's presence during group work benefits the group"

In general, a greater number of Science teachers agreed that a teacher's presence benefited pupils working in groups in contrast to English teachers who were more varied in their responses. In addition, only a minority of teachers who had not received training disagreed that their presence benefited pupils who worked in groups, in comparison to trained teachers who generally were more positive.

A similar pattern was evident within teachers' responses to the item "When pupils are grouped I do not disturb them and I let them get on with their tasks". The majority of English teachers indicated that they did not avoid interacting with groups (see Figure 4.7). In contrast, Science teachers gave more diverse answers, ranging from agree to disagree, suggesting variability in their behaviour

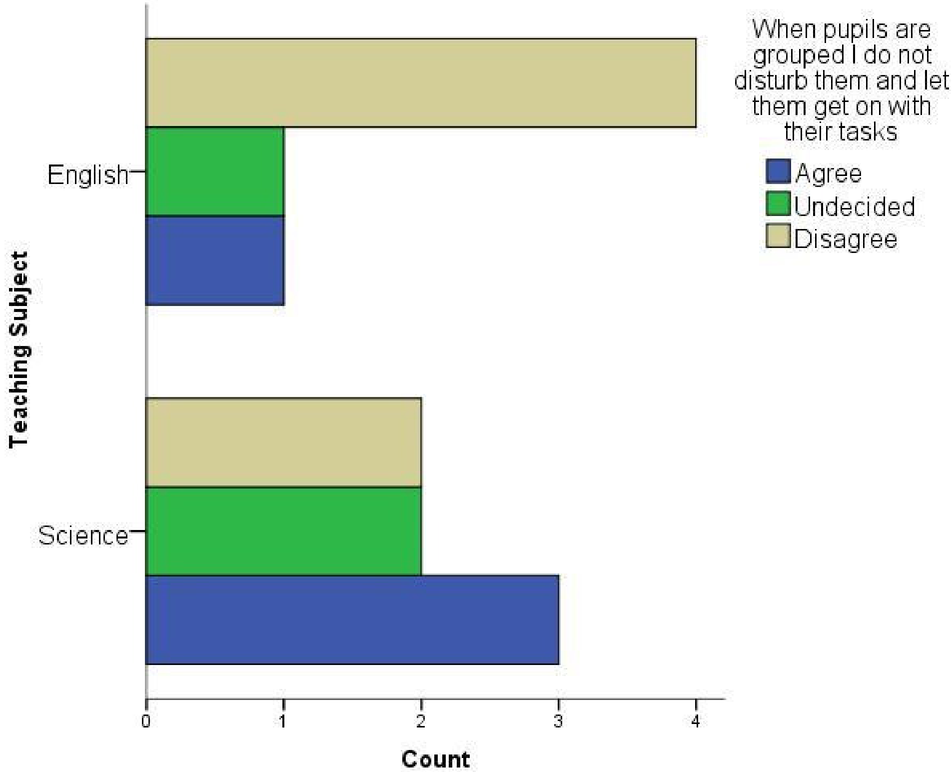


Figure 4.7 Comparison of Science and English teachers' responses to the item investigating "When pupils are grouped I do not disturb them and let them get on with their tasks"

Figure 4.8 compares trained and non-trained teachers' responses, where a greater number of teachers who had not received training disagree with this statement (in other words they would interrupt groups) in comparison to fewer of their trained counterparts.

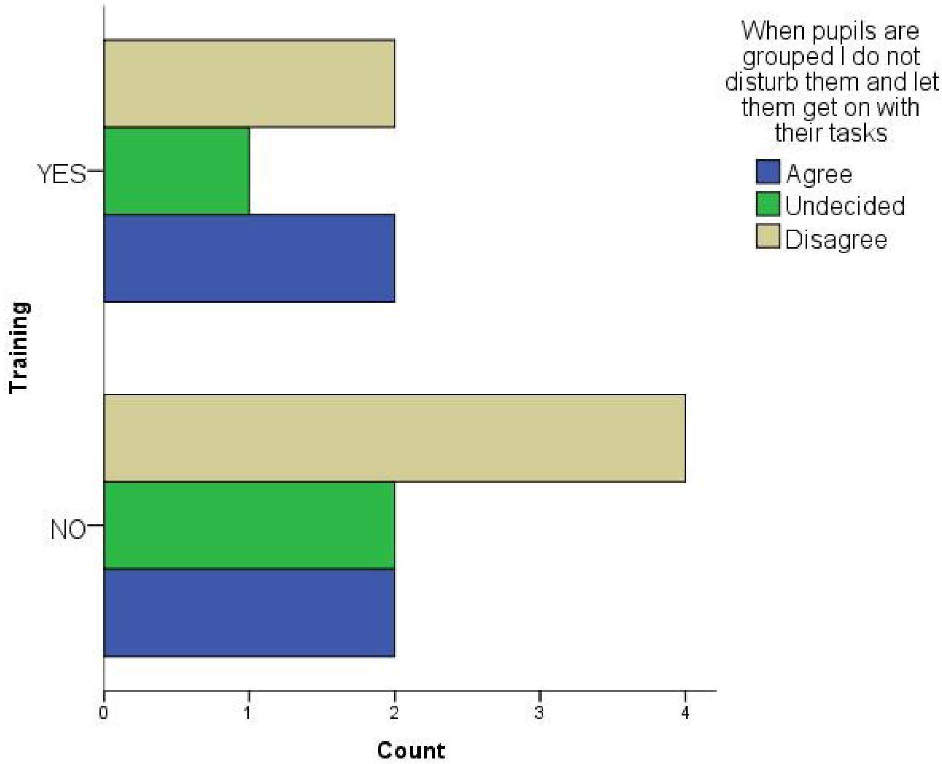
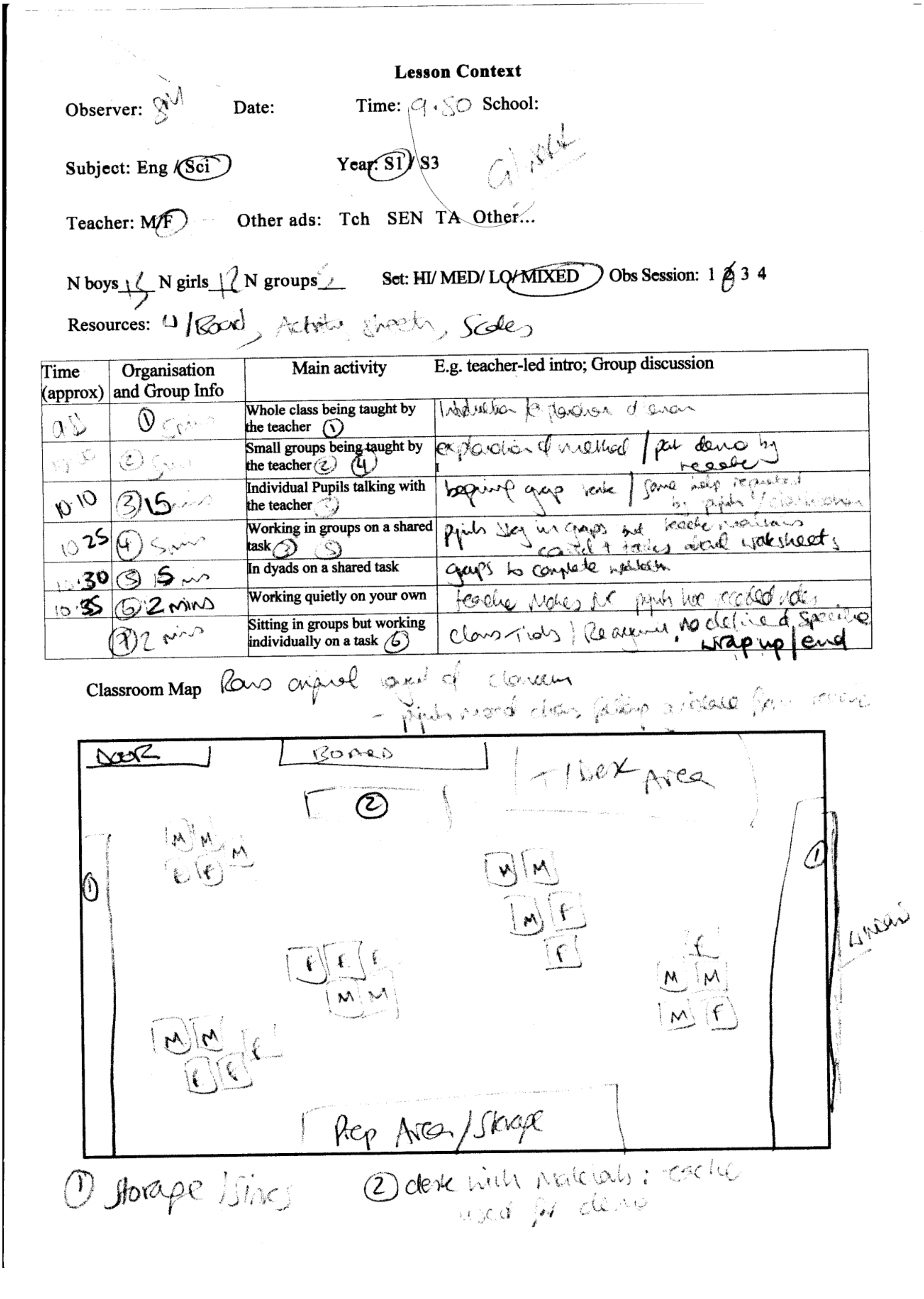


Figure 4.8 Comparison of Trained and non-trained teachers' responses to the item investigating "When pupils are grouped I do not disturb them and let them get on with their tasks"

However, teachers' responses to these questions cannot be considered conclusive, as within the responses given, a proportion of teachers chose the undecided option. This could indicate that the questions are insufficiently specific to quantify teachers' behaviour within the middle of lessons. Alternatively, it could be that teachers, even those who had received training, are unclear as to the optimal course of action needed whilst pupils complete tasks in groups.

4.6 Context of group work lessons

To supplement data obtained from observing pupils and teachers, content recorded on the lesson context sheets during group work lessons adds to the profile of group work that is being developed. Characteristics of group work lessons can also be understood through comparison with teaching observed within conventional lessons. An example of a completed lesson context sheet is presented in Figure 4.9



Lesson Context

Observer: Date: Time: 9.50 School:

Subject: Eng / Sci Year: S1 / S3

Teacher: M/F Other ads: Tch SEN TA Other...

N boys 15 N girls 12 N groups 2 Set: HI/ MED/ LO/ MIXED Obs Session: 1 2 3 4

Resources: Board, Activity sheets, Scales

Time (approx)	Organisation and Group Info	Main activity	E.g. teacher-led intro; Group discussion
	1	Whole class being taught by the teacher 1	
	2	Small groups being taught by the teacher 2 4	explanation of method / part demo by teacher
10.10	3 15	Individual Pupils talking with the teacher	begin group task
10.25	4	Working in groups on a shared task 2 5	worksheets
10.30	5 15	In dyads on a shared task	groups to complete
10.35	6 2 mins	Working quietly on your own	
	7 2 mins	Sitting in groups but working individually on a task 6	wrap up / end

Classroom Map

Figure 4.9 Example of a lesson context sheet completed during observation within a group work lesson

Observation occurred in 34 group work lessons, prior to group work 12 (35%) were set out in paired/dyad seating (in rows typically facing the front of the class), 19 (56%) as small groups (where pupils faced each other and had a minimum of two to a maximum to six members). and a further 3 (9%) used individual seating. Yet notes made when pupils worked as small groups reported that small group seating was most often used (85%). This means that the arrangement of tables and chairs typically used within classrooms had consequences as the classroom layout had to be adapted to suit group work. During 6 of the 12 lessons structured to have paired/dyad seating in rows at the outset adaptations of the seating layout occurred moving from the original arrangement to small groups. Within each of the 3 lessons set out using individual seating, adaptation took place with seating moving to a dyad group arrangement. The other approach recorded was when pupils took upon themselves to coordinate their seating arrangements with the instructional approach for example; a pair seated together in a row could become a small group, as pupils would reverse the orientation of their chairs rather than attempt to manoeuvre desks. The constraints on space within both English and Science classrooms – the need to store equipment and textbooks meant that cupboards frequently ran the length of classrooms – helps explain such behaviour by pupils. Pupils' attempts to reorganise their seating arrangements was less frequently observed within conventional lessons. Teachers of conventional lessons preferred to engage with the whole class, transmitting knowledge to pupils. Within conventional lessons if pupils worked with their peers, interaction was most often a means to share resources.

In the 19 lessons where small groups were used as the typical classroom layout, only on two occasions were adaptations noted. Teachers who used individual or paired seating in rows were observed to dedicate time to adapt the classroom layout so that group seating arrangements could be established. There appears to be an assumption that when classroom seating arrangements are set up as small groups no additional preparation is required. Structuring the layout of the classroom so that tables and chairs are in small groups may have the advantage of reducing time required to rearrange tables and chairs prior to group work, but in fact presents more difficulties than teachers anticipate. In particular, a concern relates to whether or not pupils who normally sit in groups within each lesson remain in their usual allocated seat or whether teachers make an additional effort to compose groups. Lack of preparation may be problematic, making it difficult to determine whether or not groups are arranged so that they provide an optimal environment that encourages interaction and indeed making it difficult for pupils to assess whether they ought to work as groups or not. Teacher observation suggests little effort is made by teachers to set up group work, indicating that pupils may take time to realise that they ought to work as groups.

Figure 4.10 presents the typical layout of classrooms during group work. The classroom layout is based on the classroom plans that were sketched onto the lesson context sheets during classroom observation. Most often groups contained similar if not an equal number of either sex (e.g. 2 male and 2 female pupils), indicating that pupils worked in heterogeneous groups. Within this figure the presence of the teacher has not been explained – teachers adopted different strategies when interacting with small groups. Some opted to reign in communication, and help back from communicating with groups unless pupils explicitly invited attention. Other teachers made it very obvious with their physical presence that groups were being monitored – both so that pupils' behaviour met classroom norms and that groups concentrated on their task. Thus, teachers' behaviour within group work lessons differed to their conventional counterparts who for the greatest part of the lesson were found to be in close proximity to their desk.

Activities commonly distributed were intended to be shared by groups, which the cluster analysis reported that pupils focused on completing for the duration of lessons. Common to group work lessons in both teaching subjects was the use of posters as tasks – groups would aim to complete a substantial part of a poster within a lesson. Posters in English were used in relation to developing profiles of characters and tended to be referred to as preparatory work for forthcoming writing activities. The use of posters in Science varied more widely, pupils were observed to use them to record findings but also to develop connections between explanations.

Within English and Science, specific topics were the focus of group work lessons. Group work in English classes focused on textual analysis, examining poetry and novels. Discussion in groups also examined character development, development of reasoning skills and examination of mood within text. Thus, group work in English was tied to specific skill sets, where pupils could compare their approach to learning with their peers. In contrast, groups in Science looked at multiple topics: examining curricula areas such as properties of sound, electricity and circuits, fuel and the environment, atomic structure and states of matter.

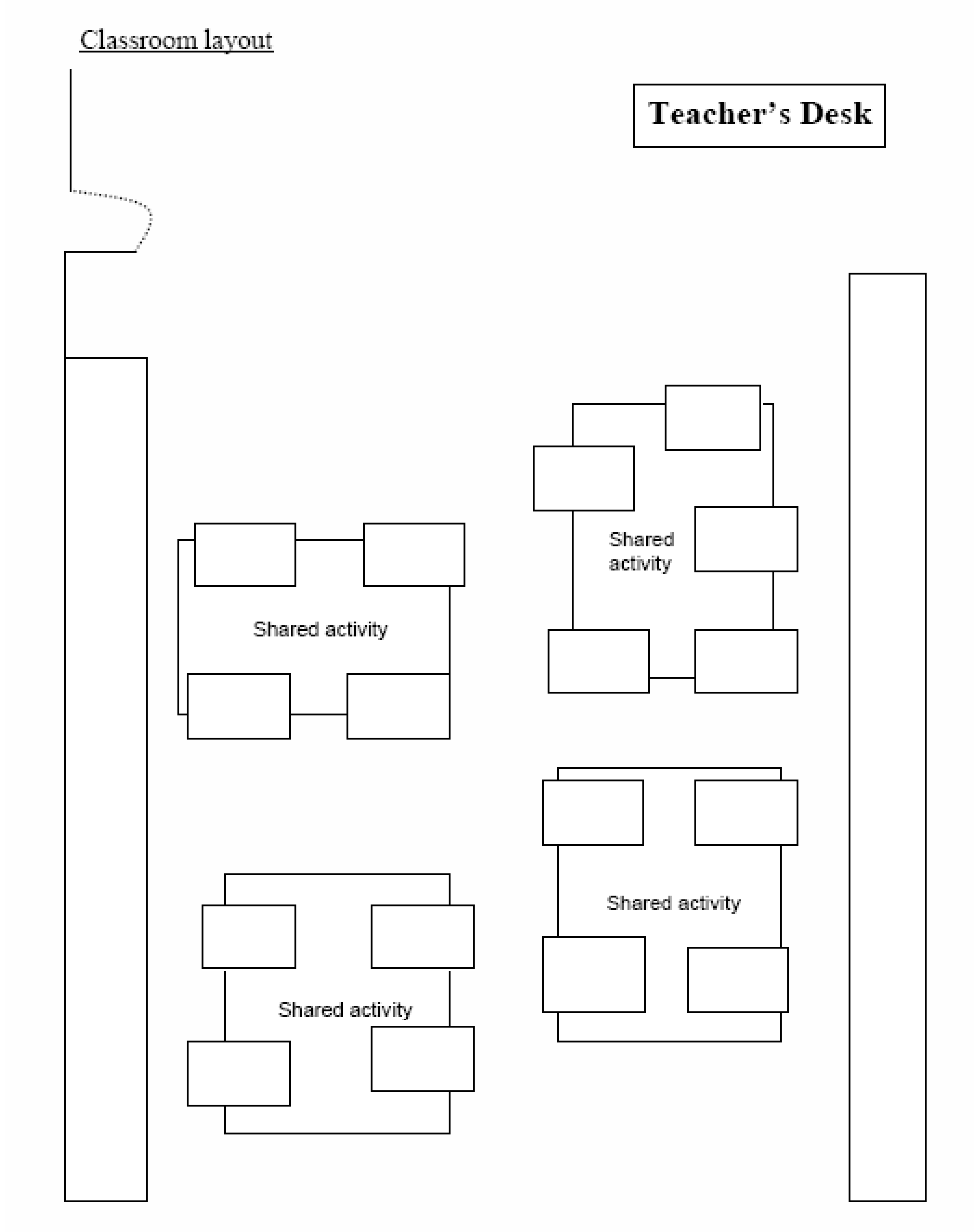


Figure 4.10 Depiction of a classroom during a group work activity

The content of the lesson context sheets also gave insight regarding the overall nature of group work lessons. The fast-paced structure of group work lessons related to few incidences of teachers employing a lesson plan that involved coordinating sections of lessons and moving the activities forward so that pupils' learning progressed in tandem with teachers' expectations. The use of group work without additional consideration being given to the lesson in its entirety makes it difficult for pupils to relate what they learnt in groups with the academic purpose of the lesson. This is exaggerated by the frequency of transitions made by teachers during both types of lessons. Within two instances during lessons making use of group work, pupils' engagement was considered important – time was regularly given for pupil reflection during group work and within Science pupils had to decide their preferred prediction from a selection presented by the teacher. Within other classrooms, whole-class reflection led by the teacher was preferred where few instances were recorded of content discussed by groups being used to sustain the whole-class discussion, suggesting that teachers approach to whole-class reflection varied little from established routines evident within conventional lessons.

The lesson context sheets summarised the characteristics of group work lessons. It is apparent that an understanding is developing amongst teachers, which includes the need for pupils to experience group work regularly. However, teachers' grasp of the relevant factors may be somewhat superficial as teachers haphazardly prepare the classroom environments prior to pupils engaging in group work and without such understanding teachers cannot effectively support learning resulting from peer interaction.

4.7 Discussion

Study 1 focused on depicting group work within first and third year Science and English Scottish secondary classrooms. Particular attention was given to examining both pupil and teacher behaviour and making comparisons between data collected within the two types of lesson. Specific items from pupil and teacher questionnaires were incorporated to give a more rounded understanding of classroom interaction and help evaluated what features of lessons contribute to the nature of group work.

The general characteristics of groups help explain the most common observed practice that was recorded within Science and English lessons. For the main part, teachers maintained control regarding the allocation of pupils to groups. This resulted in group size being kept constant, with groups ranging from a minimum of two to a maximum of six members. Teachers introduced tasks and made it clear that each group within the classroom would be given the same activity to complete. Rarely were groups given different activities, nor were groups asked to engage in specific forms of group work (for example, as mentioned earlier, Jigsaw cooperative groups requires that collaboration in groups follows a specific procedure). Teachers frequently gave specific instructions to guide pupils as to how the physical layout of the classroom could be altered to provide a more suitable layout; typically this meant that a part of each lesson had to be sacrificed to accommodate this. Such variation relates to suggestions given regarding pupil engagement within classrooms (Meece, Blumenfeld, & Hoyle, 1988) who pointed out that variety within lessons led to higher levels of pupil involvement. Lessons that incorporated a greater volume of different layouts, varied forms of activities and tasks and generally included the main forms of teaching approaches were argued to be factors important in maintaining pupils' attention and engagement within the lesson.

The findings of the cluster analysis clearly documented that pupils were willing to work in groups and maintain task engagement, contrasting with established research findings (Galton, et al., 1999b). This account was strengthened by observation of specific forms of dialogue known to contribute to pupils' learning (Christie, et al., 2009; Howe, et al., 2007). Higher proportions of these dialogue features were identified within the group work cluster; pupils without specific training, recognised the value of group work and seized opportunities to work, discuss and interact with their peers during lessons. Pupils were not merely seated as groups, nor did they demonstrate difficulties completing tasks as groups, rather pupils' enthusiasm contributed to the interaction occurring among peers.

Two main implications follow from the finding that dialogue features known to contribute to learning within group work settings were also observed within conventional lessons. It suggests that pupils grasp any available opportunity for interaction, even within conventional lessons, showing their enthusiasm for peer interaction. Indeed, such interaction gives an insight into teachers' acceptance of such behaviour within conventional lessons. Following on from previous research (Kutnick, et al., 2005a) teachers appear concerned with pupils' behaviour and the level of control they have regarding their classroom. Therefore, if pupils work well and complete tasks, they may well opt to work in the manner that suits them best, knowing that teachers will allow such interaction as long as it is not disruptive.

Even though guidance (Scottish Office Education and Industry Department, 1996) encourages teachers to vary tasks to accommodate different learning styles, identical or similar tasks were distributed to groups. Teachers' reluctance to accommodate differences in pupils' understanding of teaching subjects by varying tasks indicates they preferred to support learners on an individual basis rather than focusing on the activities completed during lessons. This finding is of particular significance as accommodating the needs of pupils is known to be particularly problematic during first year when pupils transfer from primary schools and during third year when pupils move to formalised assessed learning (Galton, Morrison, & Pell, 2000; West, Sweeting, & Young, 2010). Despite policy decisions regarding class size which could potentially have influenced the nature of classroom group work - English classes potentially can have a maximum of 33 pupils whereas Science is restricted to 20 pupils (Scottish Negotiating Committee for Teachers, 2007) - only minor differences were apparent when pupil interaction or teacher behaviour were examined in relation to teaching subject. So it appears that Study 1 is in accordance with a number of studies which indicate that despite teachers' reports of reductions in the variety of instructional strategies within larger classes, class size has little impact upon teachers' behaviour (Hargreaves, et al., 1998; Pedder, 2006).

Pupils' ease with group work was also echoed within the answers given to items investigating the frequency of specific teaching formats. Whole-class, group work and individual work were the most frequently experienced teaching approaches within both Science and English lessons. However, this contrasts with the findings of the most recent Scottish Survey of Achievement (SSA) of English (2006), which reported a decrease in the use of group work in accordance with the advancement of teaching years. By the second year of secondary, group work within English classes was intermittently experienced by pupils within the SSA sample. It appears that adjustment to teaching practice may well have occurred following the publication of such findings (Scottish Survey of Achievement, 2006) and good practice reports (HMIe, 2008a). English teachers' reports of their current practice concurred with the findings emerging from pupils involved with the present study. Generally, English teachers included small groups within their instructional practices a few times each week.

Moving from consideration of frequency to one of preferences, pupils' views regarding teaching approaches revealed interesting patterns. In relation to Science lessons, pupils from conventional lessons largely endorsed the whole-class and group work items in the questionnaire. Pupils who had been observed in group work lessons were more consistent, with the highest level of positive agreement occurring in relation to groups, followed by whole-class and lastly individual work. Clearly experiencing group work has a positive impact on pupils' perceptions of working in groups within Science. Comparable findings regarding the popularity of group work and activities that have an inherent interactive nature have been repeated elsewhere (Owen, Dickson, Stanisstreet, & Boyes, 2008; Thompson & Soyibo, 2002). Pupils' responses in relation to individual work indicate that a higher proportion who were observed during group work lessons prefer to work by themselves than their counterparts within conventional lessons. This finding should not imply a lack of satisfaction on behalf of this subset of pupils rather that for some pupils their preferred setting involved completing tasks individually.

Pupils' responses regarding English lessons were similar irrespective of whether pupils' had experienced group work or conventional teaching whilst lesson observations were recorded. Overall, group work was the most favoured approach within English lessons, followed by whole-class teaching; whereas individual work received the least enthusiastic response. This apparent separation ought to be understood in relation to findings recorded onto the lesson context sheets. Pupils were frequently placed in individual (or paired seating) within lessons irrespective of the teaching and learning approach. Thus, it would seem that pupils have connected their less than enthusiastic beliefs regarding individual work with the seating arrangement they frequently experience.

In relation to both English and Science lessons, a separate category for paired work was included with the aim to elucidate pupils' understanding (whether or not they conceived working in pairs as a form of group work). However, this approach may have inadvertently confused pupils' responses. Dyad work may well have received reduced ratings as few opportunities specifically aimed at paired work were provided within classrooms, making such a category less pertinent when pupils were asked to make a selection. Thus to avoid creating an artificial separation between dyad and small group work, a superior response category would explain that small group work includes working in pairs, reflecting the description of group work utilised within the thesis.

A carefully worded item was included within the questions examining pupils' experience of different teaching approaches as criticisms of standard practice have included descriptions where pupils have been seated in groups but completed tasks individually. Pupils' responses regarding English lessons indicated only moderate experience. In contrast, pupils' responses in relation to Science varied in accordance with whether they were observed working in groups or during conventional lessons. Pupils within conventional lessons reported proportionally higher frequencies of being seated as a group but working individually within most lessons in comparison to a much lower proportion of pupils from group work lessons. Although this seating arrangement may appear to be compatible with whole-class teaching, it is problematic as it sends mixed signals to pupils. Teachers may inadvertently assign pupils tasks suited to individual work but through no fault of their own pupils interact with their peers as a means of completing the task. Commentary on such problematic approaches in relation to their use within primary classrooms has documented that such formats most likely inhibit the objectives of the teacher and lead to disruptive classrooms (Baines, et al., 2003; Galton, et al., 1999b). When teachers' responses to similar questions were compared according to whether they had received training in group work, teachers who had not received training reported moderate use of this seating and working arrangement. In contrast, teachers who had received training were more restrained rarely using such an arrangement.

In general, teachers and pupils were in agreement regarding the frequency of specific teaching approaches. The frequency of small groups within Science requires explanation. Science teachers who had received training showed greater variation in their reported use of teaching small groups in comparison with their non-trained equivalents, who reported small groups occurring a few times each week. Small groups were used by trained teachers every lesson, once a week and rarely. Teaching small groups refers to when pupils are seated in groups but listening and interacting with their teacher. Pupils were regularly taught in such a manner prior to working on a shared task within groups. Generally, the classroom layout has been shown to influence the nature of instruction used by teachers (Fang, 1996; Galton, et al., 1999b; Martin, 2002) and this is substantiated as teachers preferred to set up the classroom environment (that is move tables and arrange groups) prior to beginning the lesson.

Teachers' behaviour at the introduction and conclusion of lessons was examined to help explain the variability in pupils' behaviour. To what extent teachers directly foster pupils' interaction within groups is not clear. Yet how their behaviour contributes indirectly was observed as teachers refrained from their usual introductory evaluative behaviours suggesting they recognised the importance of pupils' experiencing novelty within group work lessons. This also implies that teachers consider the discovery of information to feature within the type of learning pupils experience in groups. Perhaps such restraint by teachers encouraged pupils to continue on task behaviour within group work lessons.

Further interpretation of detectable patterns in teachers' behaviour is complicated by the finding that lesson conclusions were equally constrained within group work and conventional classes. Such constraints help explain the apparent similarity between teachers' behaviours when comparisons were made across the different lesson types.

In general, teachers made more attempts at making links and connections at the outset of lessons. Although feedback and evaluative comments featured within either lesson stage, they tended to be more frequent within the first part of lessons. These two features would seem somewhat complementary; teachers' attempts at probing pupils' thinking and understanding with evaluative comments can be supported with feedback that allows teachers to give praise and reassurance (indicative of IRF structures, particularly statements that signify Initiation and Feedback type behaviours). While teachers' questioning behaviour did not even approximate consistent patterns this may relate to other observation categories assuming content, which otherwise may have been coded as questions. Finally, teachers preferred to source ideas from pupils in order to address the point they were trying to make (rather than attend to misconceptions or irregularities in the contributions given by pupils, as alluded to in earlier discussion of IRF structures within Section 2.4.2). Indeed inconsistencies in a single pupil's thinking ought to have been addressed, as they likely echo similar confusion in other pupils. Teachers typically sought out, incorporated and recognised pupil contributions that supported their objective, whereas contributions not meeting teachers' aims were ignored; whether such action is sufficient in adding value to group work remains to be seen.

Teachers incorporated multiple factors into their lesson plans, and most likely had prepared content for inclusion at the end of lessons, however it appears that teachers made little more than minimal attempts at concluding lessons. The opportunities available to teachers for drawing conclusions were constrained by contextual factors – such as tackling equipment within Science or rearranging the classroom within English. Frequently, teachers simply ran out of time within which they could adequately conclude a lesson. Such contextual constraints need to be incorporated within research and guidance focused on populations involving secondary schools. Therefore, although it appears that teachers within group work lessons are somewhat more balanced in terms of observation made at either lesson stage, such conclusions do not fully document teachers' behaviour.

When previous lessons had not been adequately concluded, the role of the subsequent lesson's introduction evolves. Its content suggests that teachers use the introduction to round up and summarise content covered within earlier lessons. Teachers contended with difficulties in concluding lessons by revising content at the outset of lessons, making concluding remarks regarding the previous lesson and on occasion resolved inconsistencies in pupils' thinking. Such behaviour was clearly an attempt to stimulate pupils' recollection of content and integrate relevant knowledge addressed within the previous lesson and may suggest teachers were aware that their attempts to set aside a proportion of a lesson for a conclusion might be met with difficulty. A potential explanation relates to timetabling within secondary schools. Schools, in Scotland, have moved from having timetabling flexibility, when two 40 minute lessons could be scheduled to run consecutively to create double periods - commonplace within practical subjects (Scottish Executive Education Department, 2005, p. 98). This has now been replaced with 50 minute lessons (Scottish Executive, 2000b, 2009a). Yet the comparable difficulties detected within secondary classrooms in England implementing a SPRinG secondary intervention reduces the validity of this explanation (Galton, Hargreaves, & Pell, 2009). English secondary schools have greater flexibility regarding lesson duration (Department of Education and Science, 1990) yet similar difficulties in accommodating lesson conclusions within Mathematics, Science and English group work lesson were recently reported (Galton, et al., 2009). Thus, teachers' management of group work requires investigation to ascertain how lesson conclusions can become a central feature of such lessons.

Likewise, further investigation is needed to ascertain how teachers can support pupils' learning during the course of a topic, suggesting a line of investigation to be examined in Study 2. Aside from rare occurrences (such as reduced explanation at the beginning and brief attempts at plenary session) it is difficult to identify what efforts were made by teachers to incorporate pupils' learning in groups with the academic purpose of the lesson and indeed relate it to the lesson in its entirety – this includes teachers' efforts within lessons and across the different stages of a topic. Teachers did not modify introductions (despite being influenced by previous lesson and failure to adequate conclude) when they used group work.

A full account of teachers' behaviour within the different types of lesson needs to include teachers' behaviour during the main body of lessons, particularly their interaction with pupils. In particular, pupil observation categories allowed for multiple forms of teacher and pupil interaction, giving a comprehensive picture of what was possible. Despite this, the cluster analysis and pupil reports agreed that pupils and teachers were rarely observed to interact. However, teachers' responses to the questionnaire suggest that attempts were made within most, if not all, lessons to interact on a one–to-one basis with their pupils. The "asymmetry" (Galton, et al., 1999b) between teacher and pupil perspectives continues.

Although group work potentially provides teachers with the means to monitor their classroom more effectively – in that teachers can evaluate groups rather than individual pupils – when teacher and pupil interaction was evaluated no apparent differences were detected within the cluster analysis. In fact, it could be said that teachers refrained from interaction with pupils, whilst groups worked on tasks. Webb (2009) argues that teachers need developed observational and analytical skills to be able to detect appropriate and inappropriate instances when groups require external assistance. An explanation of such behaviour may relate to awareness amongst teachers that pupils need to develop relationships within groups but also that passing such responsibility to pupils, fosters pupils' own sense of independence and their ability to work unaided on tasks.

However, there is also a suggestion of reluctance on the part of teachers to let pupils work by themselves. Teachers were asked to indicate their agreement with a specific statement "when pupils are grouped I do not disturb them and let them get on with their tasks" a subset reported that they would prefer to be involved. Consistent findings have been reported elsewhere (Kutnick, et al., 2005a) yet recent research (Galton, et al., 2009) indicates that teachers aware of factors central to effective group work can adapt their behaviour to allow pupils to work without interruption or external assistance for blocks of time.

The low incidence of teacher interaction with pupils (irrespective of lesson type) coupled with frequent transitions during lessons indicates that teachers may find few opportunities to identify pupils' opinions, far less incorporate such information into the main body of the lesson. Numerous transitions evident in group work and conventional lessons mirror teachers' reluctance to alter their approach to the main part of lessons. The frequency of transitions links to commentary noted earlier regarding the use of group work as a vehicle (Howe & Tolmie, 2003), where pupils work together for the primary reason of sharing resources, with interaction (if it follows) occurring as a consequence. This may indicate that teachers who restrict the quantity of time available to groups, perhaps by making numerous transitions, may not be deliberately impeding interaction, rather their views regarding group work influence their behaviour during such lessons.

Although teachers appeared to adopt a shadowing, background role, which complements interpretations of Piagetian theory and research recommendations (Blatchford et al., 2006; Cohen, 1994; Howe et al., 2007), the findings of Study 1 indicate that such practice occurred as a consequence of the numerous transitions made during lessons. Therefore, teachers were repeatedly giving reminders to pupils, pausing interaction to add detail or additional explanations. Teachers need to think about the structure of their talk (Bromme & Steinbring, 1994) so that its content is not overwhelming. They need to ensure that the main points stand out, helping to reduce the number of transitions needed within group work lessons.

In sum, pupils can manage themselves within groups, are adept at getting on with their peers and work well to complete tasks. Perhaps one contributing factor would be experience within primary education, which lays the foundation for pupils' skills during interaction. In contrast, teachers would benefit most from support regarding the implementation of groups and being given insight into how they behave whilst pupils work as groups. Research is very much in its infancy regarding this aspect of classroom interaction; thus the findings of Study 1 have only begun to establish the finer points regarding teachers' behaviour.

Additional sources of data will be examined in the subsequent chapter. So far, pupils respond to their teaching and learning environment and for the most part work well together. Yet teachers' behaviour at the start, middle and end of lessons presents a confused understanding, seemingly equating group work and whole-class instruction. For that reason other contributing factors that may foster pupils' engagement with their peers are worthy of investigation.

Chapter 5

Study 1 results: pupils' perceptions regarding the classroom environment, teaching subjects and engagement with peers

Pupils' views regarding their classroom environment, in particular how teachers responded to their contributions, were specifically measured. Two attitudinal measures examined pupil beliefs regarding Science and English and were analysed separately for each subject. The sociometric ranking measure appeared last and gathered data regarding pupils' engagement with their peers. Each will be considered in separate sections.

5.1 Pupils' views regarding the classroom environment

The classroom environment describes the opportunities given to pupils to express their ideas and examines how teachers manage these opportunities. The six-item measure asked pupils to report how frequently they thought their contributions were integrated by teachers in different contexts. As the analysis centred on examining the distribution of frequencies within pupils' responses, chi square analyses were more appropriate than non-parametric alternatives (such as Mann-Whitney tests). Items asked pupils to report their experience within lessons in terms of its content or their contribution to such lessons. Pupil responses were therefore tied to a specific context and are reported separately for each subject. Such specific questions are argued to encourage pupils to consider their answers and be precise rather than provide any answer. The six items provide insights into how teachers' behaviour is seen to vary, for example, pupils' contributions may be given more attention during the planning of an activity rather than evaluation of its execution.

A range of questions was included to gauge pupils' beliefs regarding their involvement and contribution to lesson activity and content. Equivalent proportion of pupils from group work (48.4%) and conventional (46.6%) lessons reported frequently being given opportunities to develop their explanations within English lessons, which could then be incorporated into the lesson objective. Although group work pupils frequently reported experiencing (32.4%) unsettled starts to their English lessons, a greater proportion of pupils from conventional lessons (48.5%) agreed with this statement (X^2 (4) = 9.21, *exact* $p < .05$, V = .24).

Pupils reported moderate instances of being able to develop discussion regarding points they found interesting within English. Corresponding proportions of group work pupils (36.8%) and pupils from conventional lessons (29.5%) reported rarely being involved with the development and planning of lesson content. In relation to the final item "Everyone has a chance to say what they think" a significant difference was detected (X^2 (4) = 13.4, *exact* $p < .05$, V = .29). Pupils from conventional lessons reported more frequent (43.2%) opportunities to express themselves and more diverse classroom interaction in English, in comparison with their group work counterparts (17.9%). In general group work pupils' responses to this item were more evenly spread across response categories, indicating in addition to those pupils reporting being involved in the classroom all of the time (17.9%) and frequently (46.2%), there was a subset (17.9%) who rarely experienced such opportunities. This suggests that participating within group discussion may not be as equal as that occurring within conventional lessons.

A different pattern emerged when pupils' responses to questions examining Science teaching were evaluated. Pupils consider that Science lessons are very factual, irrespective of the teaching approach. Interestingly group work pupils reported they were more frequently asked to explain their thinking within every Science lesson (51.3%) than within English lessons (20.5%). Pupils from conventional lessons reported the same pattern but to a less marked degree, (Science 32.1%, English 27.5%). Science lessons provided pupils with frequent opportunities to introduce ideas and include these within the discussion, evidenced by the high proportions reported by both group work pupils (48.7%) and pupils from conventional lessons (38.2%) of such interaction repeatedly occurring. More comparable were the proportions in each response category given by both group work pupils and pupils from conventional lessons in relation to their development of lesson content, and this can be seen within pupils' responses to questions concerning both English and Science lessons.

Pupils' responses regarding Science lessons were found to differ in relation to whether pupils settled down at the outset of lessons (X^2 (4) = 9.57, *exact p* < .05, V=.24). A greater number of pupils from conventional lessons (17.6%) reported that their lessons started without delay all of the time in comparison with fewer group work pupils (5.1%). This follows the pattern reported by pupils who answered questions regarding their English teaching. It appears that group work lessons are more unruly at their outset than conventional lessons.

5.2 Pupils' attitudes regarding teaching subjects

Seven questions were presented which explored pupils' attitudes towards English or Science subjects. Irrespective of whether pupils were observed in Science or English lessons, all pupils responded to questions concerning Science and English lessons. Pupils recorded their answers to the questions by selecting one part of a six-point scale which was presented with phrases of opposing meaning at either end; following a typical semantic differential format.

For example:

What are your opinions about your SCIENCE lessons?

I like Science lessons	□ □ □ □ □ □	I dislike Science lesson

A series of chi square analyses was computed to examine pupils' attitudes to the two teaching subjects. As the analysis centred on examining the distribution of frequencies within pupils' responses, chi square analyses were more appropriate than non-parametric alternatives (such as Mann-Whitney tests). Comparisons were made using information regarding respondents' teaching year, type of lesson within which they were observed, and gender. Research has demonstrated that the gender and teaching year of respondents are factors when explaining the pattern of responses given by pupils (Pell et al., 2007; Reid & Skryabina, 2003). Each pupil's total attitude score was computed separately for each subject by summing across their rating of the items comprising the attitude measure (higher scores indicate more positive attitudes). Total scores were then included in analyses of variances (ANOVAs) performed separately for each subject, which examined whether scores varied according to the respondents gender, teaching year, and whether pupils had been observed within group work or conventional lessons. Where appropriate follow up tests were performed.

A series of chi squares was computed to compare pupils' responses to the items comprising the English attitude scale. More first year pupils (17.6%) reported low enjoyment of their English lessons than their third year counterparts (8.3%), (X^2 (4) = 9.79*, exact p* < .05, phi = 0.24). More female third year pupils (57.9%) agreed that English was important in relation to other school subjects than comparable first year pupils (47.2%), (X^2 (4) = 10.78*, exact p* < .05, phi = 0.38).

A three-way ANOVA examining English attitude scores (gender x teaching year x lesson type) produced main effects of type of lesson (F (1, 156) = 4.19, $p < .05$, $\eta^2 = .03$), and teaching year F (1, 156) = 4.19, $p < .05$, $\eta^2 = .03$) and detected a significant interaction between lesson type and teaching year (F (1, 156) = 7.79, $p < .01$, $\eta^2 = .05$), clearly visible in Figure 5.1.

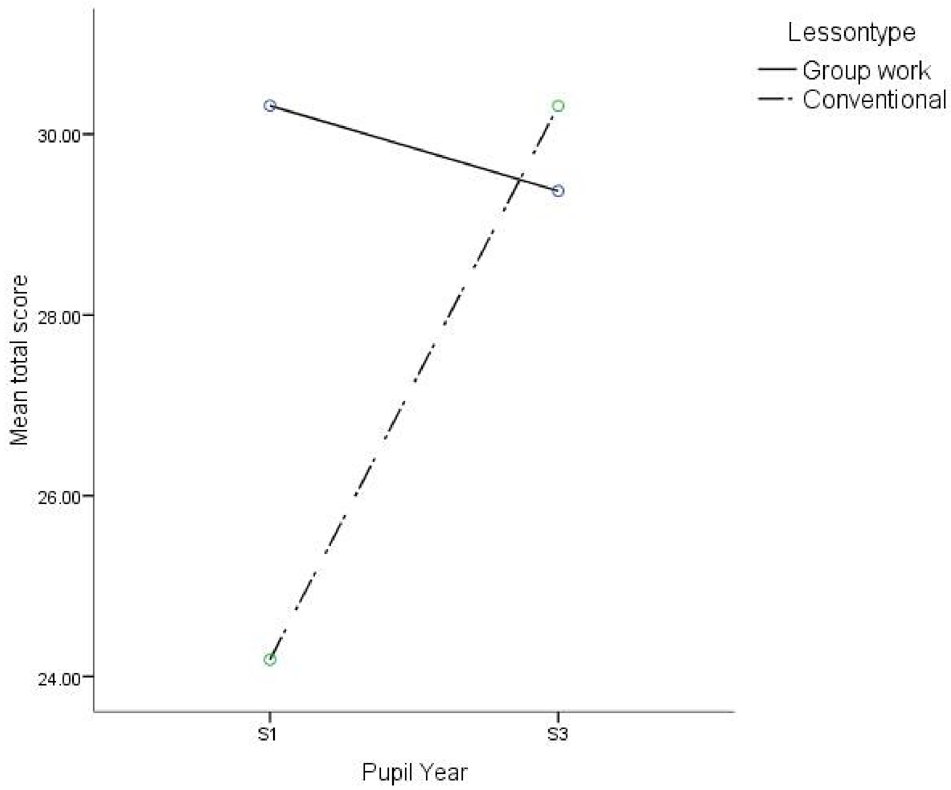


Figure 5.1 Comparison of pupils' mean English attitude scores, according to their teaching year and lesson type

Follow up analysis using Tukey HSD (see Appendix 8) revealed that the interaction is attributable to first year pupils observed in group work lessons being more positive towards English than their conventional counterparts (see Table 5.1). Third year pupils from group work and conventional lessons produced comparable scores. Pupils in conventional classes showed improvement in their scores from first year equalling group work pupils' responses.

Table 5.1

Comparison of first and third year group work and conventional pupils mean English attitude scores

Year	Lesson type	N	
S1*	Conventional	25	24.19 (1.27)
	Group work	48	30.32 (0.89)
S3	Conventional	13	30.31 (1.88)
	Group work	80	29.37 (0.69)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.

* Significant difference in follow up test

A series of chi-squares comparing the items comprising the Science attitude scale did not detect any significant differences when comparisons were made between and across teaching years and teaching subjects. A three-way ANOVA (gender x teaching year x lesson type) did not detect any significant differences between pupils' attitudes towards Science as a teaching subject (all p values > .05).

5.3 Pupils' self-perceptions within the teaching subjects

Eight questions were presented which explored pupils' perceptions of self within English or Science lessons. Pupils recorded their answers to the questions by selecting one part of a six-point scale, which was presented with phrases of opposing meaning at either end, following the semantic differential format.

For example:

What are your opinions about your SCIENCE lessons?

I feel I am coping well	□ □ □ □ □ □	I feel I am not coping well

A series of chi-squares was computed to analyse pupils' perception of self separately for each subject and comparisons were made as a function of teaching year, lesson type, and gender. As the analysis centred on examining the distribution of frequencies within pupils' responses, chi square analyses were more appropriate than non-parametric alternatives (such as Mann-Whitney tests). Each pupil's total self-perception score was computed by summing across their rating of the items comprising the measure (higher scores indicate more positive attitudes). Pupils' total scores for each subject were then included in a series of ANOVAs, which examined whether scores varied according to the respondents' gender, year or whether pupils had been observed within group work or conventional lessons. Where appropriate follow up tests were performed.

5.3.1 Pupils' perception of self within English lessons

When items comprising the self-perception scale were analysed for English, a number of significant differences were detected. More first year pupils (8.8%) reported English as being a very difficult subject in comparison to third year (1.1%) pupils (X^2 (4) = 10.07, *exact p* < .05, phi = 0.25). However, a subset of third year (37.6%) and first year (31.1%) reported neutral responses to this question, suggesting that only a minority of pupils experience English lessons as being easy or difficult. Male third year pupils (37.5%)

reported English lessons to be more difficult than their first year counterparts (25.%), (X2 (4) = 9.48*, exact p* < .05, phi = 0.32) yet more third year male pupils reported coping within English lessons in comparison to first year counterparts (X^2 (3) = 9.84*, exact p* < .05, phi = 0.33). More female third year pupils (57.9%) agreed that English was important in relation to other school subjects than comparable first year pupils (47.2%), (X^2 (4) = 10.78*, exact p* < .05, phi = 0.38).

A three-way ANOVA (gender x teaching year x lesson type) confirmed a main effect of teaching year (F (1,156) = 12.72, $p < .01$, $\eta^2 = .08$), and detected a significant interaction between lesson type and teaching year (F (1, 156) = 9.02, $p < .01$, $\eta^2 = .06$) when analyses using pupils' mean self-perception scores within English were computed. The interaction between lesson type and teaching year is plotted in Figure 5.2.

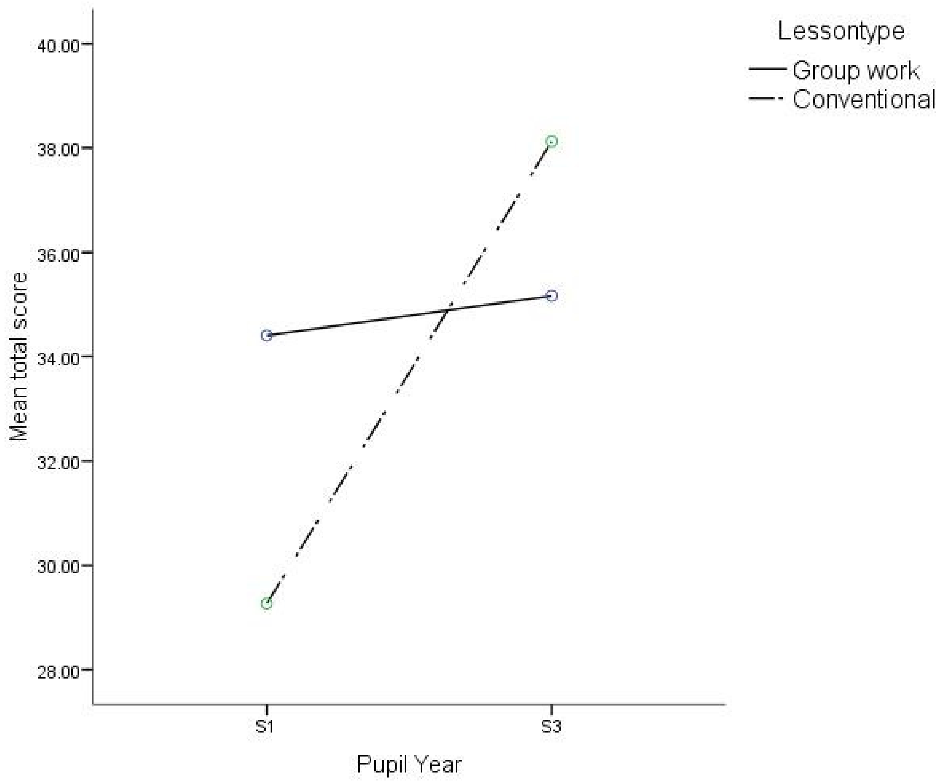


Figure 5.2 Comparison of pupils' mean English self-perception scores, according to their teaching year and lesson type

Follow up analysis using Tukey HSD (see Appendix 8) detected a significant difference between first year pupils' self-perception scores as a function of lesson type. Pupils within group work lessons produced similar scores, in comparison to more variable scores produced by pupils within conventional lessons (see Table 5.2).

Table 5.2

Comparison of first and third year group work and conventional pupils mean English self-perception scores

Year	Lesson type	n	
S1*	Conventional	24	29.26 (1.35)
	Group work	47	34.4 (0.96)
S3	Conventional	12	38.13 (1.99)
	Group work	81	35.16 (0.74)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.

* Significant difference in follow up test

5.3.2 Pupils' perception of self within Science lessons

One significant difference was detected when items comprising the self-perception scale were analysed. Comparisons of responses from first year pupils revealed that male pupils (37.5%) gave more positive responses regarding their enjoyment of Science in comparison with female pupils (27.4%), (X^2 (4) = 10.08, *exact p* < .05, phi = 0.25).

A three-way ANOVA (lesson type x teaching year x gender) indicated a main effect of type of lesson (F (1,152) = 6.78, p < .01, η^2 = .04). Pupils from conventional lessons had higher self-perception scores within Science than their group work counterparts. A significant interaction was detected between gender and teaching year (F (1, 152) = 4.86, $p < .05$, $\eta^2 = .03$) when analyses using pupils' mean self-perception scores within Science were computed. Follow up analysis using Tukey HSD (see Appendix 8) examining the interaction revealed that first year pupils from conventional lessons held more positive self-perceptions, in contrast to pupils from group work lessons (see Table 5.3). In contrast, third year pupils obtained similar scores.

Table 5.3

Comparison of first and third year group work and conventional pupils mean Science self-perception score

Year	Lesson type	n	
S1*	Conventional	24	39.14 (1.4)
	Group work	48	34.26 (0.99)
S3	Conventional	12	39.38 (2.08)
	Group work	76	36.94 (0.79)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.

* Significant difference in follow up test

These different measures combine to support the developing portrait of group work in secondary education. Pupils' responses to specific items within the questions examining the classroom environment varied according to whether they had been observed within group work or conventional lessons. Their responses can be explained by looking more closely at the processes that were involved in the teaching of such classes. Pupils were optimistic about their classroom environment. This positive view was mirrored within pupils' attitudes and self-perceptions. Specific patterns were detected regarding pupils' attitudes in Science when gender was included in the analysis. In contrast, pupils' beliefs regarding English teaching were found to vary in accordance with their movement through secondary education, influenced by the teaching approach they had experienced when classroom observations were recorded.

5.4 Discussion

This section looked at the classroom environment and examined pupils' attitudes and self-perceptions regarding each teaching subject. In general, pupils' mean scores on the attitude and self-perception measures showed their positive views regarding both teaching subjects. The engagement that pupils reported, as evidenced by their responses to specific items, also lends support to these findings.

Pupils showed enthusiasm by responding positively to questions examining their contribution to lessons. In particular, the set of questions demonstrated how pupils perceived being asked to voice their thoughts as well as occasions where pupils may have spontaneously given explanations. Thus, pupils' beliefs regarding the classroom environment, noted by their positive responses to questions, help support and explain the quantity and quality of the dialogue produced within groups. Pupils are content to provide explanations both when asked directly and more generally, for example during group work, to voluntarily discuss their thinking.

Previous findings help explain why looking at contributions and pupils' involvement within the classroom has merit. Pedder and McIntyre (2006) reported that pupils have a clear understanding of the classroom environment and are able to express how and when their contributions are integrated within lessons. Consequent teacher invitations, which ask pupils to explain or develop their contributions, provide feedback to pupils that their contributions are valued, by both peers and teachers. Indeed probes made by teachers, which push pupils to detail their reasoning, may feed into the dialogue occurring within lessons. Following on from conclusions made within Chapter 4 regarding teachers' behaviour, this signals an area that requires clarification.

Pupils within conventional and group work lessons felt that they were given equivalent chances to express themselves, more apparent within pupils' responses regarding Science than English lessons. It appears that teachers call upon or respond to contributions from particular pupils. If pupils are aware of how often they contribute, they are equally likely to appreciate who else within their class regularly voices their thoughts and gives suggestions. The identification of pupils who felt less able to voice their perspectives whilst working in groups within English suggests that discussions may be filled with ideas emerging from particular group members (particularly as a consequence of teachers restricting their involvement with groups makes it plausible that pupils manage their own discussions). But it is unclear if this relates to pupils' reluctance to voice or explain their thinking, or relates to pupils picking up tendencies of teachers to call upon those pupils who they believe will provide the answer that they seek (McIntyre, Pedder, & Rudduck, 2005). The question remains: do teachers inadvertently develop and acclimatise to their background role within group work lessons because pupils in groups appear to operate well or do difficulties with group discussion follow as a consequence of teachers restricting their involvement with groups?

Pupils explained that group work lessons were initially less settled. Teachers need to rearrange the classroom and place pupils into groups; therefore, it follows that a less settled start to group work lessons would be expected. This helps explain the contextual factors encroaching upon pupils' experience, rather than proceed with the possibly incorrect interpretation that pupils found it difficult to begin working in groups. Likewise, Pointon and Kershner (2000) recognised the value of making connections between the environmental features of classrooms and related these to primary pupils' involvement in decision making. They examined case studies of three teachers who unanimously agreed that pupils within primary classrooms were included within decisions made regarding wall displays (posters). Beyond this however, there was little evidence of pupils' ideas being integrated within the decisions made during lessons, or more specifically how teachers respond to contributions (whatever their form) given by pupils. Study 1 frequently observed groups creating wall displays and to some extent mirrored Pointon and Kershner's findings. Pupils within English lessons used posters as a form of developing or recording characters, which would be relied upon during forthcoming writing activities. The task objectives within English make it clear that the posters were necessary to complete a writing task, and were therefore recognised as an important resource. Pupils within Science lessons were observed to record explanations of experimental activity. However, it is less clear how posters created in Science would be attributed worth, or indeed it if they would become a wall display. Therefore, when the product of group work is an entity, it appears at least within science to be attributed little worth. At such times, perhaps where wall space is limited, pupils could be effectively included within decision-making processes, leading to group work encompassing an additional role. Such observations help explain the high proportions of pupils who reported rarely being invited to express their ideas about how best to proceed with tasks within group work lessons.

It was noted at the beginning of Chapter 5 that gender and teaching year have been reported as helping to explain differences in pupils' attitudes. The relationship between attitudes towards Science and the variables of gender and teaching will be considered within this paragraph, followed by lesson type in the subsequent paragraph. Attitude and self-perception towards Science did not vary when pupils' total scores were examined. Specific differences were evident when pupils' gender was looked at in relation to individual items. These differences followed trends observable within the vast literature that has focused on pupils' attitude towards Science. Both male and female pupils appreciate that Science has merit, yet female pupils do not associate their future with Science. Such patterns were detected despite numerous initiatives focused on challenging the bias regarding men and Science (Roger & Duffield, 2000). A recent review recommends unravelling patterns in responses by looking at pupils' preferences regarding discrete subjects (Osborne, et al., 2003) and this divergence has been repeated within chemistry (Cheung, 2009) and physics (Reid & Skryabina, 2003). This could relate to pupils' subject choices within Secondary education. Osborne and colleagues reported that male pupils are disproportionately represented in physics; the reverse is true of biology, whereas chemistry shows the most balanced representation. This pattern is echoed within statistics published by the Scottish Qualification Authority (Scottish Executive, 2009d), which detail awards given to pupils who have completed exams within their fourth year of secondary school. These statistics establish that such preferences are in place early within pupils' secondary education. Scottish primary pupils do not report the same range of differences (Reid & Skryabina, 2002). Thus, the current research provides an intermediate step replicating the divergence previously reported regarding second year pupils (Reid & Skryabina, 2002, 2003). In relation to the current research, gender is solely an explanatory factor in relation to pupils' attitude and self-perception as analyses in this and the previous chapter have not indicated any relationship between gender and pupils' classroom behaviour or peer interaction. Other research which explores pupils' views beyond their third year of secondary should note the potential of gender to qualify results.

The views of pupils observed in conventional lessons showed dramatic decreases in relation to their progress within secondary education whereas involvement in group work appears to keep attitudes and self-perceptions constant, particularly evident within pupils' responses regarding English teaching. One feasible explanation relates to the type and quantity of talk produced by pupils, particularly as such dialogue is argued to be a key component in the development of pupils' understanding (Howe, et al., 2007; Mercer & Littleton, 2007b). Previous research has shown that pupils' self-concepts within English classes are approximately equivalent when comparisons using respondents' gender were made (Ireson, Hallam, & Plewis, 2001) and Study 1 supports such conclusions. The findings stemming from the measures included in the questionnaire indicate that group work has the potential to inhibit decreases in pupils' attitudes and self-perceptions which typically occur as a result of pupils' progression within secondary education (Baines, Blatchford, & Kutnick, 2008). Group work may provide the means by which pupils can reassure themselves that their progress approximates their peers, thereby stabilising their attitudes and perceptions of self and providing encouragement to continue.

Despite publications which review research and outline how attitude measurement should move forward to strengthen its practice (Bennett, Green, & White, 2001; Osborne, et al., 2003; Reid, 2006), the issue of the timing of data collection has been ignored. As pupils progress through secondary education their beliefs are founded upon extensive experience. Therefore, it follows that timing may be of particular relevance when first year pupils are investigated. The myriad of approaches that have been employed is evident within the number of publications incorporating attitudinal data. For example, case studies of pupils who were in the first year of secondary teaching in England (equivalent to final year of Scottish primary education) were collected at the beginning of an academic year (Taber, 1991, 1992), while other research focused on the end of the academic year (Reid & Skryabina, 2003; Woodward & Woodward, 1998). In contrast others (Barmby, Kind, & Jones, 2007; Stark & Gray, 1999) omitted such methodological detail. In practical terms it may be too difficult for researchers to collect data during similar time periods, yet such detail ought to be included within the method section of relevant publications: to allow a fair comparison of different findings. Study 1 collected data once pupils had reached the mid-point of either academic year being investigated to avoid any resulting implications. The above points make it clear that consistency regarding data collection is imperative and guidance ought to be established.

It is clear that pupils have developed an appreciation of their role and contribution to the classroom environment. Trends reported in relation to pupils' attitude, and self-perceptions complemented findings outlined within previous research, suggesting that a representative sample was obtained. Pupils' work ethic and approach to lessons depends upon a multitude of variables, including attitude, self-perception and importance attributed to their involvement and the classroom climate. Thus, a more developed account of classroom interaction is constructed by considering different types of data, and the final section of this chapter adds to this description by exploring peer relationships.

5.5 Analysis of pupils' sociometric ratings

This section will document pupils' scores from the sociometric peer rating measure. Possible relationships between ratings and the independent variables will be considered.

Findings from the two-step cluster analysis suggest that the type of lesson should be considered as a possible explanatory variable. Previous research (Frederickson & Furnham, 1998; Sherman, 1984; Sherman & Burgess, 1985) suggests that the independent variables relating to teaching year and gender need to be included, as they are likely to influence pupils' scores.

Although pupils completed a consent form, schools could (and did) object to the use of a sociometric instrument; a sub-sample of 137 (51% male) pupils completed the sociometric instrument. Schools' objections related to the misconception that such measures would have lingering effects, when research reports no enhanced risk of, e.g., classroom stigmatisation following the completion of a similar instrument (Belldolan & Foster, 1989; Mayeux, Underwood, & Risser, 2007). Within each participating class, checks were made to ensure that a minimum of 75% of pupils completed the measure (Hymel, Vaillancourt, McDougall, & Renshaw, 2004) ensuring a degree of accuracy regarding the sociometric rating data.

The smaller number of participating classes resulted in unequal cell sizes, meaning that the homogeneity assumption of the ANOVA could not be accurately verified. To avoid enhanced probability of type 1 errors (false positives), an approach outlined within Keppel and Wickens (2004) was adopted: a stringent significant level (.01) was used, and estimated marginal means and the standard error are reported.

5.5.1 Research questions:

As teaching year and gender have been reported as having an interaction effect (Frederickson & Furnham, 1998; Sherman, 1984; Sherman & Burgess, 1985) it is expected that a greater number of same gender positive ratings will be received by first year pupils in contrast with a greater number of cross gender positive ratings by third year pupils. The nature of group work lessons could mean that group work pupils receive more positive ratings than their peers in conventional lessons.

Four features derived from the sociometric measure were analysed. The mean social distance score for each pupil was computed, higher scores (ranging from 1 to 5) indicate greater social distance. The other features: number of positive ratings; neutral ratings and negative ratings will also help to quantify the nature of the classrooms. Each of these features was compared with specific independent variables. Therefore, three possible explanatory variables were investigated: the type of lesson, teaching year and pupil gender, were compared with the four features derived from pupils' ratings.

Three-way ANOVAs (gender x teaching year x lesson type) indicated an interaction between teaching year and type of lesson ($F (1, 128) = 7.09$, $p < .01$, $\eta^2 = .053$), with regards to pupils' mean social distance rating. Follow up analysis using Tukey HSD (see Appendix 8) indicated that pupils from group work and conventional lessons exhibited different patterns in their mean social distance rating and this was dependent upon respondents' teaching year. Pupils observed in first year group work lessons, reported more cohesive classrooms than their counterparts in conventional lessons, whereas the opposite was evident in third year lessons. Explanation of the interaction becomes clear when these findings are considered separately for each teaching year within Table 5.4.

Table 5.4

Comparison of first and third year group work and conventional pupils mean social distance rating

Year	Lesson type	N	
S1*	Conventional	38	2.59 (0.1)
	Group work	30	2.36 (0.11)
S3*	Conventional	78	2.11 (0.16)
	Group work	53	2.48 (0.08)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.
* Significant difference in follow up test

Analysis of the number of positive ratings received by pupils revealed main effects of gender (F (1, 128) = 8.48, $p < .01$, $\eta^2 = .062$), and teaching year (F (1,128) = 24.42, $p < .01$, $\eta^2 = .16$). Third year pupils received a higher number of positive ratings (M = 6.55, SE = 0.39) than their first year counterparts (M = 4.08), SE = 0.31). Comparisons as a function of respondents' gender also revealed a divergence, with male pupils receiving a higher number of positive ratings (M = 6.04, SE = 0.33) than female pupils (M = 4.58, SE = 0.38).

With regards to the number of neutral ratings received by pupils an interaction between gender and teaching year (F (1,128) = 12.21, p < .01, $\eta^2 = .087$) was statistically significant, as was the interaction between lesson type and teaching year (F (1, 128) = 6.43, $p < .01$, $\eta^2 = .05$). Follow up analyses using Tukey HSD (see Appendix 8) were used to examine both interactions (see Table 5.5).

Table 5.5

Comparison of the number of neutral sociometric ratings separated by gender and lesson type for each teaching year

		n	
Male*	S1	31	4.17 (0.37)
	S3	38	3.58 (0.38)
Female*	S1	37	3.53 (0.35)
	S3	30	5.8 (0.51)
Conventional*	S1	38	3.24 (0.34)
	S3	15	3.05 (0.57)
Group work*	S1	30	4.46 (0.38)
	S3	54	6.33 (0.29)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.
* Significant difference in follow up test

Male first year pupils received a greater number of neutral ratings than their third year counterparts. In contrast, the opposite pattern was detected within female first year pupils' responses as they received fewer neutral responses in comparison to their third year counterparts. When third year pupils' responses were compared with their first year counterparts the number of negative ratings received by pupils from conventional lessons reduced, however the number of negative ratings received by pupils from group work lessons increased.

Analysis of the number of negative ratings received by pupils revealed a significant three way interaction between gender, teaching year and type of lesson (F (1, 128) = 19.90, p < .01, η^2 = .047). The mean number of negative ratings for pupils is outlined within Table 5.6. Follow up analysis using Tukey HSD (see Appendix 8) examining the interaction detected that male and female pupils varied in the extent to which they received negative ratings in the group work lessons.

Table 5.6

Comparison of the mean number of negative sociometric ratings received by male and female pupils, according to their teaching year and lesson type

		n	Conventional	Group work
Male	S1*	31	2.4 (0.46)	1.13 (0.44)
	S3*	39	0.7 (0.56)	2.18 (0.34)
Female	S1	37	2.09 (0.37)	2.29 (0.48)
	S3*	30	1.8 (0.79)	1.24 (0.36)

Note: Values enclosed in parentheses represent SE. S1 = First year, S3 = Third year.
* Significant difference in follow up test

Male first year pupils received fewer negative ratings within group work than within conventional lessons. Yet, third year male pupils reported the reverse pattern with group work pupils receiving a greater number of negative ratings than their conventional peers. Female pupils were more consistent, as the mean number of negative ratings decreased within both types of lessons when the two teaching years were compared. Comparing these findings with the mean number of neutral ratings indicates that there is some evidence to suggest that group work classes may have a higher mean number of neutral ratings but this occurs at the expense of fewer negative ratings (at least in the case of female pupils). Therefore, a tentative conclusion would suggest that group work lessons contribute to a harmonious working arrangement within classrooms.

5.6 Discussion

Pupils' relationship with their classroom peers was examined with a sociometric rating technique. The body of research involving sociometric methods tends to fall into two categories. The first encompasses research looking at change, for example development of personal identity (Kinney, 1993), or considers the development of specific populations (Bolton, Turnbow, & Marr, 1984; Carter & Hughes, 2005; Mu, Siegel, & Allinder, 2000). The second category looks at associations between sociometric status and particular variables, such as academic achievement (Hatzichristou & Hopf, 1996) or adjustment (Jackson & Bracken, 1998; Murphy & Faulkner, 2006). Much attention has been paid to the general characteristics of pupils within secondary education, yet direct comparisons of sociometric status as a function of lesson type are scarce. Some explanation comes from the limited body of studies examining secondary education and the fact that the collection of sociometric data can be both time-consuming and as noted within the current research ethically fraught (Hymel, et al., 2004).

Pupils' acceptance (at least amongst their classroom peers) was examined by the computation of the mean social distance score. First year pupils within conventional lessons showed more variation in mean scores in comparison with their group work equivalents. Third year pupils showed the reverse pattern, with pupils in conventional lessons reporting less variability than their counterparts from group work lessons. Pupils exhibited different patterns according to their teaching year, when their mean social distance rating was considered, and this was influenced by the type of lesson in which they had been observed. The findings relating to pupils' mean social distance rating suggest that the teaching year of pupils is a factor, which ties in with research that took place with primary aged pupils (Sherman, 1984; Sherman & Burgess, 1985). As the type of lesson in which pupils completed tasks was not informative when pupils' mean social distance scores were analysed pupils' relationship with their peers may be explained by the environment typified by their teacher and peers, rather than being overtly affected by examples of group work lessons that were observed. Indeed, further research to help explore this point is needed, when we consider that the number of positive responses did not vary when lesson type was included in the analyses.

This conclusion that lesson type was not responsible for the change may have been premature, when the wider picture of pupils' responses is considered. Although experiencing group work did not influence the number of positive ratings given by pupils, another pattern was observable within the neutral and negative ratings. A greater number of neutral ratings were received by pupils from group work lessons consistent with a decrease in the number of negative ratings. Although a more complex pattern emerged regarding negative ratings, corresponding changes in the frequency of such ratings would make intuitive sense. This finding does not however imply that greater experience of group work leads to more developed friendships. Instead pupils experiencing such interaction would appear to contribute to a more balanced, working climate.

Pupils' status and peer acceptance have been shown to be related to their pro-social behaviour (Eisenberg, Carlo, Murphy, & Vancourt, 1995; Pakaslahti, Karjalainen, & Keltikangas-Jarvinen, 2002), and the degree to which children enter into cooperative behaviours (Denham & Holt, 1993). Therefore, it could be argued that classrooms with a more balanced climate (in terms of its inhabitants' status) could potentially provide an environment more conducive to group work. Pakaslahti et al. (2002) showed that adolescents who had been rejected by their peers (individuals typically received few positive and multiple negative ratings) had difficulties with pro-social behaviour. By no means should this conclusion be easily accepted as research is replete with conflicting evidence, and equally studies that report similar findings (Eisenberg, et al., 1995; Eisenberg, Guthrie, Cumberland, Murphy, Shepard, Zhou, & Carlo, 2002; Eisenberg, Miller, Shell, McNalley, & Shea, 1991). An argument emerging from such literature is that pupils with rejected status may attempt to engage with their peers, but opt for ineffective or inappropriate strategies. Pakaslahti and colleagues propose that rejected adolescents lack sufficient know how and social understanding, in contrast to their more accepted peers. Perhaps the findings of the current research can be incorporated at this point. The majority of teachers arranged pupils into groups and relied upon gender as a group composition variable by asking male and female pupils to work together. Although the naturalistic nature of Study 1 means interpretation regarding pupils' sociometric status is speculative, it appears that a shift in the classroom environment (observable in pupils' neutral ratings) enhanced pupils' interaction with their peers.

Further investigation is needed to examine whether participating in group work sees a shift in the status of pupils, and this suggests a further line of investigation for Study 2. Research focused on the social effects of the ScotSPRinG project (Tolmie, et al.) reported that status differences initially exhibited by pupils were less evident following involvement in the group work programme. Tolmie et al. (2010) attributed this difference to pupils' involvement in the project, and the extent to which group work skills developed as a result. It may be that as a result of varied group work experience within their formative education that pupils in secondary schools might exhibit similar tendencies. It would be of interest to consider what changes might result from involving secondary pupils in a more developed group work programme, as these findings suggest that group work may bring about certain social advantages.

5.7 General Discussion

This section aims to bring together findings reported in Chapters 4 and 5 and relate these to content developed in the introductory chapters, in part to consolidate interpretation and conclusions made previously and infer implications relevant to the subsequent study.

The main objective of Study 1 was to provide a description of teachers and pupils' behaviour during group work. This objective was addressed by collecting a range of data including classroom observation of both pupils and teachers and questionnaires, which examined teacher and pupil beliefs regarding their teaching environment. The central features of groups observed within Science and English classes relate to parameters noted within the introduction. Groups were typically small and heterogeneous in nature, making use of factors such as gender. Research described in the introductory chapters (Section 1.7) suggests these decisions would also be shaped by pupils' ability and behaviour. Pupils varied their behaviour tailoring their approach to task completion in accordance with the type of lesson in which they worked. An additional characteristic reflects the assignment of groups to tasks of a similar nature. Groups showed cohesion, pupils remained engaged with their immediate peers and focused on their task.

These features of groups fed into the quantity and quality of talk produced during interaction, the specific characteristics of pupil dialogue indicate that productive group work occurred regularly. However, pupil talk did not regularly feature content matching the characteristics of the "resolve" category: where pupils respond to inaccuracies in others' accounts or attempt conflict resolution. This finding may indirectly support self-reflection posited by Piagetian theory and the suggestion that it occurs as a subsequent internal process (Howe, 2009; Tolmie, et al., 2010), indicating that the low frequency of observations recorded for the resolve category should not cause concern as to the quality of the dialogue taking place in groups.

Pupils' ability to tailor their approach to learning so that it is in accordance with the teaching approach established by teachers has been noted elsewhere. Consistent findings were reported in relation to experimental research (Bennett & Dunne, 1991), where teachers deliberately adapted teaching practices to meet the demands of the study (Dunne & Bennett, 1993). Bennett and Dunne's teachers' therefore aimed at practising skills they had been made aware of and passed on their interpretation of productive group work to their classes. Support exists within the literature for group work skills training (Blatchford, et al., 2006; Littleton, et al., 2005; Lou, et al., 1996) and Lou and colleagues even include this as an important feature of the studies within their meta-analysis. The findings from the current naturalistic research suggest that Scottish secondary pupils are able to achieve skills aligned with features of productive interaction without any specific training or practice (at least within secondary education). Thus, whether training relates to teaching skills or developing those already in existence needs to be clarified. Study 1 suggests methods which add to pupils' skill and understanding would be appropriate.

One contributing factor to pupils' engagement in groups was the classroom climate. The comprehensive nature of Scottish education has already been discussed within the introductory chapters and it adds to the climate that pupils experience on a daily basis. This was noted in pupils' responses to questionnaire items and their sociometric ratings.

Specific features of cooperative theory were not recorded during classroom observation rather a supportive nature towards interaction was evident. Most local authorities have some awareness of the benefits of cooperative approaches and enable teachers to undertake three-day CPD (continuing professional development) in cooperative learning (Seagraves, Clinton, & Kenesson, 2007). Indeed the argument supported by research that the creation and maintenance of such climates are contingent on a teacher's abilities (Baines, et al., 2009b; Galton & Williamson, 1992; O'Connor & Michaels, 1993), centralises the investigation of teachers' behaviour in relation to group work.

In general, gender did not help explain pupils' behaviour and beliefs to the extent that previous research had suggested. In relation to pupils' attitudes and self-perceptions, teaching year and gender were regularly intertwined repeating patterns reported by previous studies, yet few within-year cross-gender differences or within-year within-gender differences were detected. This suggests that studies examining a single teaching year should aim to obtain a balanced sample as regards to gender but not necessarily predict that gender will be associated with outcomes. Notwithstanding this was the inclusion of gender when pupils' sociometric ratings were studied. Gender helped explain the pattern that male pupils are overtly more popular within both types of lessons. Further results relating to gender and lesson type show a developing relationship, as pupils' ratings of their peers suggest that the climate of lessons using group work was enhanced by the use of group work.

During the time when pupils completed tasks, teachers and pupils rarely interacted. Teachers adopted a background role preferring that pupils complete tasks largely independently of external assistance. Research suggests that outside assistance from teachers is in effect confined to specific occasions (Webb, Franke, De, Chan, Freund, Shein, & Melkonian, 2009), for example when groups have stalled or it becomes clear that decisions are based on inappropriate conclusions. This shadowing role has been included within SPRinG studies (Blatchford, et al., 2006), which has demonstrated gains in academic achievement within English (Baines, et al., 2007) and Scottish - SCOTSPRinG (Howe, et al., 2007) - primary school contexts suggesting that this approach may be the most appropriate one for teachers to adopt. Evidently, teachers' adoption of this monitoring role suggests that scaffolding does little to explain the pupil-teacher relationship during lessons that utilise group work. This is particularly disconcerting as Vygotskyian theory is particularly focused on asymmetrical relationships.

In particular, findings relating to teacher behaviour suggest a number of unintended impediments to collaboration. The frequency of transitions made by teachers during lessons was equivalent within both types of lesson and indicated that when pupils worked in groups they experienced few instances of sustained group interaction. Therefore, it would be worthwhile to investigate whether teachers were able to limit the number of transitions made during group work lessons and if successful find out the consequences of such change, with a particular focus on peer interaction.

Most group work research that has considered teachers has focused on teacher-pupil interaction whilst pupils work in groups, whereas an objective of Study 1 was to document teacher behaviour prior to and following group interaction. Although teachers' responses to the questionnaire and the organisation of the classroom show that teachers have some grasp of the factors integral to group work their behaviour prior to and following group work suggests otherwise. Little variation was evident between the two types of instruction, indicating that teachers can believe they understand the separation between whole-class instruction and small group work, yet their behaviour conflicts with their own reports. This underlies the necessity of collecting both self-report and observational data. A central finding was that teachers encountered difficulties managing lesson time. The pattern of results indicates teachers' reliance upon lesson introductions to compensate for minimal or non-existent lesson conclusions during the preceding session.

The lack of variation in teachers' behaviour between beginnings and ends of lessons suggests a research question to be investigated in Study 2, that teachers would benefit from specific guidance regarding classroom group work approaches. Teachers have expressed insight regarding group work suggesting that documents or lesson materials specific to their teaching subject would help impart some confidence within their initial attempts to integrate group work within a topic (Seagraves, et al., 2007). As it stands, teachers who have received training in cooperative learning as part of their CPD showed little transfer of that training to their classroom behaviour. The development of such documents would enhance teachers' approaches and instruction during group work, avoiding the pitfalls identified within current practice in secondary education. However, prior to such material being prepared, tried and tested, methodology needs to be established, which will be the focus of Study 2 that completes this doctoral research.

Chapter 6

Study 2: Briefing and debriefing: investigating the role of the teacher within group work science lessons

By the time that pupils reach secondary education, the expectation is that they will be familiar with group work. The evidence collected in Study 1 shows that pupils possess some understanding of what is required in order to work with peers and for the large part display appropriate patterns of behaviour, opting to work with their group, rather than seek opportunities for interaction with adjacent peers. The level of pupils' skill in peer interaction closely approximates the ideals explored in the introductory chapters, and is somewhat surprising considering the difficulties teachers encountered in their attempts to support group work. This chapter begins by introducing the parameters that define Study 2, whose purpose is to verify whether teachers are able to consolidate their understanding of principles supporting productive group work and reflect this in their approach to introducing (briefing) and concluding (debriefing) group work lessons.

6.1 Parameters of the second study

Study 1 profiled the characteristics of the small groups that teachers use in classrooms. Their nature has implications for the methodology of Study 2, which replaced conventional teaching of a specific topic area with an intervention employing a programme of group work. The intervention was evaluated by examining classroom interaction; intervention teachers' behaviour was compared with teachers sourced from the same school who maintained the school's conventional approach. It focused on S1 science. The intervention was restricted to a single teaching year for two reasons. Few differences were obtained regarding teaching years in Study 1 and stakeholders involved in pupils' education were expected to be more amenable to projects occurring within the first year of secondary school. Although every year of secondary education is important, the first is not as crucial as the third in terms of progression towards the qualifications pupils hope to achieve. Study 1 provided confirmatory evidence that an intervention could be developed suited to Science first year teaching. Resources which could be adapted for the project were sourced from Topping, Thurston, Tolmie, Christie, Murray and Karagiannidou (2007). Preparing an intervention suited to English was less desirable for two reasons. Firstly, intervention materials appropriate for English teaching would need to undergo development and this would be incompatible with the timeframe of Study 2. Secondly, teachers of English were hesitant to participate in Study 1, despite the naturalistic non-intervention format. Similar, if not more serious, problems could be anticipated within Study 2.

6.2 Role of the teacher

Relevant theoretical perspectives were discussed in the introductory chapters when the features of collaborative group work were being established. A number of studies agree that the teacher has a fundamental role to play in the establishment and continuation of a supportive classroom environment (Baines, et al., 2009b; Galton & Williamson, 1992; O'Connor & Michaels, 1993; Oliveira & Sadler, 2008). Yet a significant limitation is that studies have focused on adult and child interaction whilst groups complete tasks but avoided investigating how teachers assign meaning to the knowledge encountered by pupils within groups. Such a constraint is particularly problematic for publications that have attempted to make research findings accessible to practitioners (Baines, Blatchford, & Kutnick, 2009a; Gillies, 2007; Johnson & Johnson, 2007; Tharp & Gallimore, 1991) because it permits little illustrative detail as to how teachers can foster group work. In general, guidance is restricted to comments concerning group characteristics or an explanation of how teachers should articulate the norms groups should aim to achieve. Yet such principles have yet to be made tangible and available to the teaching population, thus whether they can be achieved within authentic classrooms needs to be addressed, particularly in light of concerns raised by Webb (2009) that teachers can both contribute to and hinder interaction.

Teacher talk and behaviour can support group work, in doing so it demands that teachers align their perspective with the representations held by pupils and requires teachers to gauge to what extent pupils' comprehension can be stretched. This mirrors the interpretation held by many within education regarding the nature of scaffolding outlined in Chapter 2. Rather than dismiss scaffolding on the basis that Study 1 reported scant evidence for such interaction, it should be highlighted as support for how teachers should prepare and address pupils within group work lessons. Thus, a version of scaffolding may need to operate at a class level when teachers grasp opportunities to talk about group work and the topic under investigation.

Although it may be difficult to conceive scaffolding operating in this manner there is indirect evidence to support this assertion. Tharp and Gallimore (1991, p. 110) propose that through the "weaving of new, schooled concepts with the concepts of everyday life" teachers can instigate a change in their talk, and develop connections in pupils' understanding. Studies by Mercer and colleagues (Fernandez, Wegerif, Mercer, & Rojas-Drummond, 2001; Mercer, 2002) lend support and have raised awareness of teachers' behaviour which were included as part of a broader intervention. The studies reported that progression in teachers' behaviour could lead to developments in the understanding shared by pupils and their teacher for the duration of a joint activity (labelled the intermental development zone) and the nature of talk used by teachers within lessons.

Further separate studies indicate agreement regarding one aspect of teacher behaviour – how teachers foster group work must be founded upon their understanding of group thinking (Chiu, 2004; Ding, Li, Piccolo, & Kulm, 2007; Hardy, Jonen, Moller, & Stern, 2006; Meloth & Deering, 1999; Webb, 2009). This should not suggest an increased level of monitoring during lessons, rather teachers ought to have sufficient skill, being able to target questions and elicit specific detail when briefing and debriefing groups. Therefore, the means adopted by teachers to communicate their expectations, signal to pupils that their teacher regards group work as valuable.

Findings from Study 1 and teachers' own reports of their understanding of the use of groups (MacQuarrie, 2006) were influential when guidance was devised for Study 2, which encouraged teachers to reflect on their approach and behaviour. Study 1 unearthed few attempts of teachers establishing and maintaining a dialogue with pupils, and teachers did not reliably report that they explained the norms for interaction before commencing group work. In response, detailed explanation of briefing and debriefing talk were included in Study 2 and can be condensed into "process" and "contextualise" characteristics. These characteristics help signal to teachers that their role is vital when group work is introduced to classrooms. Process talk stemmed from inclusion of similar content to that deployed in the SPRinG and SCOTSPRinG studies. It was designed to coordinate and align teachers' and pupils' understanding of group interaction. Teachers were provided with specific details as to how they could explain and give feedback to pupils about interaction in groups, such reminders having been shown to be influential in pupils' continued focus and attention to learning whilst working as groups. For the duration of the study pupils received specific guidelines regarding group work, thus the evaluation of group work is also a prominent feature of Study 2, in order to assess whether subtle reminders regarding group interaction adds to the skills that pupils already have. Thus observation of both teachers' and pupils' behaviour will be a feature of Study 2.

The second aspect, "contextualise", focused on clarifying communication between pupils and their teacher regarding the concepts and principles being studied within a lesson. Teachers were recommended to add meaning to pupils' understanding, by probing thinking, and making connections with real life examples and content examined in previous lessons. It is argued that such statements provide pupils with a specific message, that teachers recognise and value contributions and explanations sourced from groups and that content learned in groups has intrinsic value for pupils' understanding of Science. Consequently, group work is described as a teaching approach that enables a shared framework between a teacher and their class to be established.

As evidenced within Study 1 and stemming from the theoretical perspectives outlined in Chapter 2 a supportive climate contributes to pupils' experience of group work. To ensure that both teachers and pupils held a similar comprehension of such an environment a table concisely explaining the "rights and responsibilities" (Gillies, 2007, p. 80) of groups was included within the intervention documents. Teachers were advised to refer to this resource to embed examples of productive interaction into their talk, leading to a shared understanding of the nature of positive interdependence (Johnson & Johnson, 2005). The guidelines also provided pupils with a tool that they could utilise to remind group members who tended to evade giving contributions.

The remainder of this chapter will look at relevant research that employed interventions where group work held a prominent role, followed by an overview of the intervention including explanation of its measures and the research questions central to Study 2. In contrast to the consistent findings regarding primary pupils, whether interaction and group talk enhance the knowledge gain or the group work abilities of secondary pupils remains unclear. Similarly, whether teachers can establish a lesson structured to accommodate group work is of particular significance to Study 2.

Howe and colleagues (2007) introduced an intervention to Scottish primary classes (referenced previously as SCOTSPRinG) and compared primary pupils who experienced certain topics using the intervention approach with other primary pupils who had not yet received similar instruction (a non-instructed control group) and reported clear advantages stemming from participation in the intervention (both in terms of the group work skills demonstrated by pupils and pupils' performance on academic tests). By contrast, research conducted as part of the SPRinG programme intervention (Baines, et al., 2007; Kutnick, Ota, & Berdondini, 2008), based in English primary schools, employed an instructed control group. These studies also reported significant benefits following participation in group work, with intervention pupils showing greater academic development over a school year in comparison to their control counterparts. Both pieces of research report advantages stemming from equipping primary pupils with specific skills and providing ample opportunities to interact in groups. The use of academic tests within these studies suggests that the effectiveness of Study 2 could be partly assessed with a similar measure.

Extensions of both studies were prepared for Secondary education The SCOTSPRinG transition project (Thurston, Topping, Tolmie, Christie, Karagiannidou, & Murray, 2010) aimed to follow-up pupils involved in the primary study and to evaluate the impact of introducing a methodology adapted to suit secondary pupils. Follow-up pupils (participants of the earlier primary SCOTSPRinG project) demonstrated sustained achievement gains (restricted to the topics that the SCOTSPRinG primary intervention focused on). Whereas pupils who encountered the intervention for the first time within secondary science showed achievement comparable with their instructed control counterparts (Topping, et al., 2007). Findings emerging from Study 1 help explain some relevant aspects of Thurston and colleagues' (2010) study. Study 1 has established that secondary pupils arrive equipped with some skill at peer interaction which may have reduced predicted differences (in knowledge gain) between intervention classes (pupils participating for the first time in the group work project) and their conventional counterparts (pupils experiencing teaching as normal). This and the reality that the transition project faced challenges from a sub-set of its participants impinged on its outcomes.

The SPRinG project (Galton, et al., 2009) examined Key Stage 3 pupils within English secondary schools (comparable to pupils within their final year of Scottish primary education and the initial two years of Scottish secondary education). Like the SCOTSPRinG transition project, the Key Stage 3 project faced opposition from teachers, and evolved to accommodate the requirements of the English, Science and Mathematics curriculum. Each participating teacher deployed the group work approach during two specific units of work, and to provide a comparison group, used a conventional approach within a further two units of work. The conventional approach incorporated an important constraint as teachers avoided using group work when exploring new concepts or solving problems and limited its use to practical work for duration of the research. However, the correlational analysis employed to investigate the impact of the intervention project is insufficient to detect whether the different patterns of pupil achievement relate to the intervention. As is stands, it is not clear whether pupils' pre-test scores were included in the analysis (allowing a baseline for each participant to be employed, leading to more accurate assessment of changes in achievement to be obtained). Galton and colleagues concluded that the impact of the intervention would be enhanced had teachers been able to accommodate time at the close of group work lessons to "de-brief". Galton and colleagues' findings add to Study 1's findings and echoes the difficulties regarding the incorporation of lesson conclusions within group work lessons.

Kutnick and colleagues (2005b) note that numerous investigations restrict their interpretation of outcomes to either the cognitive or the social domain. Mercer (2008) argues against research having a sole focus restricted to examining pupils' test scores pointing out that recordings of classroom interaction and supplementary data are informative. Yet, it is too soon to agree with Kutnick and colleagues' assertion that both social and cognitive consequences need be considered because the relationship between group members influences the cognitive enhancement of individuals following an intervention. Rather the conclusions of Study 1 indicate that multiple measures are informative and appropriate to assess the complex nature of group work lessons. Previous research investigating secondary education noted that the inclusion of specific measures aimed at assessing the efficacy of an intervention would be informative. As noted earlier these include observation of classroom behaviour, a test of pupils' academic understanding (of the topic area under investigation) and to clarify the findings reported in Study 1, a measure of peer relationships.

Few published reports examine pupils' evaluation of classroom investigations that include group work. In fact, the scarcity of such studies led to the revision of a review (which included assessing students' attitudes towards science following experience of small group work) to reflect more accurately studies collected during their literature selection process (Bennett, et al., 2004). Since the publication of that document, only a small number of studies have included measures that investigate pupils' perspectives and followed up possible relationships between pupils' attitudes to group work and the subject being studied. It is difficult to understand why studies fail to report any findings when pupils' perceptions of their approach to learning and their individual capabilities (within specific subject areas) have been related to academic achievement (Wigfield & Karpathian, 1991), self-efficacy (Schunk & Meece, 2006) and have been associated with the content of teachers' talk (Burnett, 1999; Burnett, Pillay, & Dart, 2003; Burnett & Proctor, 2002).

One of the few studies investigating pupils' attitudes towards group work found primary pupils who experienced a SPRinG intervention showed less decline in their beliefs regarding their group work skills than pupils who experienced the conventional forms of teaching approaches (Blatchford, et al., 2005). Key Stage 3 pupils presented a more complex picture, understood by developing profiles using cluster analysis. Contributing factors included pupils' gender and personality characteristics and that group work attitudes remained stable despite deterioration in pupils' attitudes to teaching subjects (Pell, et al., 2007). As both gender and teaching year were important in explaining Key Stage 3 pupils' beliefs regarding group work the generalisation of such findings to a Scottish population is questionable due to the interweaving factors underlying pupils' attitudes. However, the inclusion and use of a group work attitudinal measure would be informative in helping to assess changes that transpire within the time span of an intervention and add to the account presented by Pell and colleagues. Additional grounds for examining pupils' group work attitudes comes from Study 1, which reported that a minority of pupils were not amenable to opportunities that involved interacting with their peers indicating that positive beliefs regarding group work are not universal. Consequently assessing pupils' attitudes towards science and group work will contribute to the evaluation of the intervention.

So far, pupils are recognised as being able to tailor their approach to learning in accordance with the demands of tasks distributed by their teacher, but does such skill reflect a deeper understanding by pupils? Group interaction may be perceived as a form of skilled behaviour, practised during lessons conducive to group work. Alternatively, it may reflect pupils' perception of group work as being meaningful in that it adds to their capacity to learn and as such retains particular significance. To this end a measure devised to examine pupils' recollection of group discussion will be incorporated within Study 2 to help tease out the significance of group work for pupils.

One reason for the inclusion of this measure stems from evidence suggesting that participation in groups can stimulate long-term gains, which depend upon post-group processing (Howe 2005). If pupils fail to recollect what actually took place and was said during group discussion, such discussion may be less likely to contribute to their understanding (e.g. pupils will not be able to use such understanding productively in future contexts).

There is indirect experimental evidence to suggest that students involved in a single group work session are able to accurately recall the written stimuli upon which interaction was based (Blankenstein, Dolmans, Vleuten, & Schmidt, 2009). University students given an abstract to read one week before group interaction displayed superior recall of the text following group interaction in comparison to students who read the text and answered questions individually. Yet evidence from Sommerville and Hammond (2007) indicates that accessing pupils' recall of group discussion may not be straight-forward, primary aged pupils overrated their contribution and reported others' statements as their own. These two studies reflect emerging findings and as such are limited. Blankenstein and colleagues (2009) used simulated group discussion with university students and Sommerville and Hammond (2007) used a turn taking activity with primary aged pupils. Nonetheless, they suggest care must be taken with the written information that is given prior to group work and that an accurate record is made of group discussion so that accurate comparisons can be made. Particularly as there is the expectation that pupils will continue to reflect on group dialogue, long after the initial discussion (Howe, et al., 2005), suggesting that statements given by pupils to complete the recall measure ought to be similar in their meaning rather than their phrasing.

A recent meta-analysis (Roseth, et al., 2008) reported a positive association between peer relationships, established in part by classroom interaction, secondary pupils' achievement and the use of cooperative group work. The 2008 meta-analysis built on conclusions made by Lou and colleagues (1996) which established a tentative positive relationship between grouping and self-concept. Hanze and Berger (2007) reported a relationship between pupils' negative academic self-concept (at pre-test) in relation to their perception of competence. Female pupils perceived themselves as being more competent than their conventional counterparts having participated in the intervention, yet this development was not detrimental to other students. Although Hanze and Berger's findings need to be considered cautiously, these and the other studies cited suggest measuring pupils' academic self-concept would be informative, helping to elucidate the relationship between group interaction and pupils' beliefs regarding their learning. While Lou and colleagues qualified various forms of self-concept as appropriate for inclusion within their meta-analysis, academic self-concept explains how pupils' perceive themselves and their potential for learning (Burden, 1998) and is therefore more informative for the purposes of Study 2.

6.3 Overview of the intervention

The intervention supported teachers' planning and implementation of group work lessons. The following section explains features of the intervention, of which a visual representation is presented in Figure 6.1. Three phases are outlined, denoting the progression of the intervention.

Phase 1	Phase 2	Phase 3
Initial Steps *Recruitment and coaching sessions.* *Pre-tests*	Schools coordinated their implementation of the intervention with the conventional teaching of the topic area. *Communication maintained with schools.* *Classroom observation*	Impact *Main outcomes assessed by analysing classroom observation and pupils' test scores*

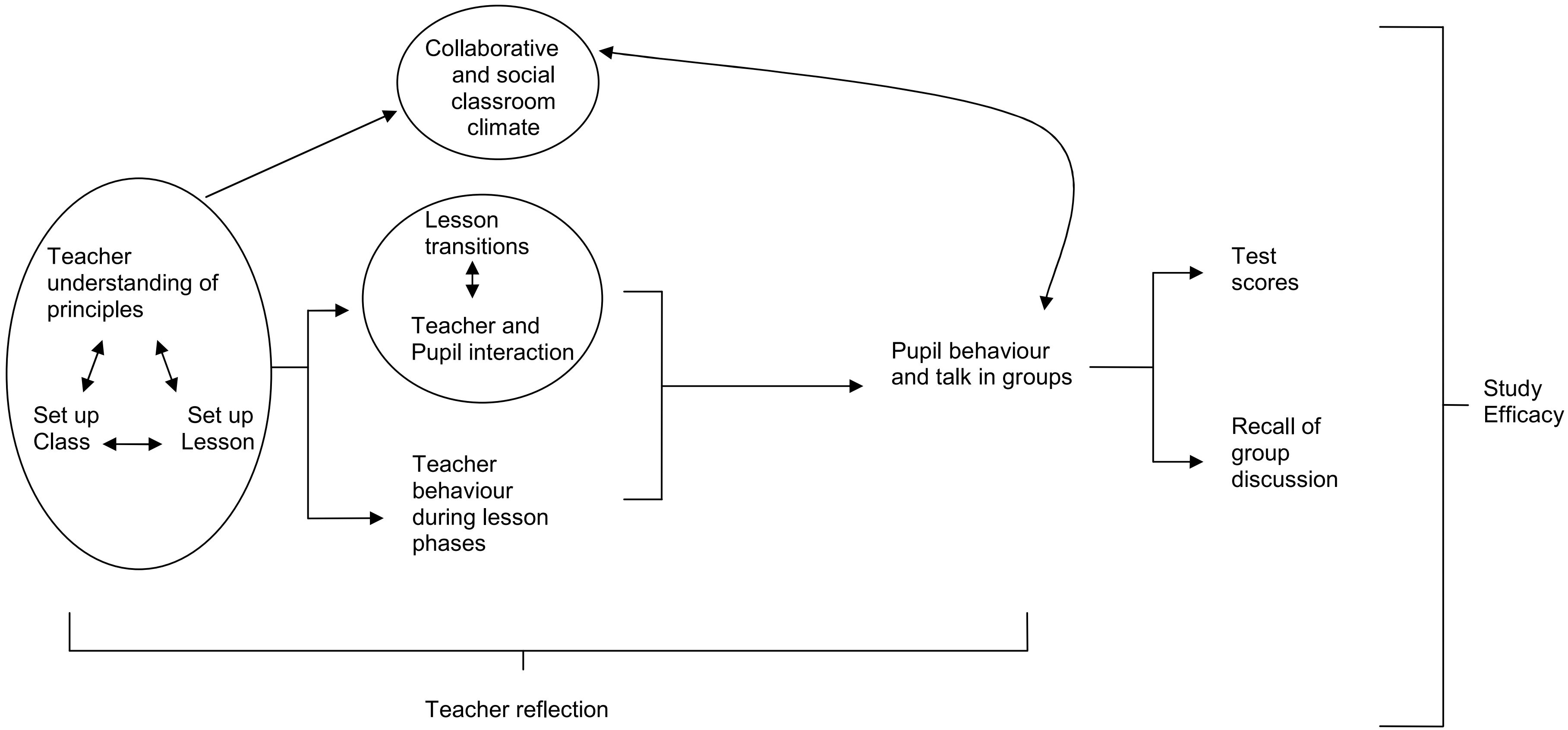


Figure 6.1 Visual representation of Study 2 that depicts the separate phases of the intervention

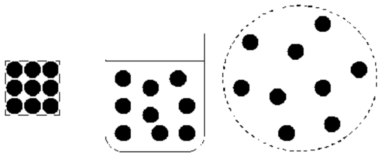
A single topic “Materials” was the focus of Study 2, which in addition to other teaching points considered the properties and composition of solids, liquids and gases, introducing and explaining processes such as evaporation and condensation and signalling the separation between physical and chemical changes. It featured within the SCOTSPRinG transition resources (Topping, et al., 2007) and lessons in this topic area within Study 1 featured group work (see section 4.6), indicating that teachers believed it to be suited to interaction and/or would be amenable to its incorporation. The topic area remains a vital contributor to the new curriculum, thus schools should be amenable to developing their group work skills by implementing an intervention based on the topic. Further, as the topic area bridges disciplines it provides multiple means of developing lesson content by relating it to real-life examples – a skill emphasised in the Curriculum for Excellence (Scottish Executive, 2009b) and the effective teaching of Science (Braund & Reiss, 2006; HMIe, 2008b; Scottish Executive, 2001).

Fourteen activities - in the form of worksheets aimed at groups - were presented in booklet form. Modifications to a document sourced from the SCOTSPRinG transition project (Topping, et al., 2007) accommodated the objectives of Study 2. Predominantly alterations related to appearance, for example, diagrams associated with activities were revised. Response boxes were added to prompt and encourage pupils to record their thinking.

The majority of activities included a practical element, where experimentation was incorporated into an activity to help address a research question that related to the main objective of the lesson. Three extracts are presented (using a reduced scale), the first (see

Figure 6.2) relies upon group discussion as the means by which the task is completed and necessitates that pupils take turns when presenting their ideas. The second worksheet (Figure 6.3) invites groups to make predictions, following a task that involves the preparation and recording of what takes place during an experiment and asks the group to compare their ideas in order to develop an explanation. The third worksheet (Figure 6.4) presents an activity where group work facilitates the sharing of resources, involving skills such as giving and asking for help. Interpretation of the outcome investigated by experimentation during the activity involved group discussion. An expanded list of skills used within each activity is located at the end of the teacher booklet (Appendix 9). The language and expressions used on each example outline the friendly tone of the worksheets. Reminders encouraged groups to be autonomous when working on tasks. These prompts related to the “Think then share” strategy - abbreviated from “Think, pair, share” as utilised in the SCOTSPRinG transition research (Topping, et al., 2007). Pupils were asked to reflect on their answers and interpretation of events, prior to discussing the questions posed on the worksheets with the group, signalled by “Think” within activities. Berthold and colleagues tested the learning outcomes of pupils grouped to receive cognitive, meta-cognitive or combined prompts and found that cognitive prompts were as effective as the combined groups. Thus, following on from these and other arguments cognitive prompts were integrated into activities to help overcome shallow processing (Berthold, Nückles, & Renkl, 2007; Howe & Tolmie, 2003; Howe, et al., 2000; King, 1994).

Activity – Particles in solids, liquids and gases



What are we going to do?

- You are going to think about what the particles of water are like in a solid, a liquid and a gas.
- Can you write a list of what you think the particles are like in each state?
- Think about how much each will move and how each could be attracted by other particles.

Group work skills we are looking for:

- Taking turns
- Making group decisions and reaching agreement

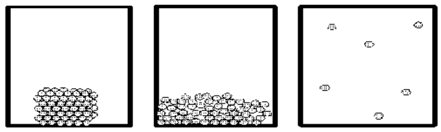
Task : Describing the Particles in Solids, Liquids and Gases

What should we do?

1. Look at the pictures below.

1

2. They represent a solid, liquid or a gas.



3. Now consider these phrases:

The particles are fairly close together with some attraction between them

The particles are free to move in all directions and collide with each other and with the walls of a container and are widely spaced out

The particles are held tightly and packed fairly close together

The particles are able to move around in all directions but movement is limited by attractions between particles

The particles have little attraction between them

The particles are strongly attracted to each other and are in fixed positions but they do vibrate.

2

4. Think

- Which picture does each phrase describe?

5. Share

- Compare and discuss your ideas, and come to a group consensus about which picture each phrase goes with.

What should we record?

Place each of the phrases in the correct column in the table below:

Solid	Liquid	Gas

3

Figure 6.2 Example of a "Solids, Liquids, Gases" activity worksheet completed by Intervention groups

Activity - Diffusion

What are we going to do?

- You are going to think about how particles can diffuse through water.
- You are going to think about the boiling tube that you will put a drop of food colouring in.
- Do you think the food colouring will travel through the water?
- If you think it will spread then what direction do you think it will take?
- Why will it move?

Group work skills that we are looking for:

- Active listening
- Summarising conversations

Task One : Observing Diffusion

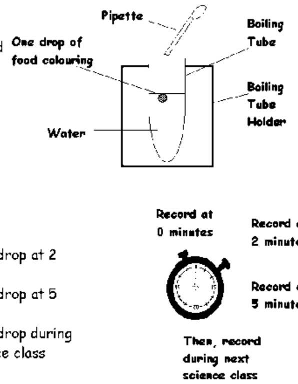
What will we need?

- A boiling tube
- A boiling tube holder
- Food colouring
- A pipette

1

What should we do?

1. Use the pipette to place one drop of food colouring into a boiling-tube of water
2. Do not shake the boiling tube
3. Observe the drop at 0 minutes
4. Observe the drop at 2 minutes
5. Observe the drop at 5 minutes
6. Observe the drop during your next science class



What should we record?

a) Complete the first diagram on the next page at '0 minutes' to show what the contents of the boiling tube looks like.
b) Complete the second and third diagrams after 2 and 5 minutes.
c) Complete diagram 4 during your next science class.

2

Appearance of the droplet in the boiling tube:	Appearance of the droplet in the boiling tube:	Appearance of the droplet in the boiling tube:	Appearance of the droplet in the boiling tube:
Diagram 1	Diagram 2	Diagram 3	Diagram 4
0 minutes	2 minutes	5 minutes	Next science class

3

Task Two : Think and Share

What should we do?

1. **Think** individually about the following questions
   a) What has happened to the colour of the water?
   b) Why do you think this has happened?
   c) Can you think of an explanation for this event?

2. Share

- Compare and discuss your ideas in your group.

What should we record?

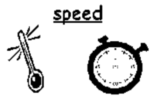
- List the different explanations discussed in your group in the space below:

- Write down a summary of your group's answers to the above questions:

4

Figure 6.3 Example of a "diffusion" activity worksheet completed by Intervention groups

Activity - Changing temperature to alter reaction speed



What are we going to do?

- You are going to see how changing the temperature of a solution will alter the speed of a chemical reaction.
- As the solution gets warmer what do you think will happen to the speed of the reaction between two chemicals?
- Why do you think this is so?

Group work skills we are looking for:

- Giving and asking for help
- Making group decisions and reaching agreement

Task One : Experimenting with Temperature

What will we need?

- Chemical Solution A
- 50ml ice cold water
- 50ml tap water
- 50ml warm water
- A thermometer
- 200ml measuring cylinder
- Three 250ml Perspex beakers
- Paper
- A stopwatch
- Chemical solution B
- 10ml measuring cylinder
- Safety – goggles, gloves, lab coat

Stage One:

a) Measure 50ml of chemical solution A using the 200ml measuring cylinder

b) Pour the 50ml of solution A into the perspex beaker and mix it with 50ml tap water

c) Draw an 'X' in pen on a piece of paper. Place the paper on the bench

d) Place the beaker so that it covers the 'X' on the paper

Stage two:

a) Stir once with the thermometer and take the temperature of the solution

b) Measure 2.5ml of chemical solution B

c) Add this to the beaker

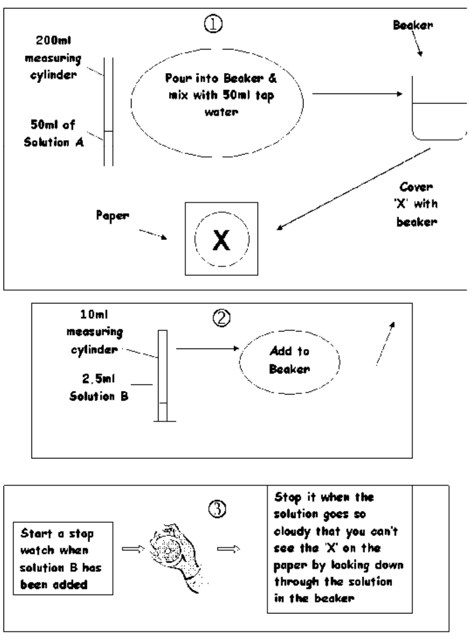
d) When you have added Solution B, start a stopwatch

Stage three:

a) Chemical solution B will react with chemical solution A and cause the liquid in the beaker to go cloudy (form a precipitate)

b) Time how long it takes for the solution to go so cloudy that the 'X' on the paper below can no longer be seen through the solution from on top.

What should we do?



Stage Four

a) Repeat the above experiment twice, using different temperatures of water:

Prepare beakers with solutions of the following mixtures:

- 50 ml chemical solution A and 50 ml ice cold water
- 50 ml chemical solution A and 50 ml warm water
- Then add 2.5ml of Solution B.

What should we record?

- Complete the following table:

Mixture		Temperature of mixture (°C)	Time for 'X' to disappear (seconds)
50ml of chemical solution A + 2.5ml solution B	50ml of tap water		
50ml of chemical solution A + 2.5ml solution B	50ml of ice cold water		
50ml of chemical solution A + 2.5ml solution B	50ml of warm water		

(Note worksheet continues on next page)

Task Two : Think and Share

What should we do?

1. Think about the following questions:

- What happened to the reaction time as the temperature changed?
- Why do you think this was the case?

2. Share

- *Compare and discuss your ideas in your group*

What should we record?

- *Complete the following sentences using the terms:*

increased **changed** **faster**

The reaction rate ____________ as the temperature changed. As the temperature ________ the reaction rate became _________.

- Write a summary of why you think this was the case.

5

Figure 6.4 Example of a "changing temperature to alter reaction time" activity worksheet completed by Intervention groups

The teacher booklet provides guidance to support teachers' implementation of the intervention. A set of guidelines were developed specifically for Study 2. They specified details intended to help teachers when they came to arrange the class into groups. The characteristics that support productive groups - noted in Chapters 1 to 3 and the outcomes of Study 1 – were crucial to these principles. At this point, the characteristics of group members and how pupils within groups should interact were also disclosed – reflecting aspects of particular theoretical significance namely: individual accountability and positive interdependence. A table provided in Gillies (2007, p. 80) stressed these two aspects (group characteristics and group composition), and provided a resource that teachers could share with pupils, explaining the roles pupils should adopt when working in groups and the contribution of these roles to productive group work.

The subsequent section looked more closely at teachers' behaviour within lessons. Guidance regarding teachers' roles within intervention lessons was given. For clarity, content was presented in relation to the introduction, middle and conclusion of lessons. In particular, two points were emphasised. The first was the need to consider the practical implications required for intervention lessons (termed setting up the classroom) in contrast to preparation of the lesson content (setting up the lesson). The second was the need to differentiate between group work procedures and content knowledge at the introduction and conclusion of lessons. All forms of SPRinG research noted that teachers should optimise when and how they describe and remind pupils of group interaction norms. However, Study 2 went further, specifying advice and guidance and explaining mechanisms teachers can rely upon to incorporate group work procedural content within lessons. Additionally, Study 2 emphasised the role of contextualisation – whereby teachers talk about the learning material explored in group work and incorporate it in into pupils' wider knowledge. Therefore, briefing and debriefing each held a dual purpose – to make group work and other Science related procedures clear and to introduce content relating to the learning aims and encourage pupils to make and reassess their frame of reference for material covered within the main part of lessons.

Such content was signalled throughout each of the lesson plans that accompanied each of the group work activities. Presenting developed plans that teachers can add to and tailor in accordance with the specific requirements of their school allowed teachers to familiarise themselves with the anticipated nature of group work lessons prior to engaging in the intervention for the first time. Teachers have claimed that such content (Seagraves, et al., 2007) reduces their anxiety when employing group work. Each lesson plan had a specific structure – links to curricular content and intended learning objectives were presented. The teaching and learning sequence described how teachers could adapt their behaviour within the briefing (introduction), activity (whilst groups complete activities), and debriefing (conclusion) stages. Until more precise evidence is available concerning how teachers should converse with groups (Webb, 2009) a background role appears to be optimal, allowing teachers' involvement to be a positive influence rather than a hindrance to interaction. Therefore, prior to entering into group work teachers were well prepared, appreciative of the skills they would rely upon when talking about group work and aware of the importance of establishing connections when introducing and concluding lessons. Lesson plans relating to the worksheets presented in Figures 6.2, 6.3 and 6.4 are presented within Appendix 9.

6.4 Lines of investigation

Study 2 will add to the developing body of research that focuses on evaluating group work within secondary education contexts. A number of measures capturing pupils' beliefs and perspectives, in addition to classroom observation, will tease out the impact of the intervention and enable comparisons between the different class types. Consequently, a number of points that merit examination can be presented.

6.4.1 Teachers' behaviour at the separate lesson phases

The few studies that examine teachers' roles during group work lessons are restricted in that they attend only to the interaction between the teacher and pupils in the classroom. This makes it difficult to hypothesise precisely how teachers will cope with the challenges they encounter during the intervention. It was expected that teachers will be observed to take more time at the end of lessons to round up and put together the different strains of information, to help pupils contextualise their understanding. Rather than increasing time spent introducing lessons, it was anticipated that changes in teachers' talk will be observed. For example, intervention teachers are likely to include content explaining the processes that encourage productive group work to pupils. Such change is argued to reflect an increase in the shared understanding developing between the class and their teacher.

6.4.2 Classroom interaction

Changes in the behaviour and dialogue of pupils as they complete tasks within groups should be detected when comparisons are made with pupils' behaviour in control classes. It must be noted that intervention pupils were experiencing a sustained programme of group work within a single topic area. The complexities of group interaction were assessed using classroom observation and a written measure (taken from Study 1) that examines the classroom environment. It was expected that there will be minimal teacher and pupil interaction within intervention classes. Although teachers within intervention classes will be involved with groups on a number of occasions, it was expected that such assistance will fall under monitoring type behaviours in accordance with the intervention's guidelines. However, despite nominal interaction between pupils and their teacher during the course of a lesson, it was expected that teachers will be able to report increases in the frequency of the number of positive interactions that pupils engage with. Pupils' ratings of their peers will be also be evaluated to assess their perceptions regarding the interaction within their Science class.

6.4.3 Pupils' recall of content discussed by their group

The scarcity of studies examining pupils' perceptions of group work have resulted in uncertainties about the value for pupils of the content produced during group discussion. For this purpose whether pupils attach particular significance to content discussed within groups will be investigated. In general, studies mention pupils' recollection of group interaction in passing and make brief attempts to connect it to what actually took place. For example Morgan (2007) reported that primary pupils recalled the practical nature of a learning activity rather than its learning objective/scientific explanation. Whether this conclusion can be tied directly to interaction is less clear as the study focused on ICT and the novelty of such approaches has been shown to impact upon the classroom environment inadvertently causing pupils to compete with their peers (Tanner & Jones, 2007), rather than cooperate to achieve a shared task. Similarly, research examining discussion based approaches (including but not restricted to group work) indicates that discussion leads to better recall of ideas (Applebee, Langer, Nystrand, & Gamoran, 2003; Nystrand, 2006; Nystrand & Gamoran, 1989). Study 2 will compare content recorded during group discussion with pupils' written recollection in an attempt to establish how interaction shapes learning. Following on from reports that pupils frequently distinguish between practical and scientific interpretation of classroom investigation, the nature of content recalled by pupils will be examined (Garcìa Franco & Taber, 2009; Morgan, 2007).

6.4.4 Pupil Achievement

Interventions based in secondary education have been far from conclusive. It was anticipated that pupils experiencing the intervention would at least match control pupils on the academic measures. Academic achievement was investigated by comparing two sets of scores and for this purpose pre- and post-academic tests derived specifically by Topping et al. (2007) were used. Despite the provision of optimal conditions for encouraging productive group work, enhanced academic comprehension may not necessarily follow (at least in the short term). Yet predictions should not be overly pessimistic: pupils skilled in interaction may experience less adjustment to the nature of peer interaction defined by the intervention. Such interaction repeatedly prompts pupils to question their understanding and re-align their thinking to accommodate changed ideas. Although such group work is indicative of interaction that stimulates knowledge gain specific predictions cannot be stated, as the effect of teachers' contextualising behaviours is unknown.

6.4.5 Pupil Attitudes

Despite research reporting variability in pupils' behaviour and beliefs regarding group work, Study 1 suggests only a minority of pupils disliked group work. This will be more formally assessed in Study 2 using a measure developed for the SPRinG research, helping to explore the effect of the intervention and support tentative conclusions made within Study 1. The sustained nature of Study 2 may not typify the straightforward interaction pupils envisage, thereby challenging pupils' predetermined beliefs regarding group work. Despite a paucity of studies that have reported the inclusion of supplementary measures; there is a suggestion that experience of a structured and sustained group work intervention may influence views regarding group work, the subject area and their experience of the classroom. Positive feedback received by pupils from their teacher regarding their performance or classroom contribution is expected to add to pupils' beliefs, in particular as tentative findings regarding such a relationship were evident within research focused on primary school pupils (Burnett, 1999).

6.4.6 Intervention efficacy

The integrity of the intervention was evaluated by considering teachers' perspectives regarding their involvement in the research project – examined in their responses to a questionnaire and comments made during a final feedback session, supported by notes made during classroom observation. The visual representation of the intervention (i.e. Figure 6.1) will be revised in the light of the results to clarify factors central to the intervention. An interesting point also follows from the subset of Study 1 teachers who reported having had experienced training relating to group work – in that few differences between these and other teachers were perceivable. It should not be assumed that such training was not effective – rather teachers were trained and then left to their own implementation of group work. Perhaps the offer of support during teachers' endeavour to regularly implement group work may be a vital characteristic to its effectiveness.

Method:

6.5 Design:

The research adopted a mixed model experimental approach to assess and evaluate the academic and social effects of introducing a Science programme whose content was completed primarily by pupils working in groups. The Science programme was based on one module targeting a single topic and was implemented between February and April

2009 in two schools. The programme was derived from the SCOTSPRinG transition research (Topping, et al., 2007). A control group was formed using a Science class from each of the participating schools, which was observed when the comparable topic area was taught using conventional methods. Teachers of the control classroom and intervention classroom coordinated their initial introduction of the topic so that pupils from either type of class would have equivalent experience. No restrictions or limitations were put in place regarding control teachers' instruction during the topic area.

Changes in teacher and pupil behaviour were assessed by analysis of the classroom observation data, supported by the additional measures that were collected. Within each lesson, both teachers and pupils were observed. However, separate designs are appropriate as different materials were used to record different stages of the lessons. For pupils, a two-way mixed design incorporated a between-subjects factor of type of lesson (intervention or control) and a within-subjects factor of time (each observation visit). For teachers, a two-way mixed design incorporated a within-subjects factor - observation of teachers at the introduction and conclusion of lessons (lesson stage) and a between-subjects factor – lesson type (intervention or control lessons). In relation to the written measures that were completed, the dependent variables were the pre-and post-test scores collected at these times and the independent variables were the type of class pupils worked in. Gender was included as an independent variable only in relation to sociometric measures as the conclusions of Study 1 (building on previous research) reported that gender influenced pupils' beliefs.

6.6 *Sampling:*

Five local authorities located in West Central Scotland were contacted to determine which secondary schools would be most amenable to the project. Two local authorities who had previously contributed participants for Study 1 were not contacted, as their schools had been closely involved in research considering peer based interaction, making them less suitable candidates. Follow-up communication with potential candidates ruled out further schools due to commitments to other research, imminent school inspection, curriculum flexibility being in place (where pupils are able to complete exams and related coursework a year earlier when particular circumstances are met), first year classes being set by subject ability, or teachers having previously undergone training in cooperative group work. Additional schools within those interested in the intervention were excluded when the topic area had been completed earlier within the school year.

Two schools located in different local authorities each provided intervention and control classrooms. The percentage of pupils eligible for free school meals was used as an indicator of the school's socio-economic status. One school was located in the 5-10 percentile of eligibility and the second school was located in the 15-20 percentile. Both schools therefore border the Scottish average of 12.9% (Scottish Executive, 2009c). Equivalent numbers of pupils consented to participate in both schools giving comparable populations. More female pupils participated although chi square goodness of fit tests revealed no statistically significant gender differences (X^2 (1) = .95, *ns*) or when separate comparisons were made for intervention (X^2 (1) = .24, *ns*) or control classes (X^2 (1) = .95, *ns*). Although classes from a single teaching year were asked to participate, pupils could vary in the age that they started school (primary school entry requirements depend upon a child's birth date). Nevertheless, independent samples tests (more appropriate for interval data) comparing the mean age of pupils according to their class type (t (73) = 0.57, *ns*) or gender (t (73) = 1.31, *ns*) were non-significant. Participant details are summarised in the Table 6.1.

Table 6.1
Sampling Characteristics of Intervention and Control pupils

Class Type	Mean Age	Male pupils (n)	Female pupils (n)	Total
Intervention	150.31 [a]	17	20	37
Control	155.42 [a]	16	22	38
Total	-	33	42	75

[a]= mean age calculated in months.

6.6.1 Recruitment of participants

Research conducted within Study 2 was in accordance with the British Psychological Society's Code of Ethical Conduct. Further ethical approval was obtained from the University of Strathclyde Psychology Department and local authorities prior to schools being contacted individually. Schools were then approached via letter, email, and telephone, to solicit their participation (Appendix 10). Teachers volunteered their participation on the understanding that each school would provide two teachers, one to participate in the intervention and another who would maintain conventional approach to the teaching of a specific topic area. During initial discussions with teachers who volunteered their participation it was ascertained that volunteers from each school were similar in their experience of teaching. Teachers were neither recent graduates nor had they been teaching for an extensive period (e.g. more than 15 years). Study 2 aimed to maintain a whole-school approach in that the Science department of a school adopts the group work intervention and informs parents of such approaches being implemented within its classrooms. Science lessons within intervention classrooms used both group work and whole-class approaches and replaced conventional approaches to the teaching of a topic area. Therefore, whether pupils were learning within intervention or control classrooms they were given equal opportunities to learn as the same material was covered in both types of classrooms. Consent from individual pupils was therefore not sought as regards the teaching intervention. The first page of the pupil questionnaire made clear that completion of the instrument was voluntary and participants could withdraw their participation at any time. Measures given to pupils were distributed with envelopes, diminishing concerns regarding anonymity.

6.7 Materials:

The science programme focused on a single topic area, which is included in both the current Scottish curricular guidelines (Learning and Teaching Scotland, 2000a) and the forthcoming Curriculum for Excellence (Scottish Executive, 2006a). Resources were stored online and made available to participating teachers concurrently with the hard copy.

6.7.1 Pupil booklet

A pupil booklet contained worksheets corresponding to 14 activities. The content of the worksheets ensured that pupils were aware of the purpose of each activity. Objectives were clearly stated and group work skills involved were listed. Reminders were strategically placed within worksheets to remind pupils that they were expected to work as groups in order to complete tasks and where appropriate that ideas generated by the group should be recorded. Intervention lessons presented opportunities for pupils to discuss, explain and record details in specific sections within the booklets.

6.7.2 Teacher booklet

A six-section booklet was presented (Appendix 9). Guidance was prepared regarding the implementation of classroom groups that emphasised the role of group composition prior to the commencement of the intervention. Additionally, the skills most likely to support pupils' interaction in groups were noted and described – a table explaining the rights and responsibilities of group members was included as a resource that teachers could share with pupils. The subsequent section focused on teachers' behaviour at the introduction and conclusion of lessons. Teachers were advised to incorporate content relating to group work behaviours (for example prompts at the introduction of a lesson and feedback about group behaviour at the conclusion of a lesson) but told that they should also aim to contextualise pupils' understanding. Such talk could outline a framework for pupils at the introduction of lessons - for example probe pupils' prior understanding - but also extend this later on by making connections with real life examples during the lesson conclusion. Such guidance featured within the lesson plan that corresponded to each activity. Each plan included descriptions of the intended learning for each activity, the approximate length of time that should be devoted to each section of a lesson and how the teaching and learning sequence should progress during a lesson.

The fourth section contained a resource list, detailing the equipment required for each activity. A summary table outlined the noteworthy features of each lesson, in particular the attainment level of each (based on the 5-14 curriculum guidelines utilised in Scotland) and their proposed length, which ranged from 20 to 40 minutes. A table, which explained the group work skills relevant to each activity, concluded the penultimate section. The final section of the teachers' booklet presented the booklet given to pupils, to which a preliminary page was added that when and where necessary teachers should use their professional judgement in relation to the emphasis and time allocated to the activities. However, a cautionary note explained that the time allocated for pupil thinking and talking should be preserved whenever possible.

6.8 Pre- and post-tests

The pre- and post-tests can be separated into the academic test and additional measures and all are presented within Appendix 11.

6.8.1 Academic test

The pre- and post-tests were identical in content with 30 multiple-choice questions (equivalent to the total feasible score). 23 of the 30 questions were descriptive and asked pupils to choose the correctly worded multiple-choice response (as in Figure 6.5). The remaining seven questions were associated with diagrams. Six presented a diagram that corresponded to each response category (as in Figure 6.6) and the final question presented a single diagram in order to depict the descriptive question. Both measures had been developed specifically for the SCOTSPRinG transition project (Topping, et al., 2007).

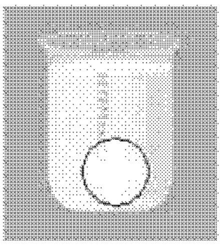
19. Which sentence best describes how particles are packed together in an ice cube?

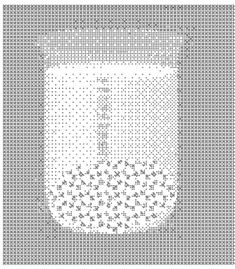
a) The particles are held tightly and packed fairly close together ☐
b) The particles have little attraction and are spread out ☐
c) The particles are free to move in all directions ☐
d) The particles are pushed away from the surface of the ice cube ☐
e) The particle spread out as far as they can ☐

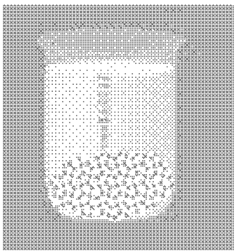
Figure 6.5 Example of a multiple-choice item included in the academic test

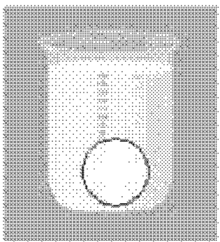
30. In which beaker would a reaction between an acid solution and marble be quickest? The same mass of marble is added to the beaker in each instance and only the particle size and temperature are changed.

Particle size

a)  Large pieces at 30°Celsius. ☐

b)  Fine powder at 10°Celsius. ☐

c)  Fine powder at 30°Celsius. ☐

d)  Large pieces at 10°Celsius. ☐

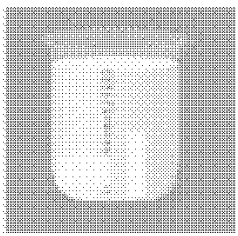
e)  Large strips at 30°Celsius. ☐

Figure 6.6 Example of a multiple choice item that employed diagrams included in the academic test

6.8.2 *Questionnaire*

Excluding the academic and recall test, Table 6.2 summarises the seven items to be completed by pupils. Four had been used in Study 1: classroom environment, attitude to science, self-perception science, and sociometric peer rating scale. Four additional items were included, attitude to group work (Topping, et al., 2007), Myself as a learner scale/measure of academic self-concept (Burden, 1998) and questions that examined pupils' perceptions regarding science classroom activities, adapted from content used within the SCOTSPRinG transition project (Topping, et al., 2007). All of these items are available in Appendix 11.

Table 6.2
Summary of measures completed by pupils

List of measures	Time of Completion		Total Score Possible	Number of items
	Pre	Post		
Academic test	✓	✓	30	30
Classroom environment	✓	✓	-	6
Attitude to Science	✓	✓	42	7
Self-perception to Science	✓	✓	48	8
Attitude to Group work	✓	✓	30	6
Sociometric	✓	✓	-	Related to class size
Science classroom activities	✓	✓	-	10
Academic self-concept (MALS)	✓	✓	100	20
Recall task (intervention pupils	n/a	✓	-	10

6.8.2.1 *Classroom environment*

The classroom environment scale investigated pupils' beliefs with six items, each probing the opportunities given to pupils to express their ideas and how teachers manage such interaction.

6.8.2.2 *Attitude and self-perception to Science*

Questions evaluating pupils' attitudes and self-perceptions employed a semantic differential format (Osgood, et al., 1971) where phrases of opposing meaning are positioned at both ends of a six-point scale. Analyses were conducted on pupils' responses to the individual items composing the measure and pupils' mean attitude scores, which were arrived at by summing across their responses to the individual items. Study 1 reported reliability coefficients of 0.9 for the attitude and 0.83 for the self-perception measures (internal reliability was calculated using Cronbach's α, see Section 3.6.5 in Chapter 3).

6.8.2.3 *Sociometric peer rating scale*

Pupils were asked to evaluate their relationships with pupils named on a list of their classmates. Pupils rated their peers by choosing one of five possible responses, using a Likert scale, with 5 - representing a positive rating - to 1 – representing a negative rating; examples of such ratings were placed at each end of the scale and at the neutral point. Each pupil's mean score was computed, providing an indicator of their degree of acceptance within a particular classroom, in addition to the frequencies of positive, negative and negative ratings. The difficulties encountered accessing such data in Study 1 indicate that collecting teachers' reports of pupil interaction, using a similar rating method would be wise. Consequently, teachers completed a rating measure that documented their perspective regarding the number of interactions that each pupil from their class engaged in.

6.8.2.4 Attitude to group work

Attitudes to group work were measured using six items, to which pupils responded using a Likert scale ranging from "Strongly agree" to "Strongly disagree". Analysis was conducted on pupils' mean score, arrived at by summing across responses to the individual items. Reliability coefficients of 0.85 were reported for this measure (originally labelled "Liking for group work") when it was used with secondary pupils (Pell, et al., 2007).

6.8.2.5 Academic self-concept

Academic self-concept was assessed using the "Myself as a learner" (MALS) scale (Burden, 1998), reported to have a reliability coefficient of 0.85, when used with children aged 11 to 13 years. Each pupil responded to twenty statements by completing a five point multiple-choice scale, ranging from "Definitely yes" to "Definitely no". Analysis was conducted on pupils' mean scores, arrived at by summing across responses to the individual items.

6.8.2.6 Science classroom activities

Pupils reported their enjoyment of ten common Science activities using a five point Likert scale where "I like it" or "I don't like it" was presented at either end. The scale was originally labelled "Science experiments" as it contributed to an attitude to science measure (Jarvis & Pell, 2002; Pell & Jarvis, 2001). It was included within the measures adopted by Study 2 as it helps to connect pupils' beliefs with specific classroom settings.

6.8.3 Recall test

The recall post-test asked pupils to complete short answer questions based on content that had been discussed with their peers during group work lessons. The post-test asked pupils to recollect explanations using questions worded in similar language to that written on the worksheets. Six of the fourteen activities available in the pupil booklet were selected for inclusion within the recall tests. The selected activities were evenly distributed throughout the course of the intervention to avoid recall bias or biases stemming from pupils' development during the intervention. Data for the recall test comparisons were collected in two ways: each classroom activity asked pupils to record their group discussion onto the worksheets, by detailing explanations suggested by their group and noting the single explanation that the group agreed best answered the question. It was expected that pupils' memory of content discussed in their group would produce similar but not identical statements. Accordingly, a classification scheme was devised to categorise pupils' statements.

6.9 Observation

Classroom observations were recorded using a systematic time sampling approach similar to that used in Study 1. A lesson context sheet was completed prior to each lesson and re-evaluated following the observations within the lesson, allowing the general layout of the classroom to be recorded along with additional salient details. Aside from minor modifications (coding boxes related to aspects of Study 1 were removed) the nature and use of the lesson context sheet remained unchanged. The measures used to record observations are available within Appendix 12.

6.9.1 Teacher observation

For each teacher, an observation grid (composed of eight 40 second windows) was completed once at the beginning and once at the lesson conclusion. A revised set of observed categories was developed for Study 2 (see Table 6.3). Revisions were made in line with findings stemming from Study 1 and to accommodate the objectives of Study 2, which looked at more specific aspects of teachers' behaviour. Eight categories were arranged into four classifications. Two related to teachers' questioning behaviour, a further two categories recorded teachers' talk according to whether it detailed group work or science procedures or contextualised pupils' understanding. The penultimate classification separated attempts made by teachers to respond to pupil contributions into two categories - and the final categories recorded the nature of the classroom layout at the introduction and conclusion of lessons.

Behaviours exhibited by teachers were recorded once within each observation window (a detailed explanation of the systematic nature of observation is outlined within the procedure section). Multiple coding, which would have required the researcher to distinguish between the boundaries of one explanatory statement and the next, could not be reliably completed within a single observation window. A count of the behaviours exhibited by teachers was considered sufficient to provide adequate data on the basis that teachers will repeat and rephrase information to ensure effective communication (Zwiers, 2008; Zwozdiak-Myers & Capel, 2008) and that this method proved successful in Study 1.

As a result, the contents of the observation grids were summed, which created overall frequencies for each teacher within each observation category.

Table 6.3

Description of observation categories used to record teacher behaviour

			Inter-rater reliability values
Questioning behaviour	A) Deep Probe	Probes students' explanations to uncover details or further thinking about their problems solving strategies (asks specific questions about details in a student's explanation). This category relates to "deep" probes where information produced within groups is attributed value and incorporated into both the main lesson objective and more generally tied to subject knowledge. Teachers would be likely to use several questions to elucidate how a problem was approached, in addition to establishing pupils' ideas/answers.	.81
	B) Shallow Probe	Engages with students around their work on the problems (either an answer or an initial explanation) but does not probe the details of student thinking about their problems solving strategies (typically repeats or reiterates, the students' work without asking any further questions).	.73
Type of talk	C) Process related Content	Teacher revises/gives feedback on processes – e.g. comments given relating to group work behaviours, interaction, classroom management or health and safety. Encompasses how teachers communicate with pupils about their expectations or standards of work during lessons.	.75
	D) Contextualising behaviours	Talk may relate to lesson objectives but should also include attempts to frame knowledge covered during the lesson. Examples include connections being made with real life examples, or pupils' ideas being developed through establishing links to previous lessons.	.80
Responding to pupil contributions	E) Fully Attend	Teacher integrates statements/group answers within his/her speech. Teachers' behaviour provides indicators of the importance assigned to pupil contributions. Includes occasions when teachers address misconceptions: for example by probing pupils' thinking, asking for additional explanations and then moving to examining the correct answer.	.74
	F) Acknowledge	Records the occasions when teachers merely acknowledge contributions made by pupils. Also includes occasions when inconsistencies are ignored and focus turns to the correct answer rather than providing an opportunity for sustained/extended discussion.	.73
Class set up	WC		n/a
	Pupil plenary		n/a

6.9.2 Pupil observation

One observation grid (composed of 8 windows each lasting 15 seconds) was recorded per pupil. Recordings were only made when pupils were engaged with tasks. Each science classroom could have a maximum size of 20 pupils, therefore each pupil was considered a potential target of observation during each class visit. To ensure a balanced approach a specific sampling technique was employed: one pupil per group was observed, each successive observation would attend to a different group, and whenever possible each subsequent observation would operate a selection process according to pupils' gender – that is observation of a male pupil would be followed by observation of a female pupil.

Minor changes were made to the observation categories in order to accommodate the findings of Study 1. Categories that significantly contributed to the cluster analysis were maintained and when appropriate extended to incorporate relevant elements of categories from Study 1. For example, a single observation category now recorded teacher involvement with pupils, rather than the two categories utilised in Study 1. Figure 6.7 explains the amendments made to the pupil observation categories.

Study 1	**Study 2**
Pupil Interaction No Interaction Interaction with nearby pupils Interaction with further away pupils *Teacher Presence* Teacher present Teacher engaged with pupil	*Pupil Interaction* Working alone Interacting with their own group Interacting with someone external to their group Teacher present and/or interacting
Task and Classroom Organisation Pupils given different individual tasks. Pupils given similar individual tasks. Groups given different tasks Groups given similar tasks Teacher leading the whole-class Pupils and teachers involved in whole class interaction	*Group set up* Seated individually Seated in groups Sitting in whole class or typical class layout
Task Activity Engaged with task. Not engaged with task Classroom preparation	*Activity level* Working on task Not focused on task Task related preparatory activity
Dialogue Inform Ask Resolve Other	*Dialogue* Inform Ask Resolve Other

Figure 6.7 Process of amendments made to the pupil observation categories

The first of five sections considered the social context of pupil and teacher interaction (see Table 6.4). The first, second and third sections complemented each other and identified whether pupils were instructed to work as groups or otherwise, and whether pupils completed tasks as individuals, groups or as a whole-class. The fourth section considered whether pupils were actively focused on completing tasks or not, and the final section focused on the dialogue produced by pupils during lessons, based on the dialogue categories from the SCOTSPRinG project (Howe, et al., 2007). These five sections allowed the precise interactive nature of a lesson to be evaluated.

Table 6.4

Description of observation categories used to record pupil behaviour

	Observation Category	Inter-rater reliability values
Interaction		
Not	Working alone	.87
COG	Interacting with their own group	1.0
CDG	Interacting with someone external to their group	.86
+T	Teacher present and/or interacting	.94
Group set up		.95
Alone	Seated individually	
Group	Seated in groups	.78
WC	Sitting in typical classroom layout	.93
Activity level		.95
On	Working on task	
Off	Not focused on task	1.0
Task Prep	Task related preparatory activity	.97
Dialogue		.77
Inform	Give explanation.	
Ask	Seeking help, direct questions	.80
Resolve	Examines others' accounts. May point out inconsistencies	.74
Other	Inaudible/uncodable	.78

Sections one to four within the pupil observation grid employed mutually exclusive coding during each observation window. Pupils were coded as exhibiting behaviours within a specific category, when that behaviour had the longest duration within an observation window. The contents of each observation grid were summed, so that frequencies within each observation category were computed and used within the analysis. This approach was used previously within the SPRinG group work intervention and the SCOTSPRinG research (Baines, et al., 2007; Howe, et al., 2007; Thurston, et al., 2008b).

Within the fifth section of the pupil observation grid multiple dialogue behaviours could have been coded, in contrast to the mutually exclusive categories used within sections one to four. A similar approach was used in the recent SCOTSPRinG transition project (Thurston, et al., 2010), providing support for the belief that dialogue behaviours from secondary pupils need to be coded in this manner, as noted earlier in relation to primary aged pupils (Howe, et al., 2007).

6.9.3 Reliability

The measures used to record observations are available within Appendix 12. Details of the reliability and categories used to record behaviour are given in the following paragraphs.

The data collected for Study 2 were coded during classroom lessons and collected solely by the main researcher; therefore, appropriate reliability checks of the observation methodology were made in advance. Excerpts of video that incorporated either group work or conventional teaching were used. The researcher and an observer trained for this purpose coded the recordings independently and inter-rater reliability of the observation grids was computed, and constitutes the final column in the teacher and pupils observation overview tables. Inter-rater agreement over teachers' behaviour was computed using Cohen's Kappa (see Table 6.3) with agreement ranging between 73% and 81% and averaging 76%. Intraclass correlation coefficients were more appropriate with the interval pupil data, where agreement, ranged between 74% and 100% with mean agreement across categories achieving 88% (see Table 6.4).

6.10 Teacher evaluation questionnaire

A questionnaire adapted from a resource used within the SCOTSPRinG research (Thurston, Christie, Howe, Tolmie, & Topping, 2008a) presented two sections (Appendix 13). The first included six items that examined the support and resources made available to intervention teachers. The first five questions asked teachers to rate a feature of the intervention and asked for a detailed explanation to be given. The sixth item presented a table where teachers reported the number of activities they were able to implement. The second section evaluated the overall impact of the intervention, presenting ten questions where teachers rated aspects of the intervention. A subsequent four questions allowed teachers to present an extended response in addition to giving a rating. A further open-ended item (placed at the end of each section) prompted teachers to provide any additional comment regarding the intervention.

6.11 Procedure:

6.11.1 Implementation of the intervention

Two school visits took place prior to the implementation of the Science programme. During the first introductory visit, further checks were made regarding the schools' suitability as potential participants and the teacher booklet was made available to the teachers who would implement the intervention with their first year Science class. The intervention teacher in each school contacted the researcher (an approximate delay of one week) once they had had sufficient time to digest the relevant documents. The second visit acted as a coaching session, developing teachers' understanding of the training materials and placing emphasis on the management of group work activities during lessons. Control teachers were happy to participate on the basis that they would receive the intervention materials once the school had participated in the research. Control teachers were advised to carry out the conventional means of teaching the topic area. Control teachers were aware that the focus of the intervention included group work and it was explained they ought to employ the conventional approach of teaching the topic area, using whatever teaching approaches they would ordinarily.

Teachers of the control classroom and intervention classroom coordinated their initial introduction of the topic. Teachers were asked to administer the pre-test one week prior to the start of the topic area and to administer the post-test two weeks after its conclusion, the inter-test period approximating about two months. At the same time, teachers completed their peer rating measure (both pre- and post-test) and intervention teachers completed the evaluation questionnaire during the post-test.

Intervention teachers were encouraged to cover as many activities as possible but were advised to rely on their professional judgement to decide whether certain activities require more or less emphasis, or more or less time than suggested within the booklet. At the same time it was stressed that key features of lessons, such as the time set aside for pupil thinking and talking, should be preserved.

6.11.2 Classroom observation

Whilst the topic area was being taught, each intervention and control class was visited by the researcher on three occasions. The arrangement of classroom visits was facilitated as Intervention and control teachers coverage of the topic area ran in parallel. The first classroom visit was scheduled once Intervention teachers had covered one week of teaching. Successive visits were staggered at similar intervals throughout the remainder of the topic. These visits were arranged at short notice to avoid any particular efforts being made by individual teachers or the school itself. Within each observation period, a lesson context sheet, teacher observations, and pupil observations were collected.

The exact nature of the classroom was detailed through completion of the lesson context sheet prior to the onset of the lesson, providing a wealth of descriptive information. During the lesson when the class moved onto another activity – for example from whole-class to group work - precise observations were recorded regarding such activity. Resources used within the classroom, and the arrangement of pupils were detailed on a classroom map.

Observation incorporated a naturalistic approach, where an observer coded lessons in vivo, but did not interrupt, or alter classroom interaction. Systematic observations utilised a specific time-sampling procedure, facilitated by the use of an observation grid, with rows corresponding to observation windows and columns corresponding to observation categories. Eight consecutive windows constituted one complete observation grid per pupil, where each window approximated 15 seconds in length. Teachers were also observed for eight windows, whose duration was closer to 60 seconds. Each observation therefore consisted of an exact period. Teachers were observed on two occasions, at the beginning and end of lessons. Once observations were complete, the lesson context sheet was re-evaluated and any additional information noted.

6.11.3 Analysis

The first aim of this research was to verify whether control and intervention pupils demonstrated equivalent understanding of the topic area by comparing their academic performance on the pre- and post- test using analyses of covariance (ANCOVAs). The impact of the intervention was also assessed by considering pupils' total scores regarding group work and Science teaching, pupils' perception of self within Science and their academic self-concept using ANCOVA. Where applicable the individual items comprising such tests were analysed following a number of steps. Kendall's tau-b compared intervention and control pupils' responses at each testing time to determine the equivalence of each sample. When an equivalent sample was detected (no significant differences were evident) a single marginal homogeneity test (extension of the McNemar test to account for ordinal repeated measures data) was computed which compared pupils' pre and post-test responses. Consequently, when a significant difference was detected within pupils' pre- or post-test responses separate marginal homogeneity tests were conducted.

The classroom observation data were analysed in relation to the second research question (see section 6.4.2) which asked whether teachers and pupils varied their behaviour over the course of the intervention. Independent t-tests and two-way mixed ANOVA were used to investigate pupils' behaviour. A Kruskal-Wallis test was performed on the sum of teacher observations to determine whether the intervention had an effect on their approach to lessons. Follow-up analysis included Wilcoxon signed rank tests and Mann-Whitney tests. Spearman rho correlations were computed to detect associations in teachers' behaviour. The final measure examined pupils' and teachers' perceptions of pupil interaction. ANCOVAs were computed on the separate measures derived from the pupil rating scale. Ratings given by teachers were analysed with Kendall's tau-b comparisons. Pupils' ability to recall content that had been discussed by their group during class time was evaluated using separate analyses. Responses given to short answer questions distributed during the post-test were examined in two ways: the degree to which pupils were able to recall group discussion and the scientific nature of what they recalled.

The final aim of this research addressed implementation efficacy using different sources of data. Content from the following sources was included: teachers' perspectives having implemented the group work activities, specific notes made during class visits, and teachers' views that were expressed during a feedback session.

Chapter 7

Study 2: Results

The impact of the intervention is evaluated in three sections. The first focuses on teacher and pupil behaviour by examining the classroom observation data. The social environment of the classroom is evaluated by considering the sociometric data given by both pupils and their teacher. The second section looks at the effectiveness of the intervention by examining pupils' performance on the pre- and post-academic test and their responses to the questionnaire, which explored their recall of group discussions. The third and final section adopts a wider perspective presenting a chain of evidence that incorporates elements from the first and second sections illustrating associations between factors included in the intervention. This is corroborated by evaluating the efficacy of the intervention, including teachers' perspectives having implemented the group work activities.

7.1 Investigate changes in classroom interaction (analysis of classroom observation)

Observations of teachers were analysed to determine whether teachers could meet the guidelines set out by the intervention. For this purpose, the data collected representing control teachers' behaviour acts as a baseline. Therefore, any equivalence between the two samples is acceptable, whereas deviation ought to be given careful consideration to verify that such change is a result of the intervention. Four teachers were observed twice (introduction and conclusion) within three separate class visits.

7.2 Analysis of teachers' behaviour

A Shapiro Wilk test of normality and homogeneity of variance tests (Levene Statistic) were computed for the teacher observation categories. The results are presented separately for intervention and control classes within Table 7.1. It is clear that specific variables exhibit non-normal and uneven distributions. Whole-class and plenary observation categories will be considered separately, due to their non-normal nature and the fact that they were used as a record of classroom organisation rather than teacher behaviour, which was the focus of the remaining six categories. Deep probe, fully attend and acknowledge categories showed non-normal distributions and need to be treated as such. Fully attend and acknowledge were also problematic for control teachers as they showed heterogeneity. As a result, fully attend and acknowledge variables will only be considered for intervention teachers (as homogeneity of variance was not violated) and when appropriate included in non-parametric analyses.

Table 7.1

Tests of Normality applied to observation categories used to record teacher behaviour

	Intervention		Control	
Category	Shapiro- Wilk Statistic	Levene Statistic	Shapiro- Wilk Statistic	Levene Statistic
Deep probe	.87	.20	.78*	.0
Shallow probe	.88	2.5	.89	.08
Process	.91	1.0	.94	.13
Contextualise	.94	.33	.89	1.3
Fully attend	.84*	.56	.55	-
Acknowledge	.88	1.25	.78*	9.1*
Whole-Class	.86*	.74	.92*	.31
Plenary	.63*	.47	.43	3.3

Note. Dashes indicate the category did not meet test assumptions. * $p < .05$

7.2.1 *Change in teachers' behaviour*

To establish that participation had an effect on teachers' behaviour, a Kruskal-Wallis test was performed using the sum of each observation category comparing intervention and control teachers' behaviour.

Table 7.2

Comparison of Intervention and Control teachers' behaviour performed using Kruskal-Wallis tests (IQR in parentheses)

Category	Intervention	Control	Significance
Deep probe	1.33 (2.0)	1.0 (1.0)	H (1) = 6.09, *exact* p < .01
Shallow probe	3.0 (2.0)	2.5 (4.0)	H (1) = .84, ns
Process	6.0 (4.0)	5.0 (3.0)	H (1) = 2.18, *exact* p < .05
Contextualise	4.5 (4.0)	2.0 (3.75)	H (1) = 7.04, *exact* p < .01
Fully attend	1.0 (2.0)	.0 (1.0)	-
Acknowledge	2.0 (2.0)	1.0 (2.0)	H (1) = .49, ns

Note. Dashes indicate the category did not meet test assumptions. IQR – Inter-quartile range.

Table 7.2 indicates that teachers within intervention classes significantly increased their use of deep probe, process and contextualise, all of which encapsulate the changes that teachers were recommended to implement within intervention classes.

7.2.2 *Teachers' briefing and debriefing behaviour*

The second research question related to whether teachers were successful in managing lessons, allowing time for developed conclusions to be integrated. Wilcoxon signed rank tests compared each observation category according to whether behaviours had been recorded at the beginning or conclusion of lessons. Tests were conducted separately for intervention and control teachers on the basis that the Kruskal-Wallis tests revealed changes in Intervention teachers' behaviour. These analyses were performed to detect whether teachers showed comparable behaviours within each lesson phase. Indeed, the non-significant findings regarding intervention teachers outlined in Table 7.3 indicates that comparable behaviours were observed, with similar frequencies of talk being introduced within the portions of lesson time being set aside for each lesson phase. The descriptive statistics reported in Table 7.3 also point out how specific variables –for example deep probes and contextualising behaviours –argued to encompass skills under-going development by intervention teachers, were a feature of their classrooms.

Table 7.3

Comparison of teachers' behaviour recorded at the introduction and conclusion of lessons (IQR in parentheses)

	Category	Introduction	Conclusion	Significance
Intervention	Deep probe	1.0 (1.75)	1.5 (2.0)	Z = -.11, ns
	Shallow probe	2.5 (2.0)	3.0 (2.25)	Z = -1.0, ns
	Process	6.5 (2.0)	4.5 (2.5)	Z = -2.1, ns
	Contextualise	3.0 (4.5)	4.5 (3.5)	Z = -.11, ns
	Fully attend	0.5 (2.5)	1.0 (2.3)	Z = .0, ns
	Acknowledge	1.5 (1.5)	1.5 (3.0)	Z = .0, ns
Control	Deep probe	0.5 (1.25)	0.5 (1.25)	Z = .0, ns
	Shallow probe	2.5 (4.0)	2.0 (3.5)	Z = -.272, ns
	Process	5.0 (3.5)	4.0 (2.5)	Z = -1.36, ns
	Contextualise	2.5 (4.5)	1.5 (2.5)	Z = 1.1, ns
	Fully attend	0.5 (1.0)	1.0 (0.7)	-
	Acknowledge	1.5 (3.0)	1.0 (0.75)	Z = -.41, ns

Note. Dashes indicate the category did not meet test assumptions. IQR – Inter-quartile range.

Changes and development in teachers' behaviour are subtle and the findings from the small sample can be viewed more clearly in Figure 7.1   Intervention teachers responded to guidance and modified their behaviour, progressing from the baseline observable in control teachers' behaviour. Figure 7.1 makes it clear that intervention teachers used specific behaviours more extensively. Intervention teachers utilised behaviours and deep probes to a greater extent than their control counterparts. Teachers' responses to pupils' contributions – recorded using two categories fully attend and acknowledge – show a bimodal distribution, which helps explain the heterogeneity of this variable within control classrooms (and suggests that the values of the medians used in the Wilcoxon tests may be somewhat deceptive). Both sets of teachers acknowledged contributions given by pupils, yet only intervention teachers made efforts to integrate such explanations and, when appropriate, encouraged pupils to reflect on their contribution.

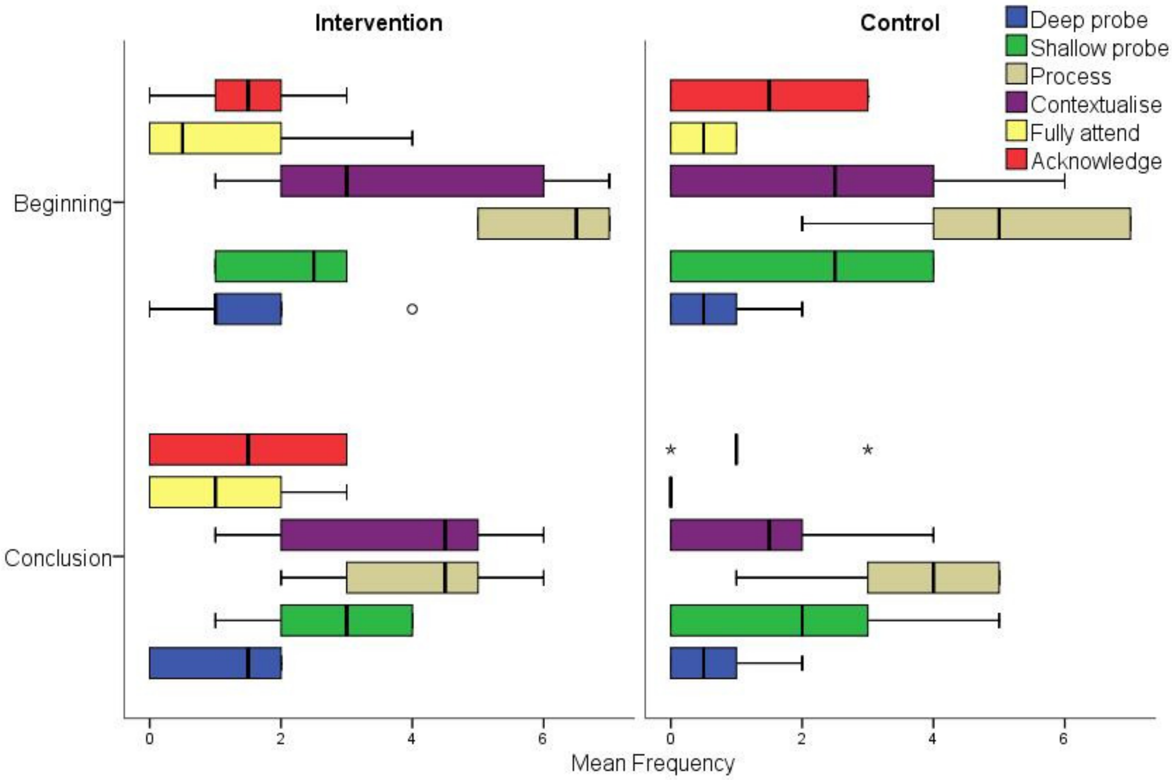


Figure 7.1 Comparison of intervention and control teachers' behaviour at the separate lesson phases

7.2.3 Associations in teachers' behaviour

Further clarification regarding teachers' behaviour is provided by correlational analysis. Spearman's rho correlations were computed separately for observations recorded in intervention and control classrooms.

Teachers of control classes showed strong positive associations between shallow probes and contextualising behaviours ($r_s = .86$ $p < .01$) and acknowledgement and contextualising behaviours ($r_s = .73$ $p < .01$). The different pattern of associations for intervention teachers, suggests that teachers made changes to their thinking and their behaviour regarding how they manage lessons that include group work. Intervention teachers showed four strong positive associations, displayed in Table 7.4, which may suggest the integration of different skills, skills that are conceivably related to the teaching of the group work programme.

Table 7.4

Significant associations between the observation categories used to record intervention teachers' behaviour

		1	2	3	4
1	Deep probe	-	$r_s = .69$ $p < .05$	$r_s = .75$ $p < .05$	$r_s = .82$ $p < .01$
2	Contextualise		-	$r_s = .45$, ns.	$r_s = .54$, *ns.*
3	Acknowledge			-	$r_s = .75$ $p < .01$
4	Fully attend				-

7.2.4 Lesson transitions

These analyses signal that the intervention teachers were able to manage lessons enabling them to accommodate adequate conclusions. An additional source of information that describes teachers' behaviour relates to their management of lessons and the number of transitions they include. Study 1 suggested that the examination of such data would be potentially informative. Within Study 2 a change in teacher behaviour is clearly apparent when the reduced the number of transitions made during intervention lessons (Mdn = 7, IQR = 1) are examined in comparison to control classrooms (Mdn = 9, IQR = 2.5) (Kolmogorov Smirnov Z = 1.73, $p < .01$, $r = .14$). This finding also gives an additional indication that the teachers had adjusted their teaching and learning approach to match the expectations laid out in the project guidelines. To establish the influence of such change upon classroom interaction, pupil behaviour recorded in both intervention and control classrooms will be analysed.

7.3 Analysis of pupil behaviour

The mean frequency of observations, formed by summing across the separate school visits were compared using independent t-tests. For all significant comparisons, effect sizes based on r^2 were computed and have been added to Table 7.5. Computation of such effect sizes helps to support the relationships suggested by the analyses.

Table 7.5

Mean frequency of observation variables used to record pupil behaviour in intervention and control classes (SD in parentheses)

	Intervention n=37	Control n=38	Significance
Interaction			
Working alone [a]	1.45 (2.04)	3.42 (2.53)	t (70.51) = 3.71, p < .01, r^2 = .40
Own group	6.35 (2.08)	4.31 (2.49)	t (73) = 3.85, p < .01, r^2 =.41
Outside of own group	0.18 (0.43)	0.27 (0.55)	t (73) = 0.77, ns
+Teacher [a]	1.75 (2.24)	0.34 (0.48)	t (39.19) = 3.74, p < .01, r^2 = .51
Group set up			
Alone [a]	0.05 (0.23)	0.49 (1.15)	t (39.99) = 2.29, p < .05, r^2 = .22
Group [a]	6.42 (1.94)	4.44 (2.64)	t (67.99) = 3.7, p < .01, r^2 = .41
Whole-Class	1.51 (1.96)	3.07 (2.45)	t (73) = 3.04, p < .01, r^2 = .34
Activity level			
On	7.09 (1.41)	6.6 (1.6)	t (73) = 1.39, ns
Off	0.54 (1.00)	0.43 (0.86)	t (73) = 0.51, ns
Task Prep [a]	0.38 (0.93)	0.87 (1.43)	t (63.83) = 1.76, ns
Dialogue			
Inform [a]	1.44 (0.99)	0.65 (0.58)	t (57.87) = 4.17, p < .01, r^2 = .48
Ask	1.00 (0.77)	0.59 (0.74)	t (73) = 2.37, p < .05, r^2 = .28
Resolve	0.47 (0.55)	0.38 (0.58)	t (73) = 0.69, ns
Other	0.58 (0.68)	0.5 (0.86)	t (73) = 0.46, ns

a indicates that test statistics accounting for unequal variances are reported.

From Table 7.5, it is apparent that there was a clear divide between the two class types. Pupils in the intervention classes behaved differently from pupils in the control classes.

Interaction was rarely observed in control classes, as the majority of pupils worked by themselves, in accordance with their allocated task. In contrast, pupils in the intervention classes interacted with their peers in order to complete their group-based activities. A separation was also evident regarding the volume of teacher and pupil interaction. Teacher and pupil interaction was more frequent in the intervention classes; the large standard deviation suggests variability in this type of interaction.

Similar frequencies were evident regarding the level of on and off task behaviours for both class types. Although intervention pupils appeared to be quicker in setting up and preparing themselves and their equipment, this difference was not found to be significantly different. The final section of Table 7.5 indicates that two of the three dialogue categories were more frequently observed within intervention classes. By examining the overall frequency of observed behaviour, it is evident that there was a separation between the different class types. Pupils in the intervention classes interacted and completed the tasks in accordance with the demands made by the group work activities.

In order to clarify the impact of the intervention, and to help verify whether pupils showed variance in their behaviour during the intervention, pupils' behaviour was examined in finer detail. A two-way mixed ANOVA compared the frequencies of each of the observation categories according to time (three class visits) and class type (intervention or control), where appropriate contrasts were computed and are presented as follow up analyses. Figures are presented to help explain significant differences.

7.3.1 *Pupil Interaction*

Significant interactions between the time that observations were recorded and class type were evident for three of the variables that form the interaction sub -section of the observation schedule. Whether pupils completed tasks by themselves (F (2, 62) = 5.01, p < .01, η^2 = .14), with their group (F (2, 62) = 5.17, p < .01, η^2 = .14) and whether pupils received assistance from their teacher (Wilks Lambda = .58, F (2, 30) = 10.99, p < .01, η^2 = .42) showed variability over the time course of the intervention. A significant quadratic contrast was detected when the mean frequency of the observation category working alone was compared with time (F (1, 31) = 4.20, p < .05, η^2 = .12). A trend in intervention pupils' behaviour is evident as they increased the extent to which they worked alone during each observation visit. Pupils in control classes showed behaviour that is more consistent in the first and third class visits, whereas during the second there was a decrease in the extent to which they worked alone (see Figure 7.2).

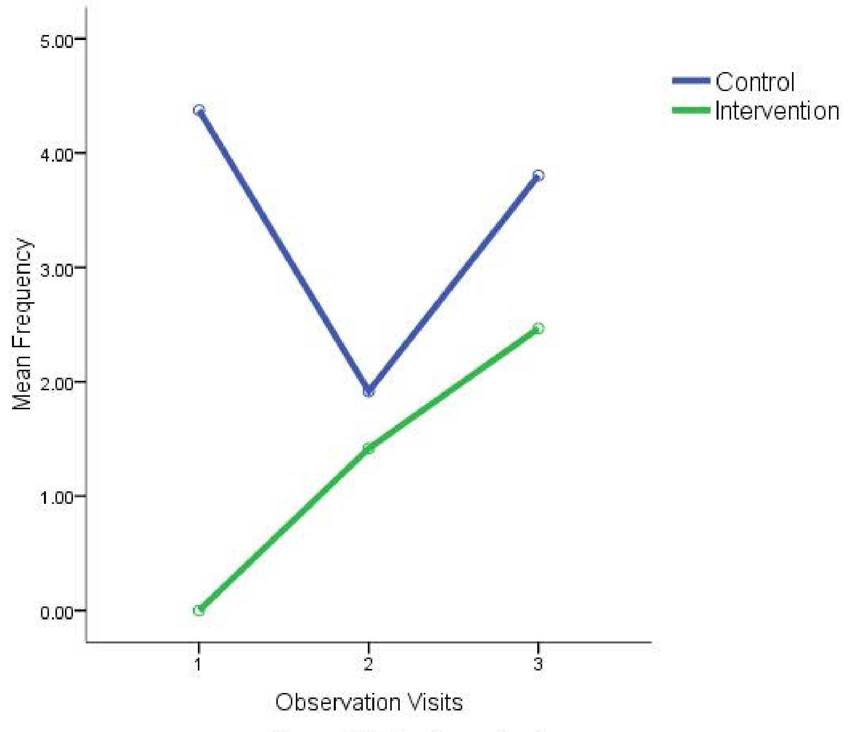


Figure 7.2 Pupil behaviour "Working alone" across observation visits by type of lesson

A quadratic trend was also significant regarding interaction in groups (F (1, 31) = 5.09, p < .05, η^2 = .14). Intervention pupils showed a slight reduction in the extent to which they worked in groups (see Figure 7.3). Pupils in control classrooms showed an uneven trend, with a higher mean frequency evident during the second classroom visit whereas equivalent means were observed during the first and third visits.

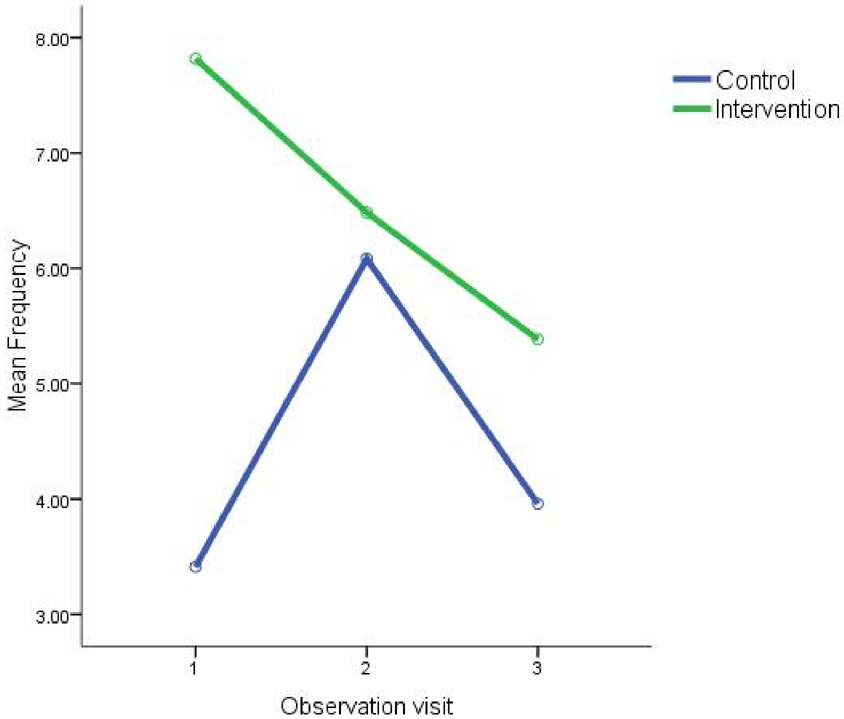


Figure 7.3 Pupil behaviour “engaged with own group” across observation visits by type of lesson

A linear trend was significant when the extent of teacher and pupil interaction was considered (F (1, 31 = 19.49, p < .01, η^2 = .39). Comparable means were observed regarding this form of interaction within the control classrooms (see Figure 7.4). Intervention pupils received the most assistance during the first observation visits and the frequency of this type of interaction tailed out over the course of the intervention, approximating that observed in control classrooms.

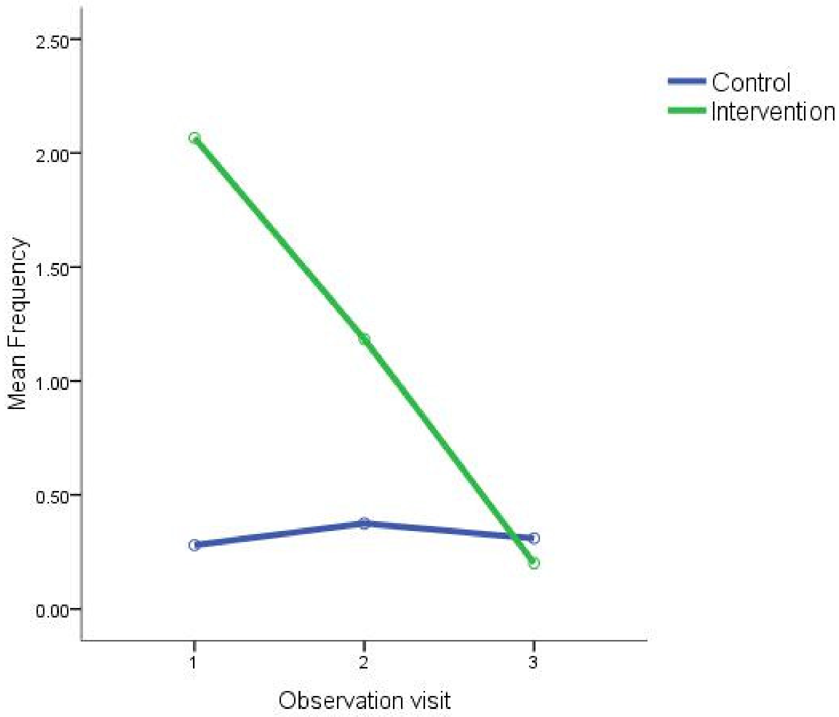


Figure 7.4 Pupil behaviour "Teacher involved in the interaction" across observation visits by type of lesson

7.3.2 Group Set Up

A main effect of class type (F (1, 31) = 5.34, $p < .05$, $\eta^2 = .15$) in relation to the allocation of tasks that pupils ought to complete individually was consistent with the findings observed using the overall means. The allocation of tasks that pupils ought to complete individually varied between the control and interaction contexts: the quadratic contrast (F (1, 31) = 5.13, $p < .05$, $\eta^2 = .14$) was based on the observation that individual tasks were not allocated to pupils in intervention classes in contrast to control classrooms.

The use of group seating within control and intervention classrooms varied over the course of the intervention (Wilks Lambda = .75, F (2, 30) = 5.12, $p < .05$, $\eta^2 = .25$). A linear trend (F (1, 31) = 4.33, $p < .05$, $\eta^2 = .12$) indicated a decrease in the extent of group working arrangements being used in intervention classrooms (see Figure 7.5).

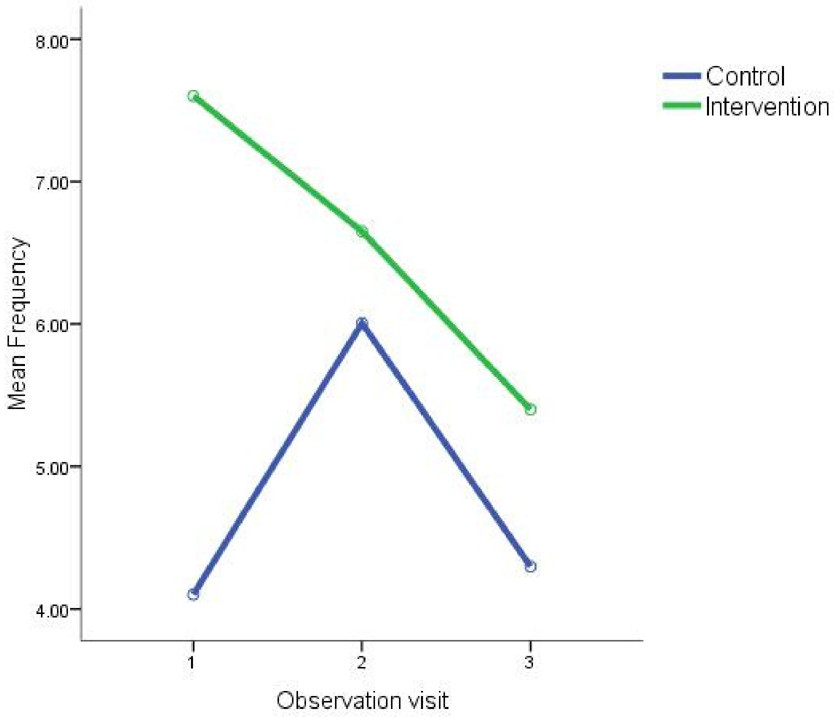


Figure 7.5 Group arrangement "Seated in groups" across observation visits by type of lesson

The extent to which whole-class seating was employed in either class type was also found to differ ($F(1, 31) = 4.53$, $p < .05$, $\eta^2 = .13$) indicating that control teachers employed whole-class working arrangements more regularly than intervention teachers. Although significant trends were not detected when contrasts were applied, an increase (albeit slight) in the use of whole-class approaches within intervention classes is apparent when Figure 7.6 is examined.

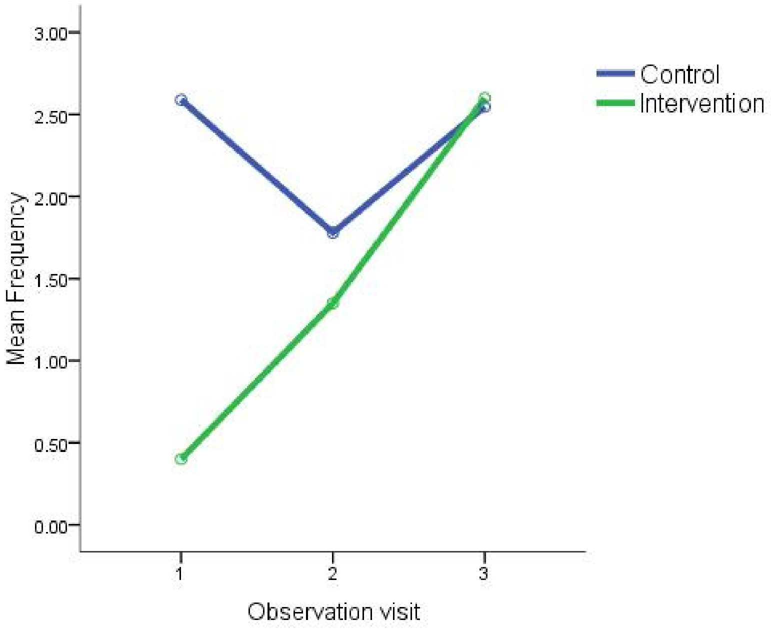


Figure 7.6 Group arrangement "Seated in whole-class layout" across observation visits by type of lesson

7.3.3 Activity level and Dialogue

Analyses examining the activity level of classes did not find significant differences when comparisons were made using data collected during the separate visits. Significant main effects of class type were evident regarding two dialogue variables, inform ($F\ (1, 31) = 5.63$, $p < .05$, $\eta^2 = .15$) and ask ($F\ (1, 31) = 6.91$, $p < .01$, $\eta^2 = .18$). Intervention pupils were observed to produce more dialogue behaviours than their counterparts in control classes during each of the three class visits, including the second visit where pupils in control classes produced the greatest frequency of dialogue behaviours (see Figures 7.7 and 7.8). Therefore engaging in a group work programme for a sustained work period may enable pupils to strengthen their skills.

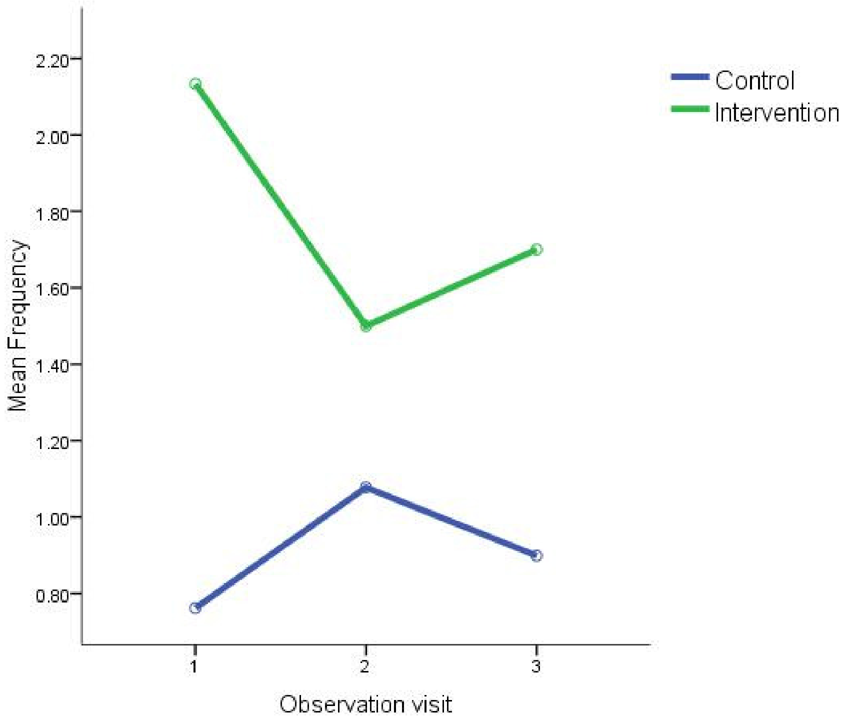


Figure 7.7 Pupil dialogue "Giving explanations" across observation visits by type of lesson

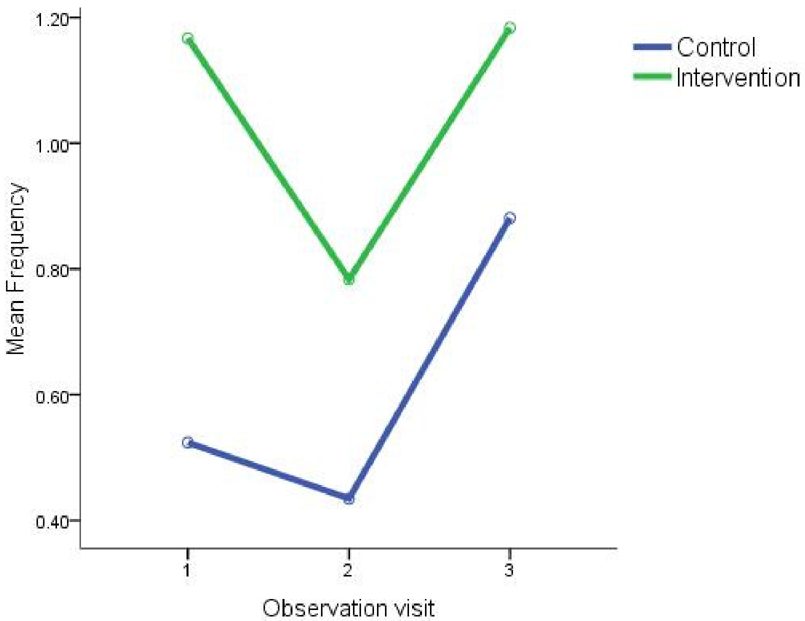


Figure 7.8 Pupils ask questions and/or seek help

7.3.3.1 Summary of pupil behaviour

Throughout Study 2, intervention pupils showed variability regarding their interaction with peers. Intervention pupils took time to adjust to the demands of the group work activities. During Study 2 pupils took increasing amounts of time to think about their contribution to group work discussion, and the findings indicate that this reduced the class time available to them to complete their group-based tasks. However, the frequency of dialogue behaviours remained constant, suggesting that pupils effectively used the time they had when they worked in groups with their peers. Similarly, these results suggest that the dialogue produced by intervention pupils surpassed that produced in control classrooms when control pupils were engaged in interaction with their peers.

An outcome of the intervention was, therefore, changes in the rate and pace of pupil and teacher interaction. Whether there are consequences of such developments in classroom interaction in relation to the social climate of the classroom will be considered in the subsequent section.

7.4 Analysis of sociometric ratings

This section will document the findings from the two types of sociometric measures that were employed.

7.4.1 Analysis of ratings given by pupils

One school objected to the use of a sociometric peer-rating instrument explaining they were uncomfortable with pupils completing such measures on two separate occasions. Therefore one intervention and one control class - within the same one school - completed the peer rating measure.

Analysis of covariance was performed on three of the four measures derived from pupils' responses to the peer rating measure. Preliminary checks were conducted to assess two specific assumptions regarding the suitability of analysis of covariance with the data set. The linearity of each dependent variable when plotted against the covariate, separately for each level of the independent variables, was checked using scatter plots. Lines of fit for each level of the independent variables were added to verify that the assumption was not violated. The homogeneity of regression slopes was checked by verifying that a non-significant interaction was present between the covariate with each level of the independent variables. However, the homogeneity of regression slope assumption could not be satisfied when checks were made regarding negative peer ratings – therefore inferential analyses for this dependent variable were not performed.

Analysis of covariance, where pre-test scores formed the covariate for each of the measures, was used to compare the post-test scores of intervention and control pupils, including whether effects varied according to pupils' gender. Analyses on the number of positive and neutral ratings found no significant differences aside from the covariates. Analysis on pupils' mean social distance ratings indicated that the pre-test was a significant covariate and reported a main effect of class type. The means for each dependent variable taken at the pre- and post-test times are presented in Table 7.6.

Table 7.6

Overview of ANCOVA analyses performed for each sociometric dependent variable (SD)

	Mean Social Distance	Number of Positive ratings	Number of Neutral ratings	Number of Negative ratings
	Pre			
Intervention	3.49 (0.43)	11.05 (4.90)	5.6 (5.1)	2.35 (2.5)
Control	3.39 (0.42)	9.45 (3.85)	7.15 (3.2)	2.35 (2.13)
	Post			
Intervention	3.78 (0.45)	12.8 (5.16)	4.2 (4.5)	1.45 (1.28)
Control	3.28 (0.93)	9.95 (5.56)	5.8 (4.61)	2.25 (2.53)
Covariate	F (1, 35) = 7.16, p < .01, η^2 = .17.	F (1, 35) = 18.09, p < .01, η^2 = .34.	F (1, 35) = 25.56, p < .01, η^2 =.42.	-
Class Type	F (1, 35) = 5.01, p < .05, η^2 = .13.	F (1, 35) = 1.76, ns.	F (1, 35) = .24, ns.	-
Gender	F (1, 35) = 1.06, *ns.*	F (1, 35) = 2.75, ns.	F (1, 35) = .03, ns.	-
Class type* Gender	F (1, 35) = 1.36, *ns.*	F (1, 35) = .17, ns.	F (1, 35) = .27, ns.	-

Note. Dashes indicate the category did not meet test assumptions

As the negative ratings given by pupils did not meet the assumption of the ANCOVA, they are presented in Figure 7.9. Study 1 indicated that gender influenced some of the pupils' sociometric ratings. Therefore, ratings given by male and female pupils are presented separately in Figure 7.9 according to whether they participated in control or intervention classrooms. In general, male and female pupils appear to differ in the extent to which they received negative ratings. Male pupils experiencing the intervention received a similar low level of negative ratings while studying the topic area; although their control counterparts also showed a drop in the number of negative ratings received, this approximated but did not reach that reported by pupils from the intervention sample. Female pupils show diverging patterns. The number of negative ratings attributed to female control pupils rose slightly while studying the topic area yet female pupils in intervention lessons showed a dramatic decrease with much lower ratings being given at the post-test.

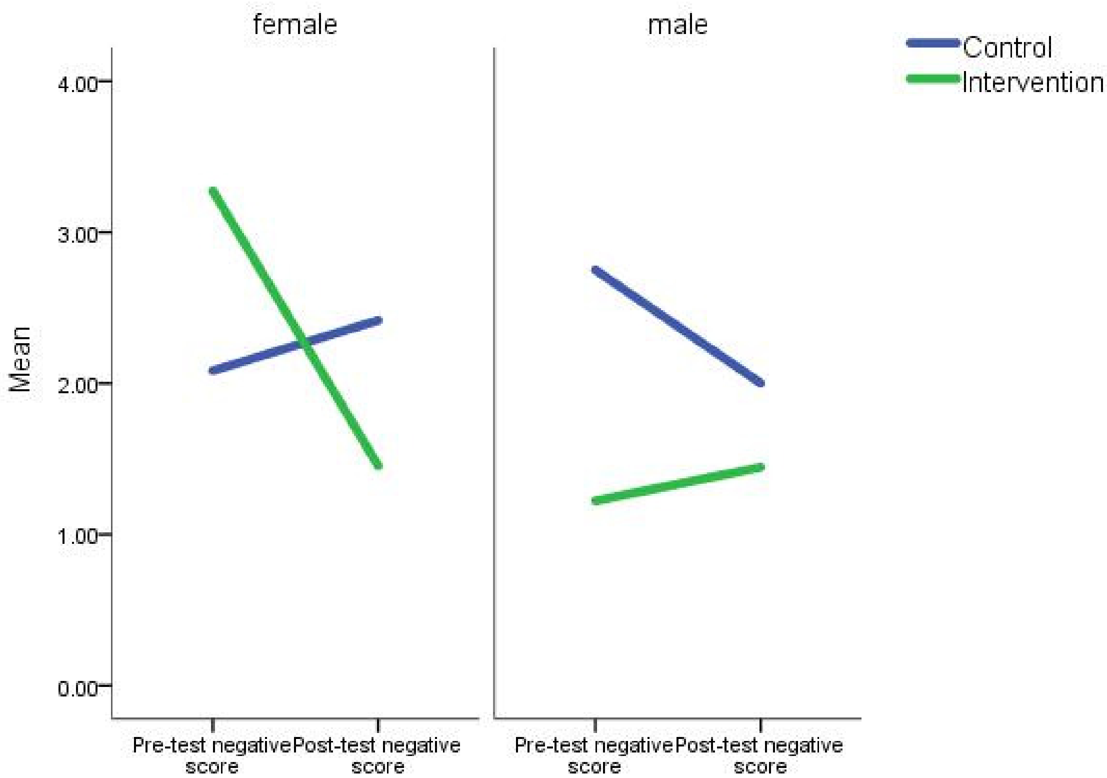


Figure 7.9 Comparison of pre-post sociometric negative ratings given by Control and Intervention pupils

7.4.2 Analysis of ratings given by teachers

Teachers were asked to report the number of positive interactions that pupils experience with lower scores (ranging from 1-5) indicating fewer positive interactions. Teachers completed this measure in the same week as pupils completed the pre- and post-tests. On the basis that a scale of 1-5 can be treated as interval data (Byrne, 2001) analysis of covariance, where pre-test scores formed the covariate for each of the measures, was used to compare teachers' post-test scores. The covariate, pre-test rating, was significantly related to teachers' post-test rating (F (1, 71) = 28.04, p < .01, η^2 = .28). There was also a main effect of class type on the post-test rating after controlling for the ratings given at the pre-test (F (1, 71) = 10.5, p < .01, η^2 = .13). The pre- and post-test ratings given by intervention and control teachers are presented in Figure 7.10.

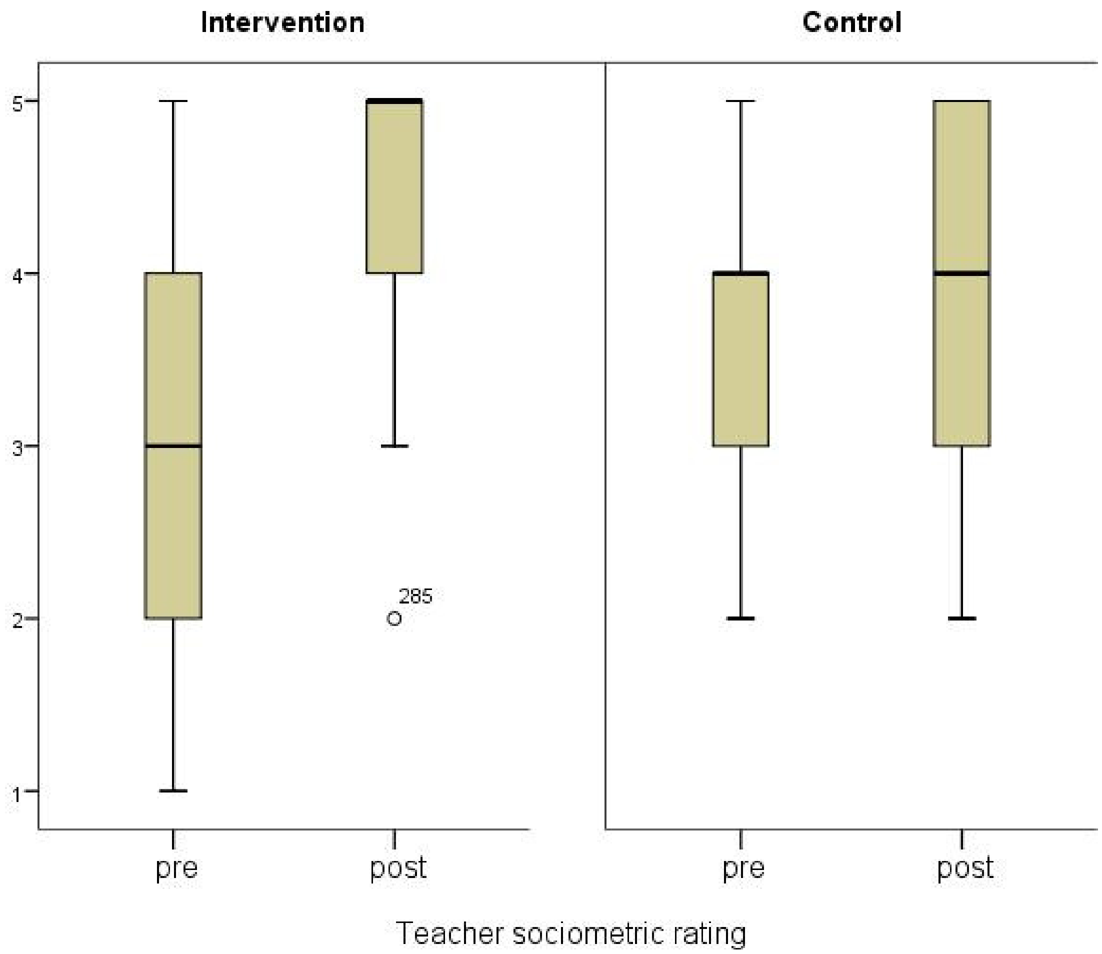


Figure 7.10 Comparison of pre- and post-test sociometric ratings given by Intervention and Control teachers

A trend is apparent when the ratings in Figure 7.10 are compared. It is clear that intervention teachers showed greater progression in their pre- to post-test ratings than their control counterparts. That pre-test ratings were included in the analyses as a covariate, and found to be a significant contributor, helps to contend with possible issues, for example that control teachers' avoidance of assigning the lowest rating (1) to pupils at the pre-test contributed to the differences evident between teachers' ratings.

The findings indicate that the intervention strengthened the productive nature of classroom interaction and enabled teachers to incorporate specific features into the classroom dialogue prior to and following group work. The analyses have so far compared pupils participating in the intervention with their control counterparts, whereas the following section will focus exclusively on intervention pupils to assess the impact on pupils' recollection of the discussion held with peers whilst working in groups.

7.5 Pupils' recall of content discussed in groups

The purpose of this exercise was to examine pupils' ability to recall content discussed by their group, signifying the value that pupils assign to group work (that is pupils can only reflect on ideas expressed during group discussion if they retain what was said). Six of the 14 activities available in the pupil booklet (one of which "Diffusion" can be seen in Figure 6.3 in Chapter 6) were selected for inclusion within the recall tests. Each activity asked pupils to record their group discussion onto the worksheets in two ways, noting suggestions made in their group and to identify the single explanation the group agreed best answered the question. The post-test used ten questions worded using language similar to that presented on the group worksheets. Each item asked pupils to recall explanations given by their group.

However, the execution of the approach detailed in the previous paragraph encountered problems as one teacher omitted two activities that had been selected for inclusion within the recall tests. Although pupils from the second intervention classroom provided adequate responses to questions for one of these activities (Balloon's going up) they failed to provide responses for the second activity (Catalyst). Thus so that an adequate data set was obtained analysis based on five activities will be presented, where pupils' responses come from both intervention classes. A second problem arose in that insufficient data were collected to examine pupils' recollections to determine whether pupils could recall the single explanation their group agreed best answered the question. Consequently, an additional category was added to the classification scheme used to code responses. The nature of the classification scheme focused on the content recorded during discussion and the content recalled later by pupils at the post-test. This included the nature of responses – whether they related to practical or scientific aspects. Each category distinguishes between different types of coding, presented within Table 7.7.

Table 7.7

Classification scheme used to code pupils' responses to recall items

	Categories
Relationship between responses recorded at separate collection times	
1	No content recorded in pupil booklet
2	Content recorded in booklets omitted at post-test
3	Post-test explanation not related to content recorded in group work booklet
4	Post-test explanation related to content recorded in group work booklet
Scientific nature of response	
5	Macro (explanation based on observation of practical class activity)
6	Molar (scientific explanation)
7	Macro and Molar (Both)
Validity of pupils' answers to questions	
8	Multiple explanations given at post-test

7.5.1 Initial Screening

Pupils' individual contributions were combined with responses from other members of their group to generate a set of answers per group, which allowed initial screening. Checks were made to ensure that a minimum of 75% of pupils from a group completed the measure, to ensure an accurate data set. Responses to the seven questions have been classified with the first four codes and are graphed in Figure 7.11. The relative proportion of each code is presented separately for each activity and indicates there are sufficient data suited to further analysis.

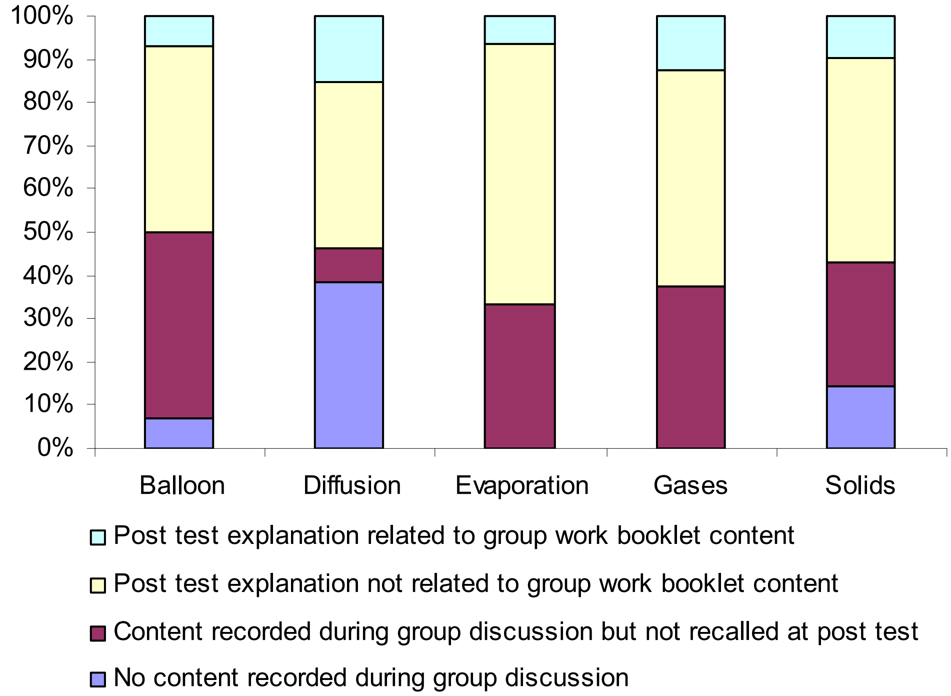


Figure 7.11 Groups' recall of classroom discussion, content coded and presented separately for each activity

Groups seem to revise their explanation to questions, with few answers given at the post-test that expand on content recorded during class time. To some extent, this was anticipated based on the expectation that pupils would reflect on such content and in doing so alter it. The frequency of such behaviour was far greater than the number of post-test answers that were related to groups' classroom discussions. Yet such interpretation needs to be tentative, considering that group members were not always diligent in recording group discussion within three of the five activities. An example of coding assigned to pre-to post- test responses is provided in Table 7.8. This example helps to outline how the three sections of the classification scheme were used.

Table 7.8

Example of coding applied to content recorded at the pre-and post-test

Solids Q3: Does water undergo a chemical change as it boils?		
Pre-test	Post-test	Coding
No it doesn't because the particles are just separating. So therefore it is still H_20.	No because it is just natural not chemical	Post-test explanation related to content recorded in group work booklet Molar-Molar Single post-test explanation

7.5.2 Examining the nature of pupils' recollection

The following section will consider contributions made by individual pupils by examining their scientific nature and classify them with the second set of categories. Pupils' responses recorded during group work (time 1) were compared with answers given by pupils at the post-test (time 2). Mutually exclusive coding was applied – that is a response could only be assigned one of the three possible codes, for example this means that "Both" functions as a separate category signifying a response containing molar and macro explanations. Had pupils made more attempts to record details of their group discussion in their class booklet, a test of marginal homogeneity or McNemar-Bowker test of internal symmetry may have been more appropriate, when post-test responses could have been classified in relation to pupils' group discussion with greater accuracy. Main analyses were restricted to those pupils for whom pre- and post-test data were available. The strength and significance of the association between these nominal variables was calculated with Cramer's V and are presented in Table 7.9.

Table 7.9

Overview of pupils' responses to recall items between completion times

	n	Cramer's V
Balloon all ideas	4	-
Single idea	3	-
Diffusion	18	Cramer's V = .59, $p < .01$
Evaporation all ideas	30	Cramer's V = 1.0, $p < .01$
Single idea	11	-
Gases	37	Cramer's V = .37, $p < .05$
Solid Q1	31	Cramer's V = .31, *ns*
Solid Q2	36	Cramer's V = .43, $p < .05$
Solid Q3	33	Cramer's V = .55, $p < .01$

Note. Dashes indicate the category did not meet test assumptions

Associations between pupils' responses show moderate to substantial correlation coefficients. Five relationships are evident between pupils' written report of their discussion and their recollections of its content. These equations were reached by comparing the coding assigned to pupils' responses recorded during class time with that recalled during the post-test. The significant relationships were given further consideration by examining their content in a series of graphs that plot responses made by pupils during class time and at the post-test.

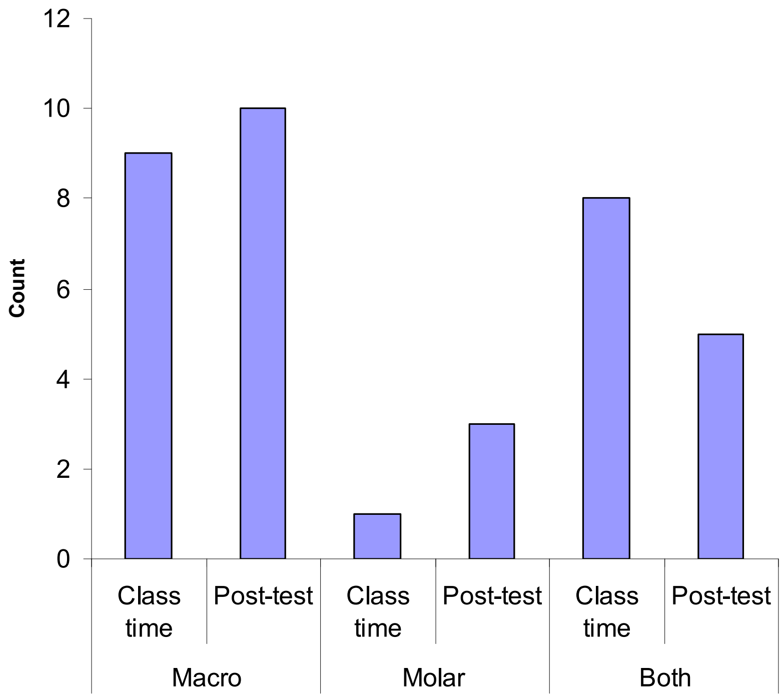


Figure 7.12 Comparison of pupils' pre- and post-test responses to the diffusion recall item

Pupils' responses to questions concerning the diffusion activity showed clear patterns (see Figure 7.12). Similar quantities of responses given during class time were assigned Macro and Both codes, whereas fewer post-test responses were coded as having recalled both aspects. An increase was detected in the number of Molar responses given during class time and later during the post-test.

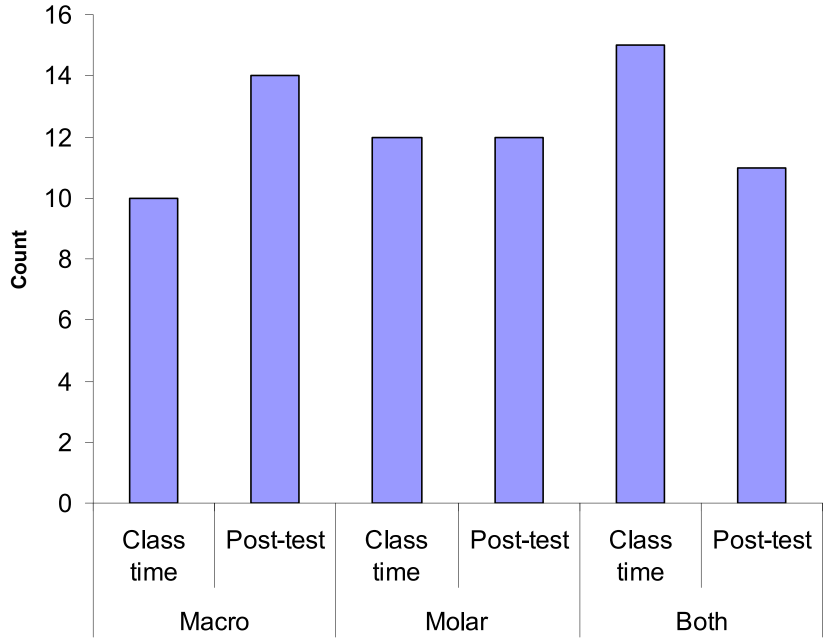


Figure 7.13 Comparison of pupils' pre- and post-test responses to the gases recall item

Pupils' responses to questions investigating the gas activity are presented in Figure 7.13. The number of responses given during class time and at the post-test that were coded as Molar were consistent, thus the increase in macro responses occurred at the expense of responses coded as including both forms of scientific explanation, which showed a decrease between the two testing periods.

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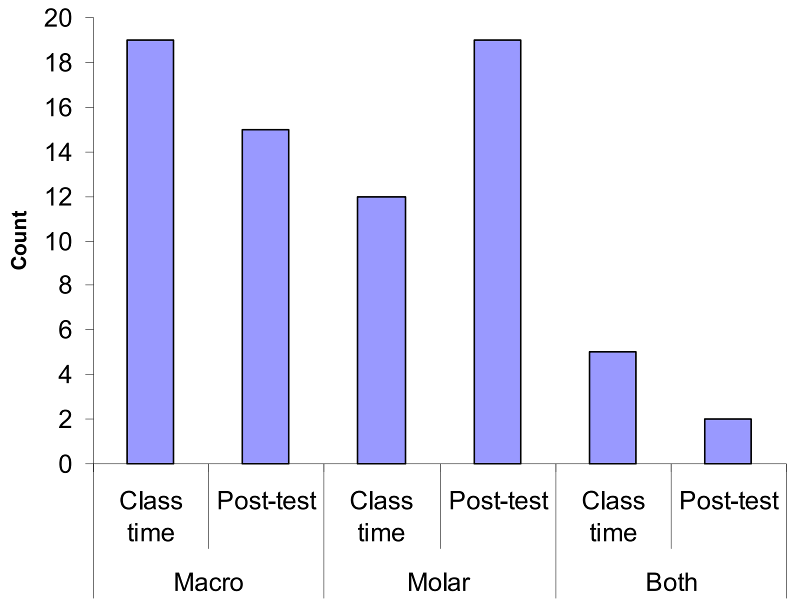

Figure 7.14 Comparison of pupils' pre- and post-test responses to the second recall item investigating solids

A trend was observable in pupils' responses to the second question investigating the activity of solids (Figure 7.14). The number of responses coded as Molar showed an increase at the post-test, this was in contrast to a reduction evident in responses assigned macro and both codes. In comparison to the quantities evident in the previous two figures, a much smaller quantity of responses that included both types of scientific explanation is evident.

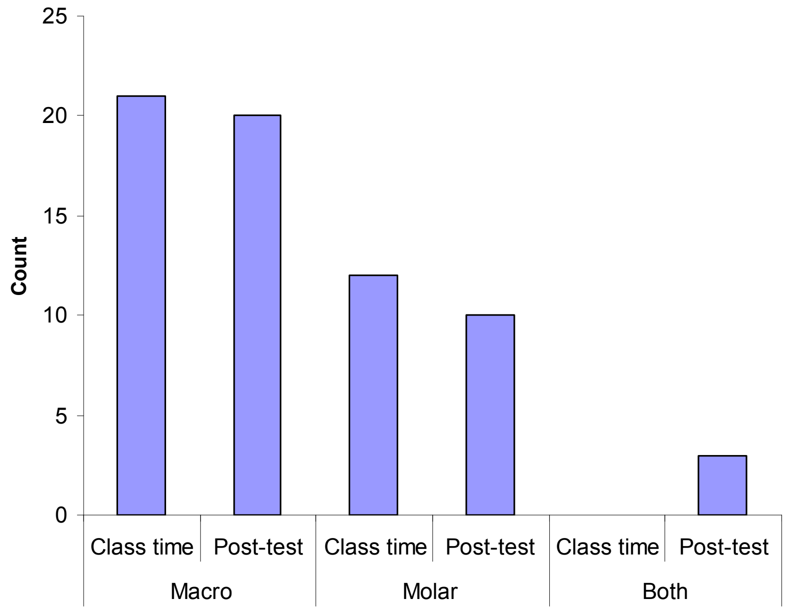

Figure 7.15 Comparison of pupils' pre- and post-test responses to the third recall item investigating solids

Pupils' responses to the third question examining the solids activity are presented in Figure 7.15. The majority of responses given during class time and within pupils' post-test responses were assigned macro codes. A slight decrease was evident in the number of molar responses, whereas responses including both forms of scientific explanation only appeared during the post-test.

By themselves, these figures begin to elucidate the relationships evident between pupils' recollections of group discussion. Also informative are the number of explanations given by pupils at the post-test, which were examined to explain the findings relating to whether pupils' recall consisted of multiple or single ideas. Pupils were prompted within each post-test question to recall all ideas discussed within their group or provide the single explanation agreed by their group. Whether pupils could comply with this instruction is of interest – currently it is uncertain whether pupils remember how a group decision was arrived at - in other words pupils may retain the most appropriate explanation at the expense of the other content that was discussed.

The number of occasions when pupils provided either a single response or more than a single response is presented within Table 7.10. Responses from 36 pupils were obtained yet rarely were multiple answers provided. Therefore, it is apparent that despite clear and repeated prompts the majority of pupils reported a single explanation.

Table 7.10

Type and frequency of explanations recalled by pupils during the post-test

	Post-test items	Single	Multiple
Balloon	2	34	2
Diffusion	1	36	0
Evaporation	2	31	1
Gases	1	29	7
Solids	3	30	6

This section has considered the association, nature and frequency of responses given by pupils in an attempt to understand pupils' recall of group discussion. Evidence of moderate relationships between what was recorded by pupils during group discussion and what they later recollected was revealed when associations on these statements were calculated. Analysis of the observational data has indicated developments in both teacher and pupil behaviour. To assess the impact of the intervention, analysis of the additional outcomes that were investigated was conducted.

7.6 Impact of the intervention on attainment and questionnaire measures

Table 7.11 displays the number of pupils who completed the different tests according to their class type and testing time.

Table 7.11

Number of pre- and post-tests completed by Intervention and Control pupils at each testing time for the attainment and questionnaire measures

	Academic		Group work Attitude		Science Attitude		Science Self-Perception		MALS	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Intervention	36	34	35	27	35	29	36	30	34	32
Control	37	33	34	34	35	35	35	35	35	34
Total	73	67	69	61	70	64	71	65	69	66

Table 7.11 makes it clear that despite some attrition, the numbers of pupils who completed the pre- and post-tests for each of these measures were comparable. Main analyses were restricted to those pupils for whom pre- and post-test data were available. Preliminary checks of the data set included the assessment of two specific assumptions regarding the suitability of analysis of covariance with the data set. The linearity of each dependent variable when plotted against the covariate, separately for each level of the independent variables, was checked using scatter plots. Lines of fit for each level of the independent variable were added to verify that the assumption was not violated. The homogeneity of regression slopes was checked by verifying that a non-significant interaction was present between the covariate with each level of the independent variables. Analysis of covariance was the preferred method as the pooled within-groups regression coefficient for each variable did not reach 1.0. Had it reached 1.0 an ANOVA on the difference scores would have been preferable (Garson, 2002).

Analyses of covariance, where pre-test scores formed the covariate for each of the measures, were used to compare the post-test scores of intervention and control pupils. Apart from the covariates, the analyses found no significant differences. The means for each dependent variable taken at the pre- and post-test times are presented in Table 7.12.

Table 7.12

Overview of ANCOVA analyses performed for each dependent variable stemming from the attainment and questionnaire measures (SD in parentheses)

	Academic	Group work Attitude	Science Attitude	Science Self-Perception	MALS
	Pre				
Intervention	15.01 (3.78)	24.04 (4.66)	31.14 (4.44)	36.67 (5.75)	71.97 (9.76)
Control	15.54 (3.78)	23.4 (5.04)	30.88 (6.8)	36.44 (7.44)	73.84 (14.1)
	Post				
Intervention	16.26 (4.80)	24.04 (5.93)	30.93 (5.3)	37.2 (6.71)	69.13 (12.12)
Control	16.75 (4.25)	24.4 (5.53)	31.34 (6.08)	36.81 (5.98)	74.03 (13.5)
Covariate	F (1, 74) = 59.38, $p < .01$, $\eta^2 = .45$.	F (1, 53) = 45.45, $p < .01$, $\eta^2 = .46$.	F (1, 57) = 22.9, $p < .01$, $\eta^2 = .29$.	F (1, 59) = 58.94, $p < .01$, $\eta^2 = .50$.	F (1, 59) = 201.06, $p < .01$, $\eta^2 = .77$.
Class Type	F (1, 74) = .18, ns.	F (1, 5) = .54, ns.	F (1, 57) = .19, ns.	F (1, 59) = .03, ns.	F (1, 59) = 3.2, $p < .05$, $\eta^2 = .06$.

Pupils showed similar progression in their understanding of the topic area, held similar attitudes towards science and maintained their perceptions of themselves within science, whilst working in the intervention and control classrooms. Pupils participating in the intervention classes held marginally more positive attitudes regarding group work and marginally more positive perceptions of themselves at the post-test. With the exception of academic self-concept, differences between intervention and control pupils fall short of being statistically significant when the pre-test scores are included in our interpretation of the findings. The variation in intervention pupils' academic self-concept at the post-test is most clearly seen in Figure 7.16.

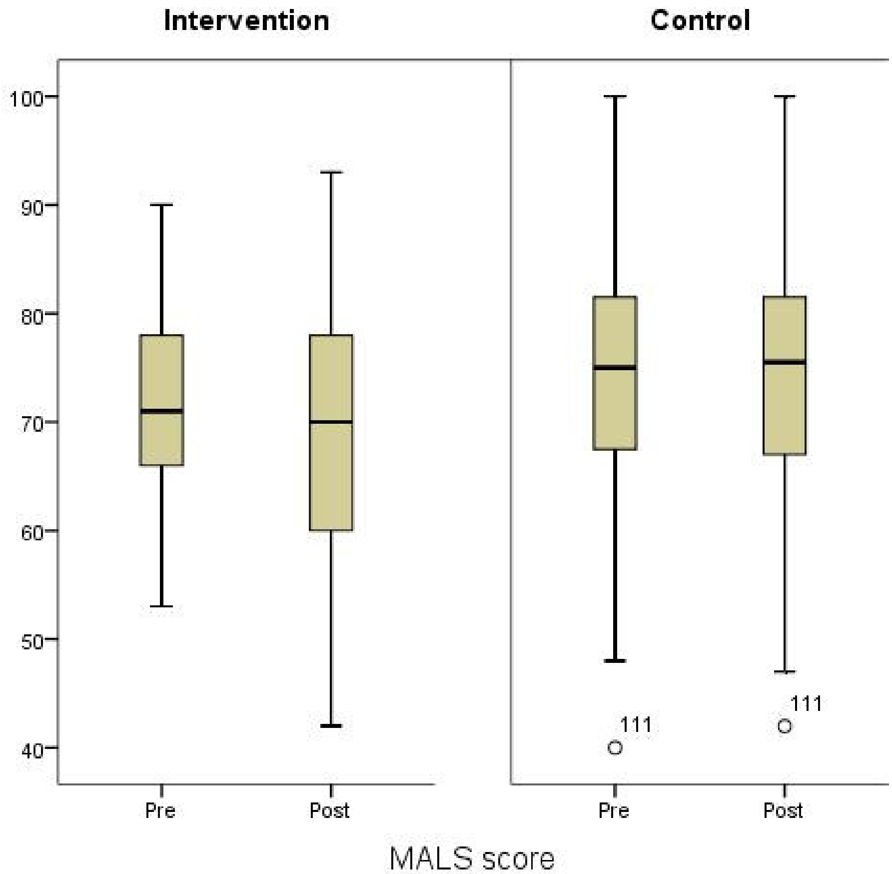

Figure 7.16 Comparison of Intervention and Control pupils pre-and post-test academic self-concept scores

Specific tests, such as the group work attitude scale, could be coded with both a numerical and a nominal value. The ANCOVAs report pupils' total scores, whereas the nominal value assigned to pupils' responses to individual items comprising each test will now be given consideration.

7.7 Analyses of additional items comprising pupil questionnaire measures

The impact of the intervention was also considered in relation to the remaining items that were included within the pupil questionnaire. Measures from which a total score could be extracted have already been considered. Yet the analyses within Study 1 and previous research (Reid & Skryabina, 2002) have indicated that examining pupils' responses to items within these measures can be informative. Additional measures, which did not involve creating a total score, for example, questions that considered pupils' beliefs regarding their classroom environment and the activities they experienced within their science lessons will also be examined. Two forms of inferential statistics were used to analyse pupils' responses. Kendall's tau b accounts for the ordinal nature of the data enabling comparisons to be made between responses given by intervention and control pupils at each test time. Marginal homogeneity tests (extension of the McNemar test suited to ordinal repeated measures data) compares responses given at the post-test to account for the responses given at the pre-test, when appropriate separate analyses were conducted for intervention and control pupils. The resulting output helps to give a clear understanding of changes following from pupils' classroom experience.

Comparisons of pupils' responses to the seven items within the attitude to science measure did not reveal significant differences when comparisons were made between the participant groups at either test time, nor when responses to the post-test were compared with the pre-test responses. Analyses of the eight items comprising the self-perception measures detected two significant differences. At the pre-test, pupils in the intervention and control classroom varied in terms of their enjoyment of practical work with pupils from the control classrooms being more positive about practical work than their intervention counterparts (see Figures 7.17 and 7.18).

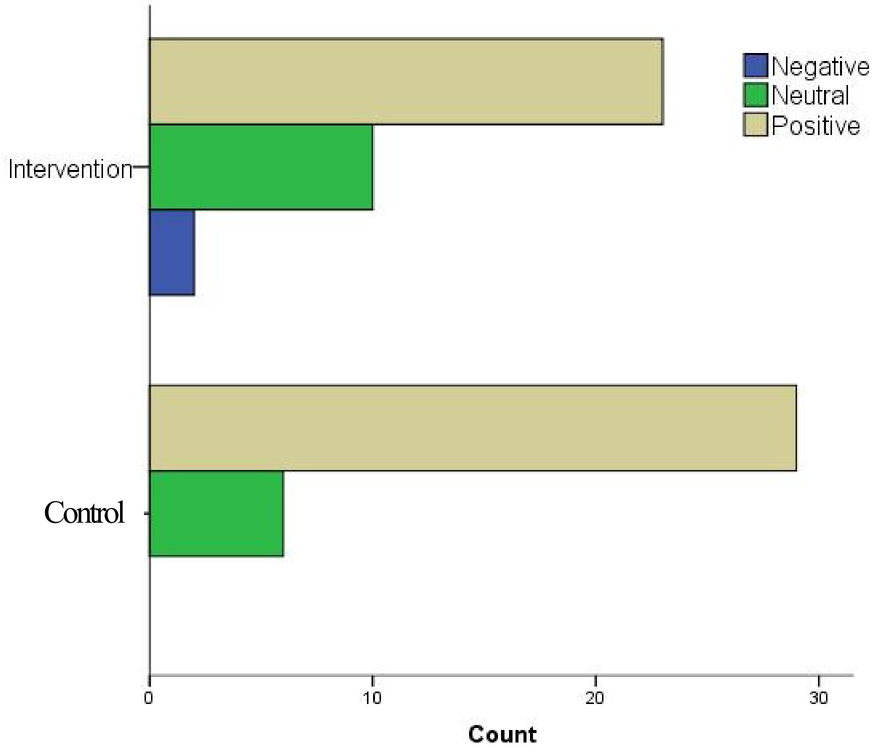

Figure 7.17 Comparison of Intervention and Control pupils' pre-test responses to "I am enjoying practical work" item

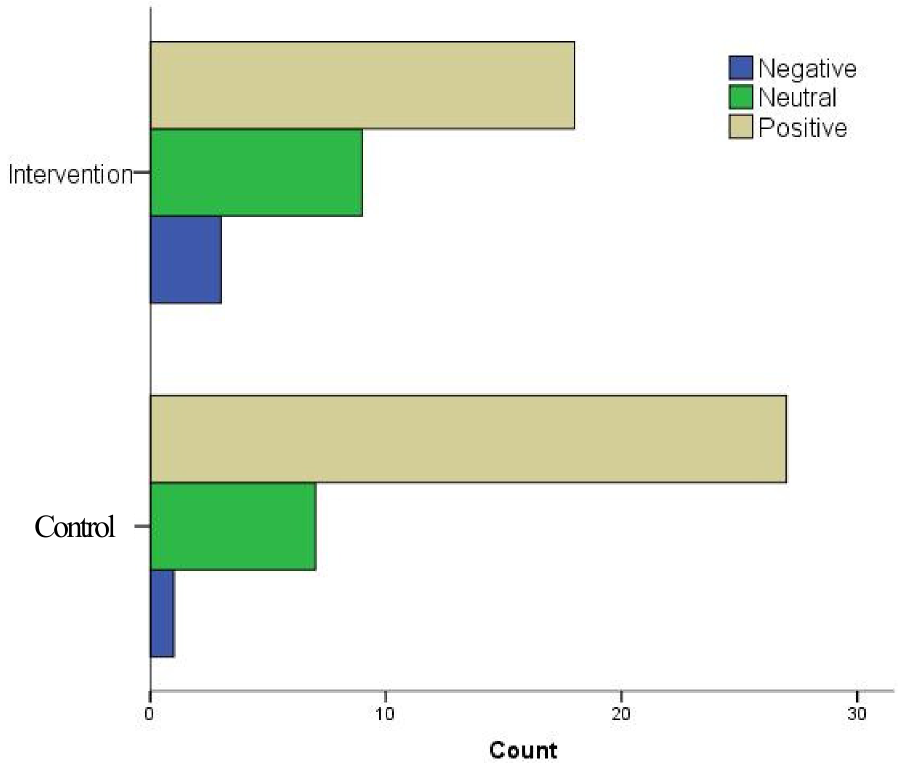

Figure 7.18 Comparison of Intervention and Control pupils' post-test responses to "I am enjoying practical work" item

For the duration of Study 2, pupils from the intervention lessons maintained a highly positive view of the science teacher (see Figures 7.19 and 7.20). In contrast, pupils from the control lessons showed more variability at each test time as to their liking of their science teacher. Although some deterioration is apparent in intervention pupils' post-test responses, evident when Figure 7.20 is viewed, statistically significant differences were not detected when pre-post test comparisons were made.

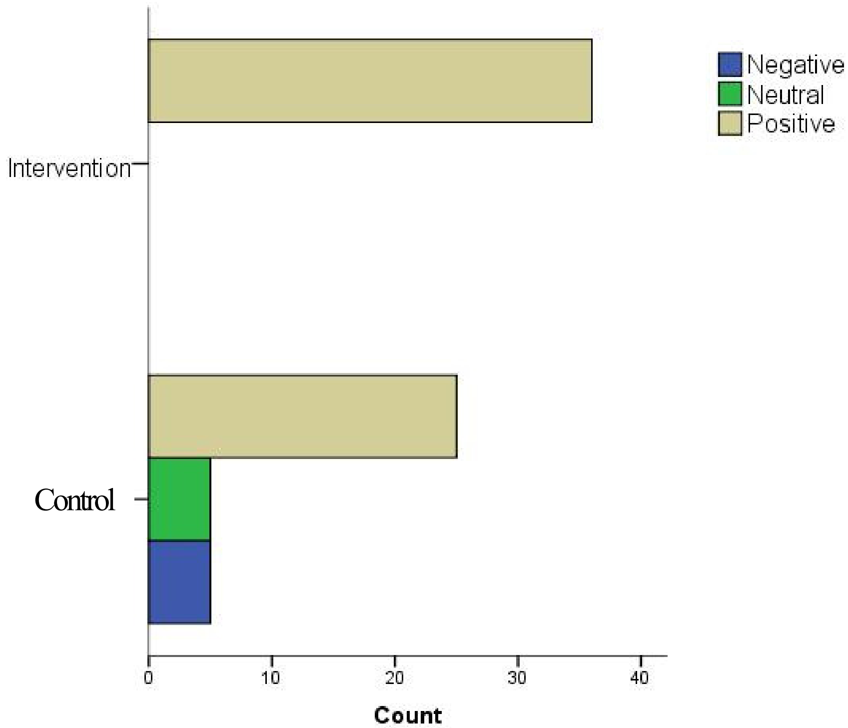

Figure 7.19 Comparison of Intervention and Control pupils' pre-test responses to "I like the teacher" item

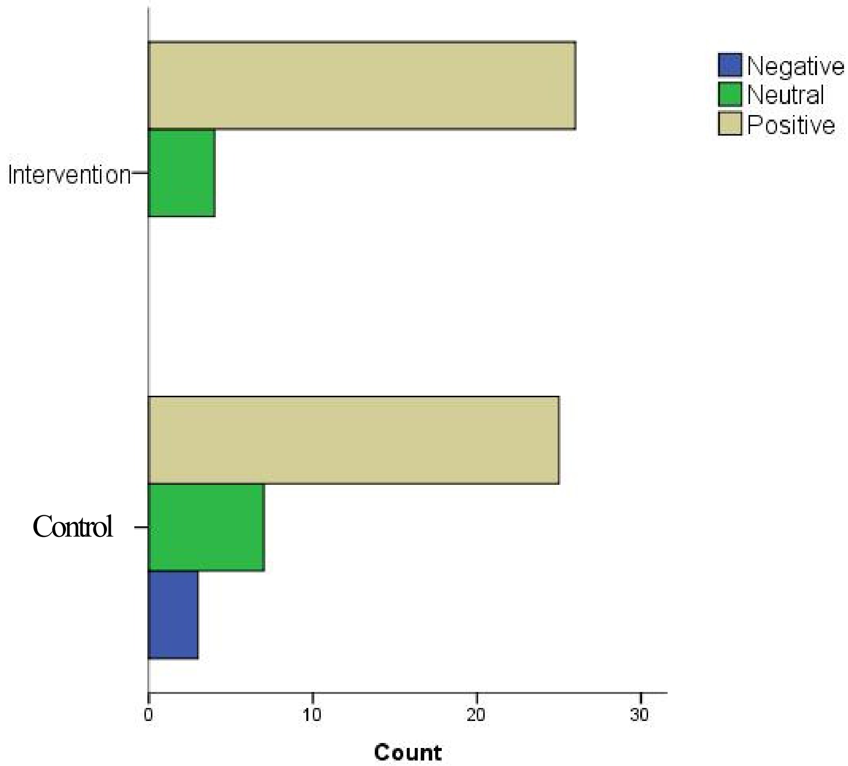

Figure 7.20 Comparison of Intervention and Control pupils' post-test responses to "I like the teacher"

7.7.1 Pupils' perception of their classroom environment

Comparisons of pupils' responses at the post-test revealed that intervention and control pupils held different expectations regarding the learning taking place within lessons. A much higher proportion of control pupils felt that they learned facts consistently within science in comparison to their intervention peers. The significant finding detected by the marginal homogeneity test indicates an upward trend in control pupils' recognition of the factual learning occurring within their Science lessons, reported in Figure 7.21 and Figure 7.22.

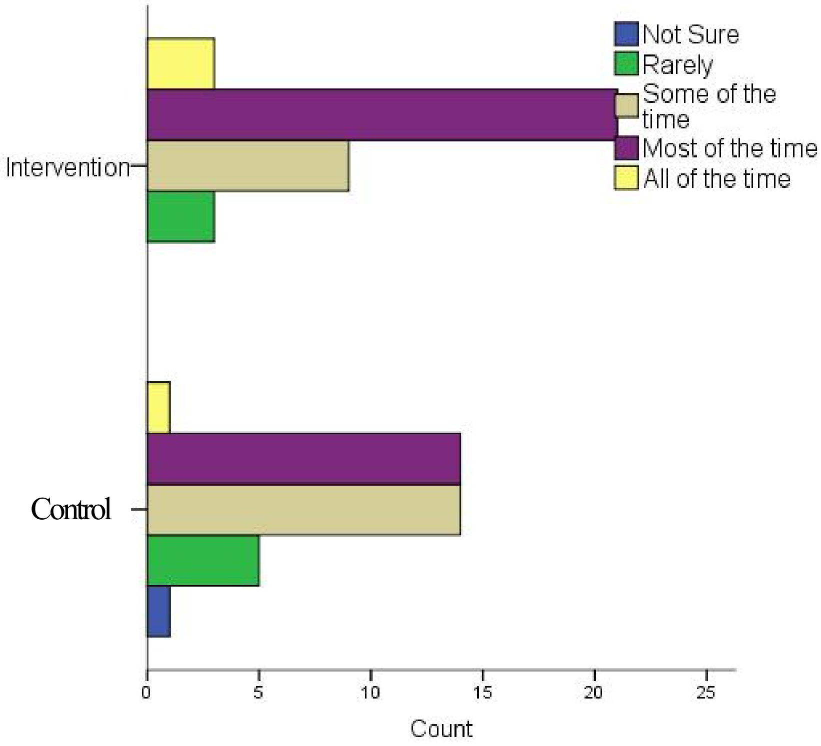

Figure 7.21 Comparison of Intervention and Control pupils' pre-test responses to "We learn a lot of facts in Science" item

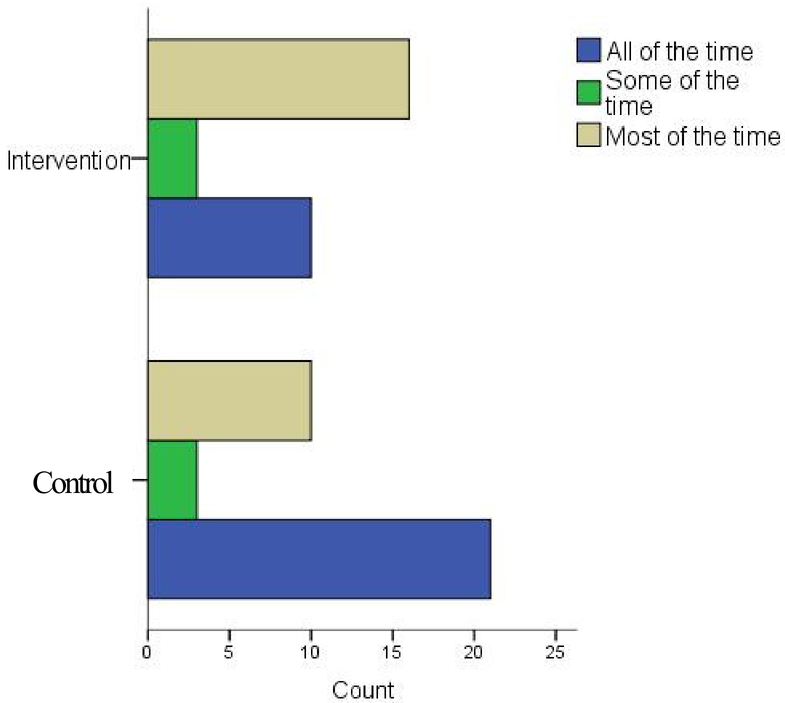

Figure 7.22 Comparison of Intervention and Control pupils' post-test responses to "We learn a lot of facts in Science" item

Significant differences between intervention and control pupils' pre-test responses to a further two items were not sustained during the course of the intervention. A sub-set of intervention pupils at the pre-test felt they were rarely prompted to give developed answers to questions (see Figure 7.23) but their post-test responses (see Figure 7.24) indicate that they were encouraged to do so within their science lessons more frequently. The non-significant marginal homogeneity comparison indicates that similar distributions were present in pupils' post-test responses.

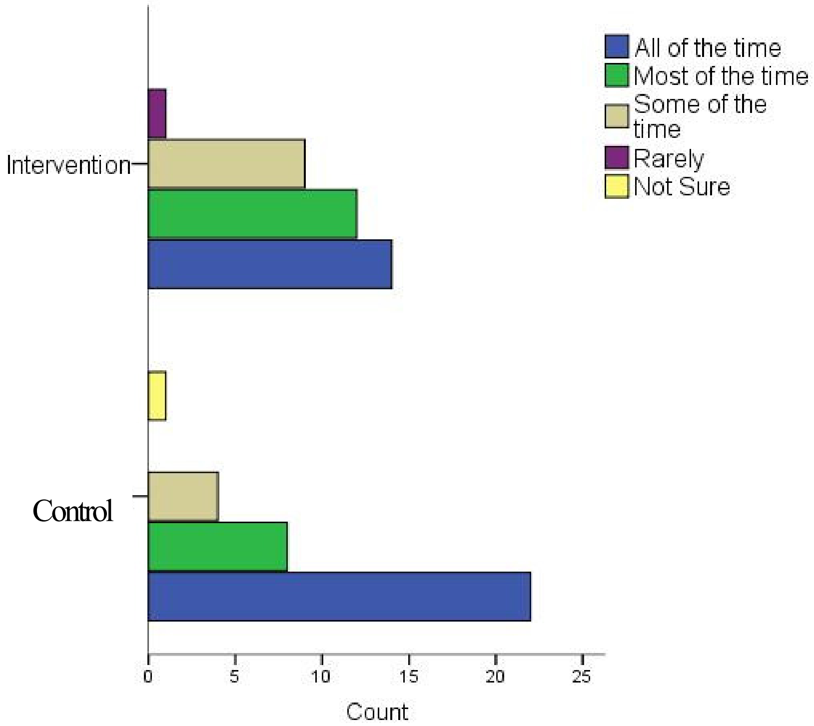

Figure 7.23 Comparison of Intervention and Control pupils' pre-test responses to "We are asked to explain our answers during Science lessons" item

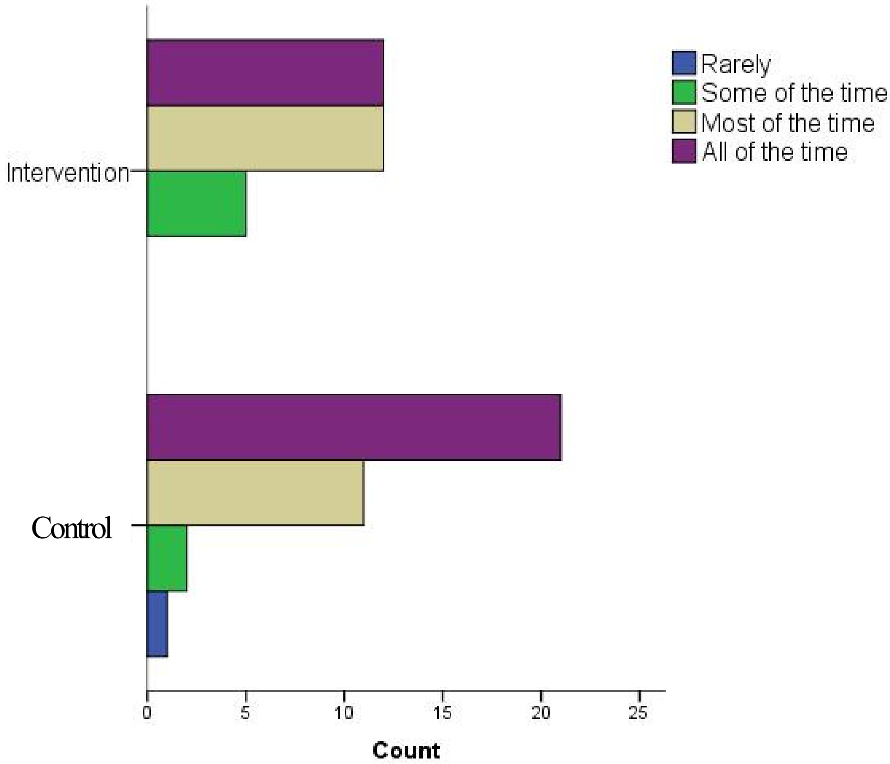

Figure 7.24 Comparison of Intervention and Control pupils' post-test responses to "We are asked to explain our answers during Science lessons" item

Intervention pupils reported at the pre-test that pupils within their class frequently quickly settled during the start of lessons (see Figure 7.25), in contrast with a smaller proportion of pupils from control classes who reported such incidences. At the post-test, pupils gave more equivalent responses with the greater proportion of pupils reporting fewer incidences of disrupted lessons (see Figure 7.26).

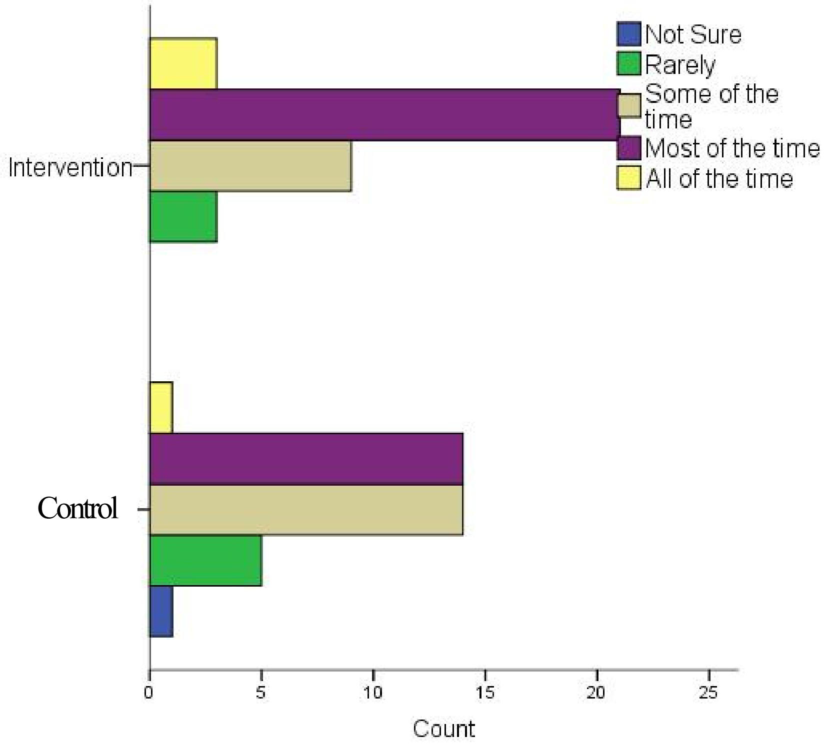

Figure 7.25 Comparison of Intervention and Control pupils' pre-test responses to "Pupils settle quickly at the start of lessons" item

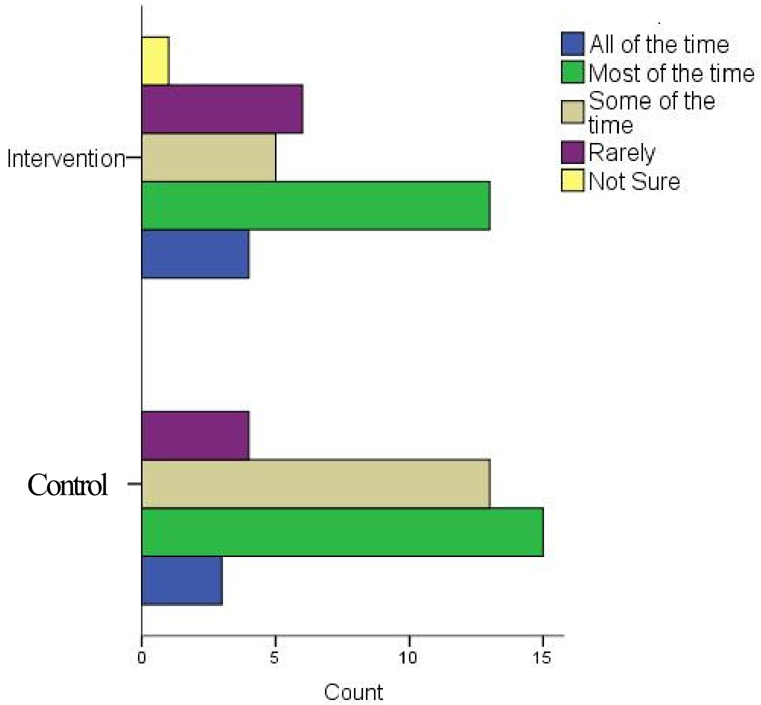

Figure 7.26 Comparison of Intervention and Control pupils' post-test responses to "Pupils settle quickly at the start of lessons" item

7.7.2 Pupils' perception of activities within Science lessons

A significant difference was detected regarding intervention and control pupils' responses regarding the occasions when they were able to work with friends during class time. At the post-test, a greater number of intervention pupils gave a positive response, whereas although control pupils also reported positive responses regarding this item, a minority were distinctly unhappy about such interaction (see Figures 7.27 and 7.28).

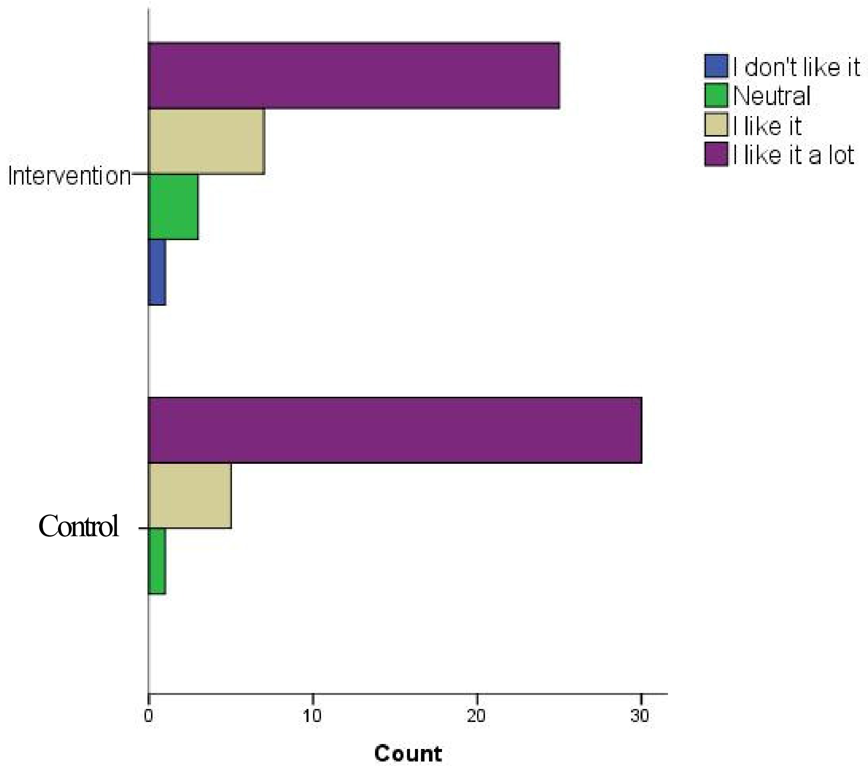

Figure 7.27 Comparison of Intervention and Control pupils' pre-test responses to "Working with friends" item

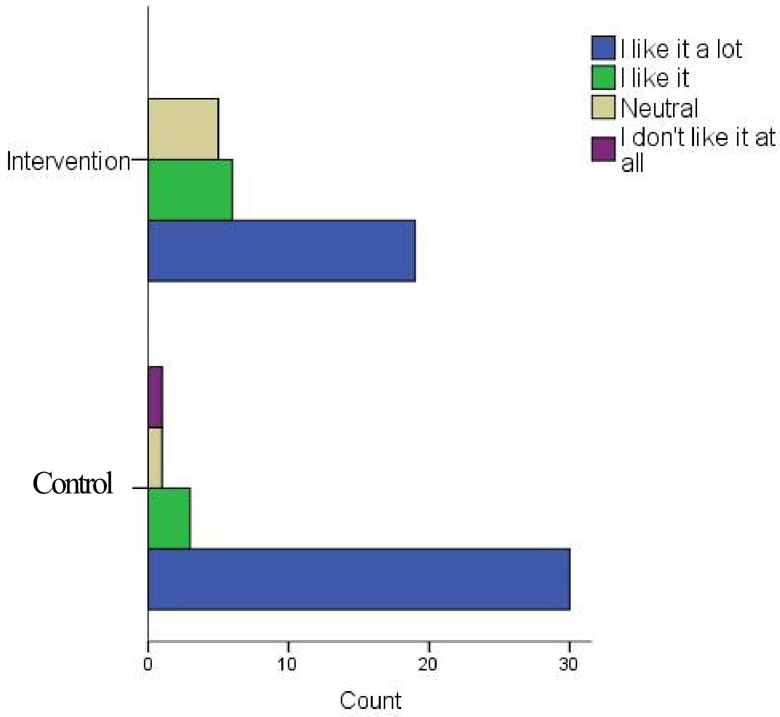

Figure 7.28 Comparison of Intervention and Control pupils' post-test responses to "Working with friends" item

At the pre-test, control pupils gave a greater number of positive responses in comparison to their intervention counterparts when describing completed work to friends, but the non-significant post-test indicates that pupils were more equivalent regarding this type of behaviour, evident in Figures 7.29 and 7.30.

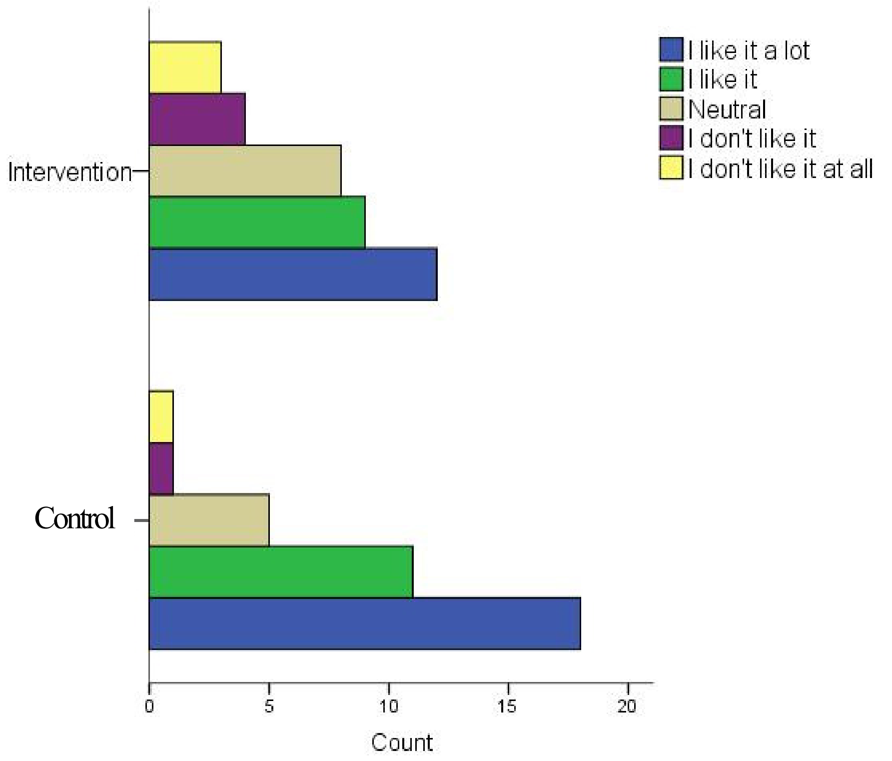

Figure 7.29 Comparison of Intervention and Control pupils' pre-test responses to "Telling friends what you have done" item

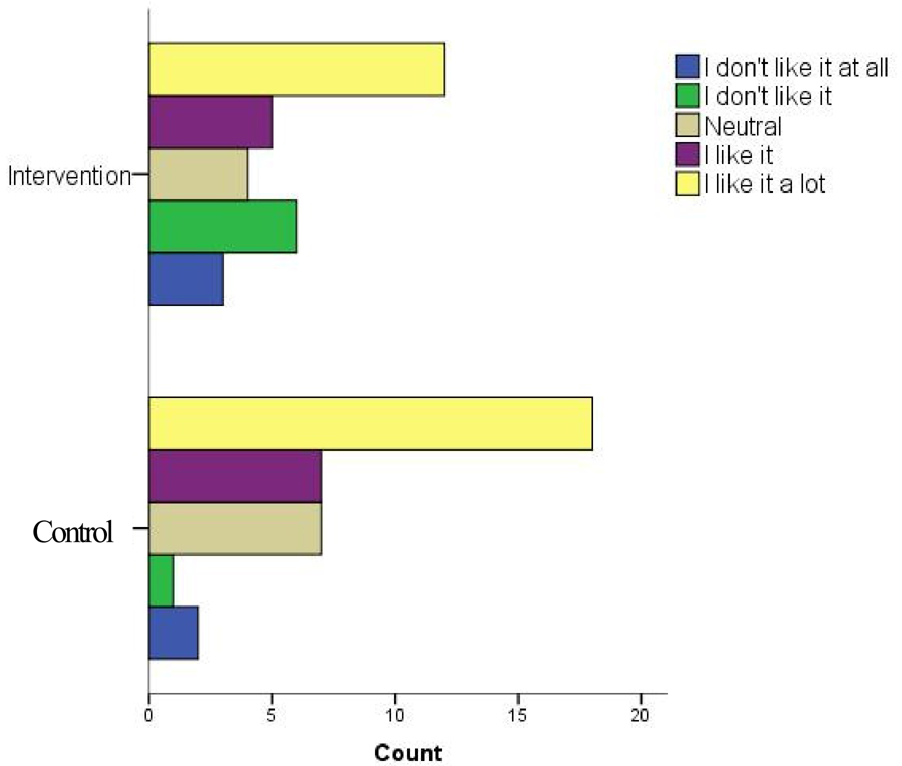

Figure 7.30 Comparison of Intervention and Control pupils' post-test responses to "Telling friends what you have done" item

7.7.3 Pupils' attitudes regarding group work

A greater proportion of intervention pupils at the pre-test held neutral views of the opportunities available for thinking when working in groups, yet this separation was not sustained as more comparable responses were evident at the post-test. A small proportion of intervention pupils held less favourable views regarding group work at the post-test, approaching the discontent evident within control pupils' responses. Changes in pupils' responses are evident in Figure 7.31 and 7.32 respectively.

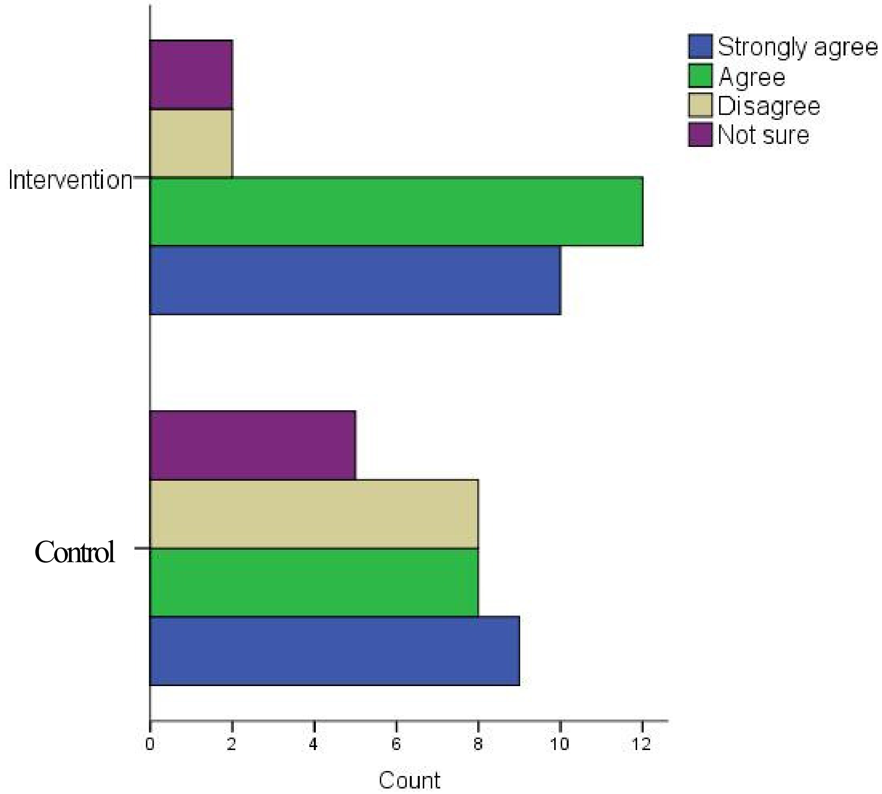

Figure 7.31 Comparison of Intervention and Control pupils' pre-test responses to "You get to think more in groups" item

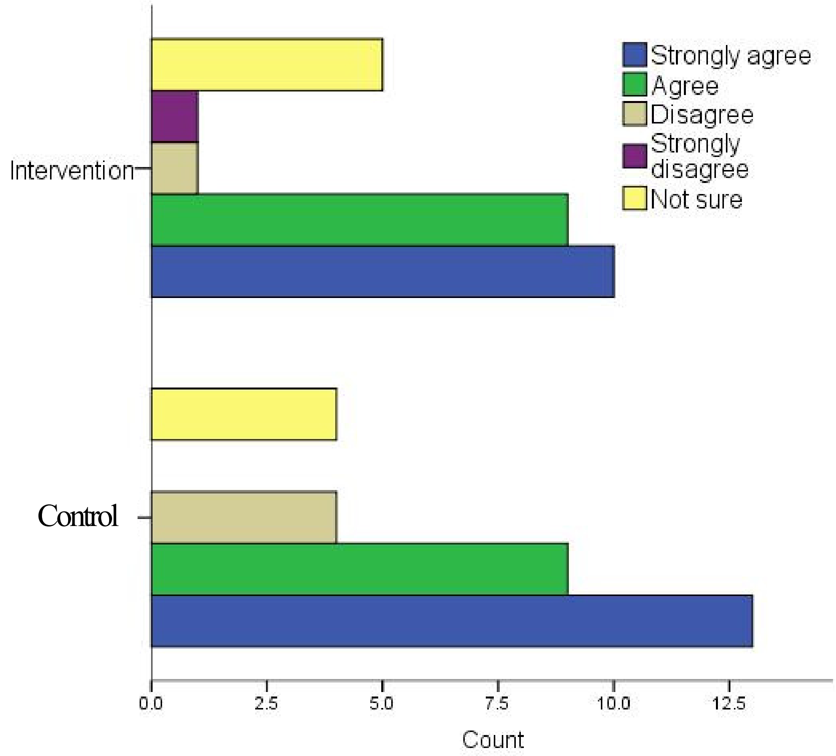

Figure 7.32 Comparison of Intervention and Control pupils' post-test response to "You get to think more in groups" item

Therefore, a number of outcomes, in particular behaviour recorded during lessons and sociometry results indicate promising findings yet this pattern was not repeated within pupils' academic and attitudinal measures. Whether this arises from the manner in which teachers implemented the intervention can be evaluated once the efficacy of the intervention has been examined in the subsequent chapter.

Chapter 8

Efficacy of implementation

A number of factors were incorporated into the design of Study 2 to support its implementation; relevant detail will be provided to describe factors that contributed to the successful execution of the intervention and supplement the findings documented within Chapter 7.

8.1 Chain of evidence

A chain of evidence provides a visual representation of relationships between the multiple variables integral to the efficacy of the intervention. Miles and Huberman (1994) argue that relationships between such variables ought to be constructed on substantiated findings, in this case relationships are based on the outcomes of analyses presented within previous sections. Thus, the visual representation of the intervention, originally provided in Chapter 6, is added to with relationships between the variables in Figure 8.1 labelled in two ways; a continuous line indicates a confirmed relation, whereas a broken line reports an emerging outcome.

The small scale nature of this project meant that it was desirable to recruit participants who were looking to improve their understanding of the mechanisms that lead to productive group work. To ensure that control and intervention pupils were comparable teachers utilised a project timetable. Teachers coordinated their implementation of the intervention the conventional teaching of the same topic within their school. This document was developed as a resource to be shared between the researcher, intervention and control teachers within a school. Teachers could therefore track their own progress and that of their fellow teacher; it enabled control teachers to identify precisely when testing packs should be distributed to their participating class and fostered communication between teachers employing the intervention and the researcher. Control teachers utilised the school's conventional approach to the teaching of the topic area, which included different teaching strategies. Thus, there were no limits placed on the approaches and style of teaching observed within control classrooms, which for the most part followed examples of conventional lessons observed previously within Study 1. Unlike the intervention classrooms, where pupils seating arrangements contributed to group cohesion, pupils were either seated in rows (spanning the breadth of the classroom) or in small groups but focused on completing work individually. When pupils were occasionally instructed to work in pairs, where pupils, the objective of such interaction was based on sharing resources, rather than overtly recognising the benefits of group interaction. Such interaction (when it did occur) neither showed the continuity in learning evident in intervention lessons nor did it demonstrate pupils independence from their teacher. Generally, teachers preferred to introduce material and maintain overall control of the lesson.

8.1.1 Classroom layout

Within the teacher booklet distinctions were made regarding the preparation needed prior to groups being used within lessons. "Setting up the classroom" related to the physical, tangible requirements. Accordingly, two variables were included in the observation grid used to record teachers during classroom visits and whether teachers incorporated recommendations regarding practice. The nature of the classroom at the start and close of lessons was recorded as relating to a whole-class format or a format relative to a plenary session. The term whole-class describes a situation where pupils are seated in their typical classroom layout and their teacher maintains the attention of the class. In contrast, a plenary describes occasions where dialogue is evident between groups, with the focus on the content that they produce, which may be guided by their teacher. Within the guidance given to teachers, both formats were classed as a form of rounding up a lesson.

Phase 1	Phase 2	Phase 3
Initial Steps *Recruitment and coaching sessions.* *Pre-tests*	Schools coordinated their implementation of the intervention with the conventional teaching of the topic area. *Communication maintained with schools.* *Classroom observation*	Impact *Main outcomes assessed by analysing classroom observation and pupils' test scores*

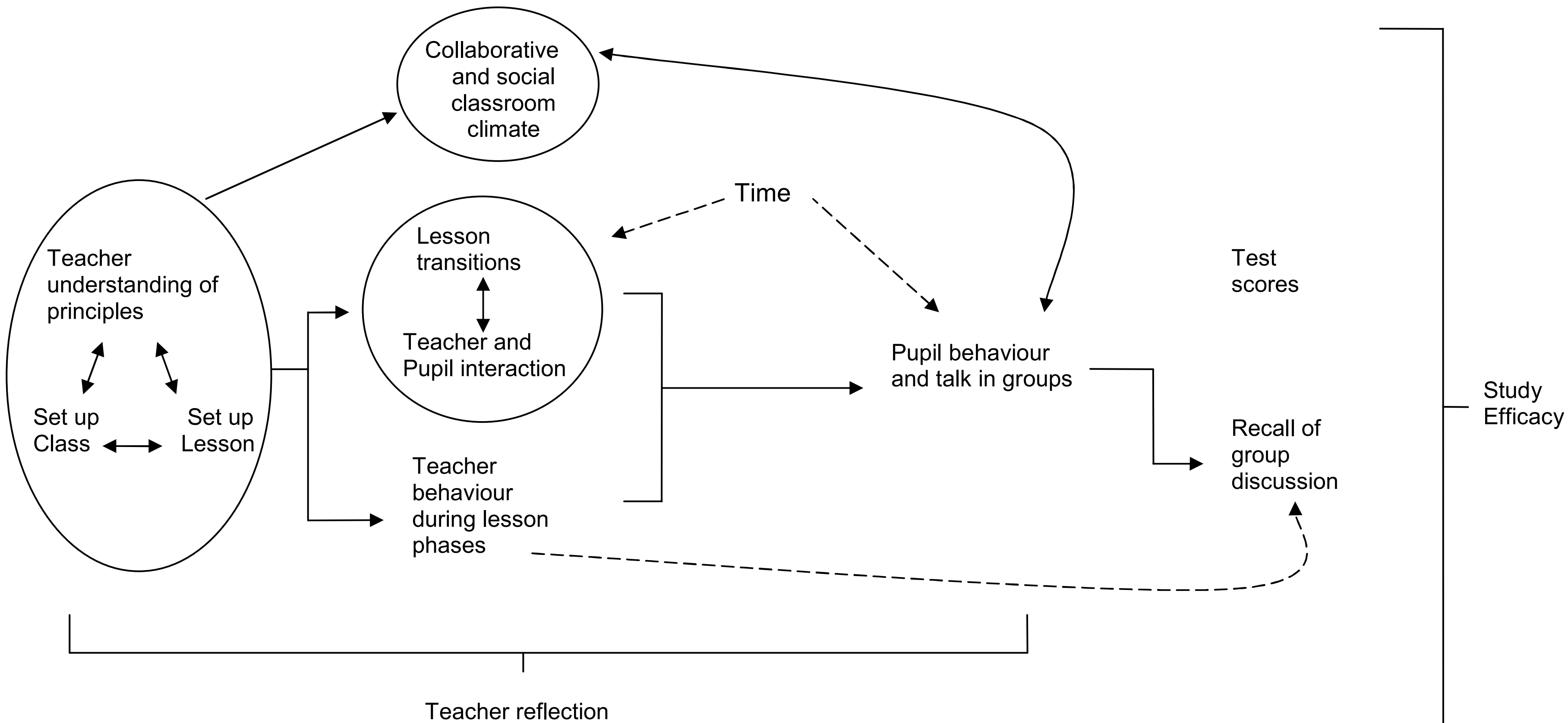

Figure 8.1 Chain of Evidence depicting how characteristics of Study 2 contributed to the efficacy of the intervention

Codes
Emerging from analysis - - - - - - - -
Confirmed relationships from analysis ———

Content recorded on the table of the lesson context sheet (a copy of this resource is available in Appendix 2) revealed differences in teachers' implementation of their practice. One teacher opted to instigate a reduced form of plenary interaction during intervention lessons and gave pupils the opportunity to express their contributions and become an integral part of the discussion. Therefore, to some extent this teacher was comfortable in giving control to pupils, yet placed strict limits on such control. This behaviour is labelled as a form of plenary as the teacher maintained overall control of the discussion rather than distributing responsibility to the groups themselves. In contrast, the second intervention teacher preferred to maintain whole-class organisation and manage the contributions given by pupils. This suggests that teachers invoke their own judgement regarding what is and is not appropriate for their class. A similarity in their behaviour was observed as both intervention teachers gave clear verbal signals that the lesson was concluding rather than solely attending to modifying the layout of the classroom. Therefore, rather than lesson conclusions solely attending to the physical state of the class, teachers effectively provided a form of closure to pupils by contextualising their understanding.

A clear relationship between teachers' comprehension of the project and its objectives was evident from their behaviour within intervention lessons. Within the second phase of Study 2, analysis of classroom observation data revealed that teachers managed lessons effectively. Firstly, adequate breaks were provided during lessons but excessive transitions were avoided. Secondly, whilst groups completed activities teachers reduced the frequency of their interaction with pupils. Finally, lesson phases, where teachers took the time to accommodate pupils' views, became an established feature of lessons. These findings (described by two variables) have been grouped in Figure 8.1 and represent teachers' behaviour during the main part of lessons. Pupils also took time to adjust to the demands of the intervention and the placement of "think then talk" suggestions in the activity worksheets saw them become more skilled at interaction. Becoming familiar with the demands of the intervention helped explain variations observed in teacher and pupil behaviour, this emerging finding is represented with a unidirectional dashed connector.

Variables pertaining to the collaborative and social climate of classrooms have been grouped together as pupils and teachers reported an improvement in the interactive nature of lessons after participating in the intervention. Direct encouragement to collaborate in groups undertaking structured activities had a positive effect on pupils' social relationships and was recognised by both parties. Bidirectional linkages have been used to connect these variables as it is argued that the experience of activities and interaction within lessons affects pupils' perception of their peers.

The final section of the chain of evidence presents the outcomes used to determine the impact of the intervention. Pupils' performance on the academic and questionnaire items indicate that participation in the intervention did not provide additional gains but resulted in no apparent ill effects. Findings regarding intervention pupils' recall of content discussed within groups indicate that teachers' contextualising behaviour may support pupils' interpretation of singular explanations relevant to specific sections of a topic area. This section also links these outcomes to the efficacy of the intervention that is dependent upon the findings and conclusions made within each subsection, which can be supported with teachers' reflections.

8.2 Teachers' appraisal of the intervention

An evaluation questionnaire (Appendix 13) was distributed close to the completion of the intervention activities and it was recommended that teachers complete the evaluation questionnaire, containing both open and closed questions, whilst pupils completed their post-tests. Teachers, therefore, would have had two weeks in which to reflect upon the intervention. Shortly afterwards a final school visit was made to distribute project materials to control teachers, and to allow collection of completed measures. The timing of the meeting was coordinated so that all interested parties within each school could be involved in the debriefing session. This session gave further insight into teachers' views regarding the project and provided supplementary detail to questionnaire responses. Had semi-structured interviews been conducted or a greater number of teachers participated, underlying themes and constructs that illustrate teachers' perspectives could have been examined in a systematic fashion (Miles & Huberman, 1994).

The closed questions presented in the questionnaire probed teachers' perspectives regarding two aspects of the intervention. First teachers' views were queried regarding their contact with the researcher, including their views regarding the level of guidance made available to them, the presence of the researcher within lessons and more generally the communication between themselves and the researcher. Both teachers made satisfactory responses to such questions, commenting that direct contact with an individual gave them the confidence to clarify points when necessary. Teachers commented that observation visits provided "a chance to ask questions and receive feedback" and allowed "experience of the researcher to be shared", therefore teachers were considering such occasions as opportunities for self-evaluation and personal development rather than perceiving observation visits as a negative experience which they might have regarded as a critique. The theme of professional development was evident elsewhere with teachers reporting, “I liked the clear advice on the role of the teacher. It was very clear what was expected of me.” Specific questions probed teachers’ views and indicated that teachers felt involvement in the study had been useful to them on a professional level – and would influence their future teaching and learning strategies: “Theory behind the lessons will be adopted for further use”.

Second, teachers’ views were also sought regarding the resources adapted for Study 2. Teachers rated highly both their own and the pupil booklet. One teacher commented that the nature of the activities encouraged higher level thinking but proposed that their diagrams could be simplified in some cases. In contrast, the other intervention teacher commented that diagrams were simple and well laid out, making it easy for pupils to follow them. This difference in opinion may be partly understood with reference to the use of electronic resources. The teacher who considered that some diagrams could be simplified did not implement electronic means of displaying resources during intervention lessons, whereas the teacher whose pupils found diagrams easy to follow regularly presented sections of the worksheet projected onto the classroom whiteboard. When this observation was probed in the debriefing session, the teacher who had not embraced the use of the electronic resources commented that the school was soon to move to its new premises equipped with resources in each classroom, in contrast to the current restricted access to modern technology from having to share resources. Additional explanation given by teachers referred to the availability of resources, which could permit exploration of a wider range of topics and be embedded within lessons spread over a school year.

8.3 How well was the project implemented in schools?

The two activities omitted by one school featured at opposite ends of the intervention. When this was pointed out to the teacher in question, in case the position of either activity explained their omission, the teacher explained that the first activity had been omitted as a similar lesson had taken place within the previous term and the second activity was omitted, as it was not typically taught to that year group. This provided further evidence that teachers strove to include the activities on each occasion that they agreed with its parameters, such as its consistency with the objectives of their school, but whenever possible followed the guidelines of the study.

Teachers reported relative ease with the management of lessons (their interaction with pupils and lesson phases) and establishing routines such as setting up the lesson, where pupils responded well to being placed into groups which were maintained for the duration of the intervention. Therefore, teachers' own reflections provide further evidence that the project was implemented in accordance with the expectations of the researcher that were laid out in the guidelines prepared for schools.

In addition to evaluating the gains achieved through their own participation, teachers consistently reported benefits to the pupils who had participated in the intervention. Teachers believed that the intervention was a positive influence, resulting in pupils being "more willing to communicate their ideas and contribute when in a group situation with the support of their peers." and that pupils "gained an independence they otherwise may not have developed".

The evaluation questionnaire gave teachers the opportunity to record their thoughts regarding their professional development and provided a means by which specific content could be discussed during debriefing sessions. Teachers reported a high degree of satisfaction from having implementing the activities, which was supported by statements given during the debriefing session and in response to the open-ended items in the evaluative questionnaire.

8.4 Study 2 Discussion

The major concern of Study 2 was to assess the contribution of an intervention to teachers' and pupils' experiences when teachers develop and formalise their approach to group work. Intervention teachers prepared both the classrooms and pupils in advance of group work taking place. The guidance presented regarding teachers' role in relation to their behaviour prior to and following group work, as well as during group work, has been substantiated. Having participated in a group work programme designed to facilitate the skills and manner in which teachers address pupils prior to and following group work, a change in intervention teachers' behaviour was detected by comparing intervention teachers with the baseline formed by their control counterparts.

Teachers of first year science who engaged in the intervention were able to develop their skills to maintain an adequate pace within group work lessons, which allowed pupils to complete tasks. They were also able to devote sufficient time to the beginning and end of lessons to support pupils' learning. The findings indicate that teachers show more flexibility with their behaviour and talk. Having been provided with a structure and specific guidance, teachers can develop strategies and incorporate new frameworks within group work lessons.

A key point emerging from the analysis of teacher behaviour relates to their use of questions or probes. Study 1 indicated that teachers' use of probes was difficult to ascertain due to its variability. However, this contrasted with research evidence noting the relevance of different types of questioning behaviour in relation to pupils' comprehension (Chin, 2006, 2007; Erdogan & Campbell, 2008). Although open and closed questions have been explored in relation to pupils' classroom contributions (see Section 2.4.2), the distinction separating them has been criticised (Galton, Hargreaves, Comber, Wall, & Pell, 1999a), therefore deep and shallow probes (labels assigned to observation categories in Study 2) were identified as more appropriate when recording questioning behaviour. Deep probes occurred more frequently during intervention lesson conclusions, whereas teachers' uses of shallow probes were almost equivalent at each lesson phase. Intervention teachers had clearly grasped the guidance they were given. They were observed to use deep probes when pupils' responses required unpicking and class time was available. Both sets of teachers acknowledged contributions given by pupils. However, only intervention teachers made efforts to integrate such explanations and when appropriate encourage pupils to give additional thought to what they had said. In essence, when teachers aimed to contextualise pupils' understanding, they used deep probes. The associations between specific observation categories for intervention teachers support this interpretation. Additionally, the relationship between deep probes and fully attend – teachers' attempts to ascertain what pupils were saying and give a sufficient response – is indicative of a progression in the manner teachers communicated with pupils prior to and following group work. Indeed an additional finding relates to teachers' skill in managing the group work lessons: interruptions or transitions within lessons were reduced, which provided increased opportunities for pupils to engage in sustained discussion. The significance of the development in teachers' behaviour must not be underestimated considering that previous studies examining interventions within group work lessons (Galton, et al., 2009) and whole-class teaching (McNeill & Krajcik, 2008) noted teachers' difficulty in conveying such information. Thus, the evidence stemming from Studies 1 and 2 makes clear that it is no longer sufficient merely to mention that teachers are important in relation to group work, rather studies and literature need to go further and evaluate how specific behaviours and mechanisms contribute to the implementation of group work in classrooms.

The relationship between teachers' beliefs and pedagogical practice has been established (Fang, 1996; Lotter, et al., 2007; Nespor, 1987; Roehrig, Kruse, & Kern, 2007). Luft (2001) documented that experienced teachers were able to tailor their behaviour despite their underlying beliefs remaining unaffected, whereas inexperienced teachers adapted their beliefs but encountered difficulties with their behaviour. A similar finding was noted regarding teachers who had participated in Study 1. Few differences in teacher behaviour were noted when observations recorded in group work and conventional lessons was compared. Minor differences were noticeable when teacher beliefs were investigated and some worrying responses were given by teachers who reported having received training. SCOTSPRinG research operated on a large scale providing intensive two-day group work training that proved to be effective (Thurston, et al., 2008a) in comparison to other programmes that aimed to achieve such modification but as evident in Study 1's findings do not appear to have been influential (Seagraves, et al., 2007). Study 2 opted to rely on teachers familiarising themselves with the intervention materials followed by a coaching session thereby emulating the two training sessions teachers would have received in the SCOTSPRinG project. Evidently, teachers' lack of skill regarding group work should not indicate they are unable to modify their behaviour.

Although CPD models typically insist that good practice should involve collaboration between teachers within and across schools, this was not feasible within the parameters of Study 2. The small scale of the study meant that online discussion forums in the manner idealised by CPD guidelines were non-feasible, whereas, if anonymity could be ensured, teachers may be more likely to participate in discussion without appearing to criticise colleagues' teaching practice. Although a coaching session may be difficult to achieve in an implementation of a larger scale, it could be facilitated with the use of online facilities. Following HMIe support the Scottish schools' digital network ("GLOW") was created as a means of sharing resources online (HMIe, 2009b). GLOW appears to provide a suitable resource, especially when its availability and nature is controlled by local authorities. Most report its implementation and are rolling out access. Yet, there are few statistics regarding teachers' accessibility suggesting alternative or additional resources may need to be sought, particularly in light of criticism coming from users (Richards, 2008, 2010).

Classroom observation clearly documented that pupils were able to maintain and hone their group work skills. Pupils' observed behaviour corresponded with the tasks assigned to the group and their seating arrangement. Group work pupils received the most assistance from their teachers during the first class visit (at the beginning of the intervention), and by the third visit the level of teacher assistance given to group work pupils tailed off, and approximated that evident within control classes (see Section 7.3.1). Yet the variation in teachers' interaction with groups related neither to difficulties with task engagement nor with group engagement. Pupils did not exert themselves in order to interact with peers adjacent to their group. This shows that pupils were content to work in groups arranged by their teacher (avoiding the potential pitfalls of friendship-based groups) and that groups could achieve such interaction without seeking assistance from their teacher or adjacent groups.

The lack of noticeable disruptive behaviour or unproductive interaction meant that intervention classes produced more dialogue than pupils working in control lessons. Thus, group work behaviour originally observed in Study 1 has been preserved. Behaviour recorded within the second observation class visit suggests that control pupils were engaged in group work. Both control and intervention pupils were observed to be seated as groups and remained engaged with their group activity; control pupils approximated their counterparts working in intervention lessons when these observation categories were examined. However, even within the second observation visit when some form of group work was operating in control lessons, intervention pupils were superior to their control counterparts when making informing and asking dialogue behaviours.

A trend was evident in intervention pupils' behaviour. As pupils experienced the group work activities, they devoted (fractionally) more class time to working out their own perspective ("thinking") before divulging such content to their group. Similar progression in cooperative learning skills have been noted elsewhere (Terwel, et al., 2001). Although it seems logical to conclude that these trends evidently occurred because of the group work intervention; such variation may be dependent on the intricacies of the topic area. Indeed the low frequencies obtained for some observation variables provides a further reason to replicate the method outlined within Study 2. However, the supportive nature of group work could explain such trends in intervention pupils' behaviour based on the theoretical perspectives outlined in Chapter 2. A change in pupils' underlying group behaviour could be clarified by the addition of observation category (perhaps labelled "encourage"), which could help elucidate the frequency to which pupils act on their right to receive help and be involved in fruitful group discussion (components of the intervention that were based on aspects of the "Learning together" framework. Such behaviour could be integral to the transferable skills pupils acquire having participated within the intervention and help explain the mechanisms contributing to productive group work.

The analysis of the classroom climate involved a number of complementary measures. Findings from one measure helped validate findings detected by another and helped to alleviate the drawbacks of having a single school complete the pupil sociometric measure. Intervention pupils showed a greater improvement in their mean social distance rating than their control counterparts. Teacher ratings indicated a comparable trend; they rated pupils according to the number of positive interactions they engaged in. Intervention teachers reported an improvement in pupils' interaction by rating a greater proportion of pupils with the highest rank, whereas control teachers were more satisfied with moderate ratings, using a lower rank than that preferred by intervention teachers. Having participated in the intervention, pupils developed their peer relation skills approaching the interaction depicted in the introductory chapters and reported by classroom based interventions (such as SPRinG and Learning Together) whilst avoiding pitfalls associated with such adjustment (Hunter & Youniss, 1982; von Salisch, 2001). That teachers and pupils showed an increasing awareness of the classroom environment is encouraging. The similarity in their views regarding the status of classroom interaction indicates that a shared understanding held between pupils and their teacher was in place. This shared understanding, outlined in the research questions regarding Study 2, is a crucial factor as its influence is argued to contribute to pupils' engagement and capacity to monitor their own learning (Ryan & Patrick, 2001).

Whether examined in line with discrete emotions (Frenzel, Goetz, Lüdtke, Pekrun, & Sutton, 2009), or from reviews of research findings, teacher enthusiasm and their approach to teaching and learning has been documented as a core factor in relation to the classroom climate. Likewise, intervention and control pupils' maintained their beliefs (no differences were detected at the post-test) regarding the classroom environment. Its contribution has been related to the nature of classroom interaction which is supported by Study 2 (Frenzel, et al., 2009; Harris & Rosenthal, 2005). Study 2 indicates that the development and maintenance of an environment conducive to interaction is vital, and can be sustained largely by the skills of the teacher. The significance of the environment for peer interaction suggests it ought to be incorporated within group work research, both on the strength of this evidence and that each of the theoretical perspectives attribute it importance.

A sceptic may argue that the findings of Study 2 stem from the nature of the classroom environment rather than the conditions that were put in place to support interaction. However, the integrity of Study 2's implementation (and its validity in primary education) provides sufficient evidence to credit the approach. This alternative explanation is further undermined as the classroom environment has only been related directly to self-regulated learning (Ryan & Patrick, 2001). Thus, the combination of factors involved in Study 2 appear to be optimal, achieving more than conventional teaching by encouraging teachers to establish and maintain a welcoming classroom climate conducive to group work which supports pupils' voicing of their ideas. Pupils do not feel excessive strain when asked to work in groups and sustain this interaction over a number of weeks. Thus, even behaviour such as deep probes, which could be seen to be challenging (and disrupt pupils' relationship with their teacher), did not negatively influence pupils' attitudes to group work. Observations documented that the nature of intervention teachers' behaviour which originally epitomized whole-class teaching - where IRF exchanges abounded and pupils' contributions were solicited only in response to closed questions (Howe, 1997) - developed so that classrooms embodied a collaborative climate showing a distinct progression from the examples of group work that were provided by teachers in Study 1.

The value of including a measure examining attitudes to group work has yet to be ascertained. Study 2 incorporated the measure on the basis that its findings would add to those reported in Study 1. Any questions regarding the validity of the group work measure can be set aside on the basis that its construction and reliability had been thoroughly tested (Blatchford, et al., 2005). Results from other studies utilising the measure (Baines, et al., 2008; Blatchford, et al., 2005) are in line with those emerging from Study 2 and are cumulatively indicative of a ceiling effect. The computation of a total score from testing attitudes to group work skews the results making improvement difficult to assess and slight deterioration more noticeable than it ought to be. Similar reports from an Australian study indicate such findings may not be restricted to the UK population (Gillies, 2003a). It is apparent that studying attitudes to group work does not necessarily provide a detailed insight into pupils' views. An alternative "What happened in the groups" asks pupils to explain and report the skills they relied upon within group work, and may be a more accurate means of assessing changes resulting from interaction (Gillies, 2004).

In an attempt to address the research question that investigated how pupils reflect on group work a test of their memory of group discussion was prepared. Difficulties in recording groups' ideas restricted the analysis yet a proportion of pupils clearly remembered the discussion and ideas generated by their group. Subsequently pupils' responses were coded in two ways – noting the frequencies of post-test content that showed progression, adding to ideas expressed during group discussion and assessing the relationship between pre-and post-test responses by assessing the scientific nature of content reported. A further complication relates to potential interference stemming from pupils' overt attention to their grasp of the correct interpretation. Indeed, if the explanation given by a group coincidentally matched the "correct" explanation for the experiment being conducted, this would reduce the number of explanations available for groups to discuss and made extrapolating the impact of the group discussion versus the scientific content complicated (Fairbrother & Hackling, 1997; Hogan & Maglienti, 2001). Following the rationale presented regarding Study 2, it could also be that teachers' contextualising behaviour acts as an external resource and inadvertently promotes synthesis of ideas, narrowing pupils' understanding in attempts to reduce misconceptions. Indirect evidence supports the spontaneous use of ideas and explanation by pupils (Johnson, 1998; Weinberger, et al., 2007).

Research (Ekeocha & Brennan, 2008) explored variation in pupils' recollection noting whether individual or group based opportunities were provided. Pupils were asked first to complete an individual recall attempt, then to make a second within their original group and finally to repeat the exercise themselves. When participants repeated their individual recall, the number of propositions recalled surpassed both that achieved by groups and participants' first attempt. One confound with Ekeocha and Brennan's research is their use of an immediate post-test, particularly in light of findings relating to retrieval attempts that suggest multiple retrieval attempts leads to superior retention and learning (Karpicke & Roediger, 2007) but Karpicke and Roediger focused on word lists rather than curricular content, indicating only tentative connections ought to be made. Therefore, whether the measure used by Ekeocha and Brennan can be labelled a post-test or their findings stem from learning within their experimental procedure ought to be investigated.

To enhance and strengthen the validity of the data collection the optimal method may utilise recording video of group interaction and then have pupils later recollecting on film. This would help explore potential biases in pupils' responses – that pupils overestimate their contributions (Sommerville & Hammond, 2007) and crucially ascertain how groups contend with such bias. A second benefit is that such data collection methods facilitate accurate recording allowing clearer insight into the progression of discussion, and avoid restricting investigations to "matching" expressions reported by pupils. Likewise, the practical and scientific meaning of pupils' responses will be supported, for example, visual and behavioural cues can contribute to the interpretation of pupils' statements. Ekeocha and Brennan's study is the first effort to expand upon research originally conducted within the fields of cognitive and Forensic psychology to examine the influence of recollections taking place within group or individual settings. Clearly, one area of such research ought to focus on the tasks used to ascertain recall, perhaps incorporating measures that have elements more in common with education than traditional investigations in psychology.

Despite the difficulties encountered with the recall measure, a tentative suggestion that some form of transactive memory– a shared memory system (Wegner, 1986) fostered by group work - is recognisable in pupils' recall of group discussion. Such an underlying system may be particularly relevant to Study 2 where pupils were assigned to groups on a permanent basis, which is argued to be a significant contributor to transactive memory (Lewis, Lange, & Gillis, 2005). Studies examining transactive memory have utilised a variety of methodologies focusing on higher education populations (Jackson & Moreland, 2009; Lewis, et al., 2005; Michinov & Michinov, 2009). An experimental study (Lewis, et al., 2005) reported enhanced group and individual learning reasoned to stem from groups' transactive memory systems. Such findings were in part ascertained using the transactive memory scale - TMS (Lewis, 2003) – which elucidates the nature of group interaction by asking participants to revisit their interaction. One limitation noted by Lewis and colleagues (2005) related to the development of transactive memory and its tendency to be concerned with superficial features of tasks. This indicates that maintaining the recall task used in Study 2, which explores both observable and scientific explanation of events, would be informative in other contexts.

Future research ought to establish a version of the TMS suited to secondary education. Such a measure may encompass that obtainable by group work attitudinal measures or Gillies (2004) "What happened in the groups" measure. Multiple avenues are amenable to exploration and suggestions made in relation to the collection of pupils' ideas (Weinberger, et al., 2007) indicate that quantitative methods need to be supported by supplementary means, particularly when analyses hope to account for references made by pupils to explanations expressed by their teacher or other sources of external assistance.

Potentially such studies have significance for educational contexts as classrooms are social environments and it is during interaction that content discussed in groups may contribute the most to pupils' learning. Thus, the inclusion of assessment materials that go beyond factual tests of academic understanding thereby gauge more fully the impact of interventions encompassing group work.

A slight deterioration in pupils' academic self-concept was detected. This reduction in pupils' inward reflection regarding their academic skill conflicts with the comparable findings detected within the remaining pre-and post-test measures. It also goes against the expectation that pupils' self-beliefs would be positive and influenced by teachers' feedback. Moreover the relationship between pupils' self-concept and learning strategies has been evident in research investigating primary and secondary aged pupils (Burnett, et al., 2003; Burnett & Proctor, 2002). One possible explanation is that the challenging nature of group work may have caused pupils to be pessimistic, thereby negatively influencing their academic self-concept. Perhaps the value of group work needs to be signalled to pupils in stronger terms, and teachers need to explain their use of questions that expose pupil contributions to criticism. There is a suggestion that the use of goal-focused instructions - where groups are asked to concern themselves with developing strategies rather than correctly completing the task – contributes to strengthened interaction skills (Harris, Yuill, & Luckin, 2008). Such advice situated on worksheets may therefore counter any unnecessary negative reflection.

The interpretation that variation in academic self-concept may have prevented increases in pupils' academic achievement remains controversial (Wigfield & Karpathian, 1991). It is too soon to accept that the intervention was the sole contributor to these findings. That pupils' perceptions of self were not affected indicates that an alternative explanation may be more relevant. Recent research that documented delayed effects of transition to secondary education - where increases in social measures were followed by an unexpected decline in subsequent months (Horobin, 2009, 2010; Munro, 2010) – suggests that extraneous factors are likely to be pertinent considering the timing of Study 2. Crucially, in the first year of secondary education, the significant difference between intervention and control pupils should not cause excessive concern as it only explained a small proportion of variance.

A focus of Study 2 was the integration of activities and methodology, so that teachers would implement their developed skills on a longitudinal basis. This research question was addressed within the debriefing session where the integrity of teachers' implementation was assessed to ensure that the intervention materials could act as suitable replacements for conventional teaching. Fallacies often quoted by teachers (Blatchford, et al., 2003) relate to the use of groups reducing the curricular content covered and that group work is necessarily a disruptive activity. This argument, described in the introductory chapters, can be conclusively dismissed given intervention pupils' comparable attainment to control pupils, and their ability to maintain their task engagement, despite challenging interaction involving the renegotiation or reconciliation of ideas.

The intervention activities did not specifically ask pupils to come to a consensus. There is varying evidence regarding the contribution of consensus to that achieved within group work whereas asymmetrical dyads or peer tutoring has yielded clearer positive findings. Howe (2009) argues the integration of consensus within asymmetrical interaction may lead to content expressed by the “expert” being attributed more value when their ideas are in line with the assigned task. If we consider teachers to be experts within classrooms, their efforts to contextualise and support group work may have different consequences depending upon the approaches groups take to achieve consensus and further complicate the nature of classroom interaction. The theoretical perspectives of Piaget and Vygotksy signal the role of the teacher in relation to classroom environment, but a more developed account of teachers’ role need to be included within theory regarding group work. Future research ought to tease out the role of teacher explanation and feedback when groups have and have not achieved consensus. It may be in situations where consensus was attained by inappropriate means or could not be achieved, that commentary from the class teacher has a substantial influence on pupils’ understanding

Chapter 9

Concluding Discussion

Group work is examined within this thesis as an aspect of teaching and learning that retains particular significance for classroom interaction. The proliferation of studies that utilise different conceptualisations of group work led to widely sourced literature being examined within the introductory chapters. This thesis explored in two studies how small groups function within authentic classrooms, examining how pupils and teachers operate in such contexts, which was elucidated in part through comparison with conventional teaching.

The characteristics and criteria that contribute to productive classroom group work were used within Study 1, which aimed to audit group work as it occurs in first and third year Science and English secondary classes. Study 1 revealed it was easy to specify variables believed to support productive group work. More challenging was the process of translating such content into effective classroom group work, which became the objective of Study 2. The systematic naturalistic observation enabled barriers to learning to be detected that inadvertently restricted teachers' and pupils' involvement in group work. Despite pupil interaction nearing the norms sketched in the introductory chapters, pupils did not make particular efforts to control or shape their discussion – making it difficult to determine whether group interaction contributed to pupils' learning. Study 1 revealed discrepancies when teachers' approaches to group work were examined. Teachers' beliefs regarding group work indicated they appreciated differences, no matter how subtle, between whole-class teaching and group work, yet their observed behaviour suggested they lacked the skill necessary to tailor their teaching and learning approaches according to their own views.

Thus, Study 1 detailed the unintended impediments to learning visible when group work was included as part of a lesson and had a number of implications for Study 2. Small heterogeneous groups combined with adequately paced lessons were likely to contribute to learning. Pupils showed an enthusiasm for interaction and responded to opportunities which provided peer engagement unhampered by teachers' inadequate approach to group work. Therefore, in designing Study 2 it was assumed that teachers ought to focus on the means by which they support learning through improving their introduction and conclusion of group work lessons. The guidance provided to the Study 2 intervention teachers, described features that supported group interaction (based on characteristics identified in the introductory chapters and the findings of Study 1), and clarified the teacher's role to give them confidence to recognise that group work lessons required particular handling so that the learning resulting from interaction could be meaningful for pupils. Changes in teachers' approach were evident at the outset and close of lessons and in their improved management of the pace of group work lessons. The associated development in teachers' beliefs must not be underestimated since this has been argued to be indicative of the likelihood of enhanced skills being retained (Meloth & Deering, 1999). The provision of guidance that described group interaction - "Think then share" - led to pupils achieving heightened awareness of such skill and appears to have enriched the nature of group interaction.

When combined, the findings of Study 1 and Study 2 indicate that sociometric techniques are informative when investigating the nature and influence of group work within education. Study 2 detected a more harmonious classroom climate – visible in both pupils' and teachers' responses - once the intervention had been implemented. This outcome built on the findings of Study 1 that suggested social distance would be informative, as it evaluates the climate of the classroom rather than focusing on specific relationships based on friendship or acquaintance status. Although tentative (Study 2 relied on a small sample) these findings suggest that supporting teachers' development of their approach to group work lessons influences pupils approach and appreciation of interaction in groups, leading to a more harmonious classroom. Classroom climate is regarded as a central factor when learning is supported within challenging classrooms (Coultas, 2007). Whether replication of these findings is possible within a wider implementation would be a valuable line of investigation for future research.

As pupils' attitudes to group work by themselves do not provide insight into pupils' views, it follows that sociometry develops importance. Thus, the use of sociometric techniques (and additional measures) enables a clearer perception of the influence of group interaction upon pupils. Yet, the potential significance of such measures contrasts with the hostility apparent within the teaching population and wider stakeholders. Sociometric measures were frequently opposed in schools and by local authorities despite research evidence suggesting that such opposition has little merit. Clearly, the reasons for such a disparity need to be ascertained so that it can be addressed, particularly as similar concerns were raised within studies investigating primary education (Schröeter, 2006), indicating that hostility towards such measures is prevalent within educational contexts.

Within study 2, during the course of a single topic area, teachers implementing the intervention were able to advance their approach to group work lessons. In comparison, it appears that pupils require additional time to show an underlying change. It is noteworthy that group work research has had a long history yet much of the research that shows improvement in children's skills encountered difficulties when their methodologies were tailored to operate in classroom contexts. Thus, there was a period when studies frequently encountered difficulties and reported variance in pupils' academic achievement or progression in their learning. Therefore, the fact that Study 2 did not provide evidence of increases in academic achievement should not prevent further research examining secondary aged pupils, who have much to gain from participating in groups. Particularly as the post-test occurred two weeks following completion of the topic area, which may not provide sufficient time for academic development to take place within secondary aged pupils. SCOTSPRinG primary research and SPRinG secondary research both utilised more than one topic area indicating that a longer intervention may improve the likelihood of potential gains in pupils' achievement and embedding group work practices more widely within schools would prove fruitful. A longer intervention would enable pre- and post-tests to span the academic year, causing less disruption to schools and achieve sufficient delay.

As noted previously, dialogue has been endorsed by theories and research as the mechanism contributing to growth following group work. Indeed, longitudinal studies or interventions that involved multiple topic areas have reported notable findings regarding pupils' dialogue (Baines, et al., 2009b; Gillies, 2000, 2002b, 2003a; Howe, et al., 2007; Mercer, et al., 2004; Terwel, et al., 2001). Within Study 1 and Study 2, pupils during group interaction used more informing and asking dialogue behaviour than their counterparts who worked in conventional and control lessons. In contrast, examples of pupils' use of resolution were scarce; making it likely that pupils' attempts to resolve conflict were private and took place after group work. This finding is consistent with interpretations made of Piagetian theory – where cognitive conflict takes place on a personal, private level (see Section 2.2.1). More fine-grained analysis could evaluate the exploration of science school knowledge used during discussion (addressing the apparent low frequency detected regarding some observation categories) and help explore teachers' support for group work in relation to cognitive conflict. A systematic approach would be recommended to gain insight into pupils' representation of knowledge. Progression may be dependent upon appropriate linkages being made, which act as scaffolds to pupils' developing comprehension (Hardy, et al., 2006). Longitudinal studies would do well to document specific dialogue features assessing their evolution in relation to pupils' progression within secondary education, perhaps clarifying the influences impinging upon pupils' recollection of group work.

Studies with other samples are also needed to determine the generalisability of the results from Study 1 and Study 2. The generalisability of the results beyond the Scottish context is not problematic considering the equivalence in findings (reported thus far) regarding secondary teachers' implementation of the SPRinG project (Galton, et al., 2009). Likewise, although tasks encompassing the structure noted in Study 2's group work activities could be implemented in a variety of subject areas (Study 1 suggests relatively little variation regarding group work across Science and English classes), verification that equivalent parameters operate within such contexts is needed, particularly as the majority of research is tailored towards Science. Study 1 noted a number of topics were amenable to group work, providing multiple opportunities for development. However, the principles underpinning the selection of additional topic areas need to be clarified. For example the topic area of "Earth in Space" (used by the SCOTSPRinG transition project) was not well received by participating teachers, neither was it included within the topics observed during Study 1. The findings of Study 1 and other research signal that future interventions should encompass English (Galton, et al., 2009; Nystrand, 2006). Teachers are amenable to developing their skills, and as dialogue is a fundamental characteristic of English teaching, it may make it particularly conducive to group work (Myhill & Brackley, 2004). At least further three teaching subjects (History, Modern Languages and Mathematics) that are associated with moderate to frequent use of group work suggest additional candidates for subsequent study (MacQuarrie, 2006). Thus, topics and learning points that teachers believe are suited to group work need to be given careful consideration and Study 2 suggests that consultation with teachers during the planning stages and the provision of support during an intervention may be vital steps to ensure its' efficacy.

Two lines of investigation are particularly relevant to future studies. Study 2 adopted the framework that teachers occupy a background role whilst groups complete tasks based on teachers' own behaviour (observed during Study 1) and supporting research evidence (see section 6.2). Yet teacher assistance when pupils work in groups should not be dismissed outright (Gillies & Haynes, 2010; Webb, et al., 2009) rather an effective framework established within classroom contexts has yet to be achieved. One means of furthering our understanding of the role that assistance from teachers can contribute to pupils' learning, would involve video recording, which can promote self-reflection in teachers assuming the provision of support (Wragg, 1999). That limited success has only been obtained by Video interactive guidance - VIG - within a study that asked teachers to develop their classroom interaction with pupils exhibiting social and emotional behavioural difficulties (Kaye, Forsyth, & Simpson, 2000) contrasts with its apparent success when used to develop parent and child relationships (Fukkink, 2008). Enabling teachers to reflect on their behaviour with video is not a new idea (Esveldt, Dawson, & Forness, 1974; Salomon & McDonald, 1970), therefore whether or not VIG proves to be a productive strategy, using video in this manner, where it is seen as a helpful resource may help to circumvent noted opposition to video recording (Blatchford, et al., 2005). A key issue for future research is to address the limitations of in vivo coding (it reflects the incidence of teachers' behaviour and was utilised within Study 1 and 2) by accessing video resources that allow fine-grained analyses, which necessitate more protracted decisions. Longitudinal research could easily integrate such a mechanism, both to examine the long lasting effects of group work and to make certain that developments in teachers' practice are not short-lived.

Different measures utilised within Study 2 documented that pupils retain features of group discussion and their engagement in productive interaction establishes that group work is meaningful for pupils. However, a predicted gain from such interaction in enhanced individual performance on the academic post-test was not detected. The intervention contributed to pupils' capacity to learn, but there appears to have been lack of transfer of analytical skills from a group to a individual context and this needs to be examined. Gillies and Kahn (2009) reported consistent findings in that groups given questioning training were observed to have improved dialogue skills but such skills were not detected when they were given written tasks to complete. Indirect evidence suggests the integration of particular guidance in the form of prompts could be used to target such complications. Research conducted in the United States explored the role of fading instructional support – where guidance printed on instructional materials is gradually reduced over a specific period – documented their influence in supporting pupils' capacity to learn (McNeill, Lizotte, Krajcik, & Marx, 2006). The study compared a continuous condition with instructional support that was gradually reduced over the course of a topic. McNeill and colleagues argued that equivalent gains were detected initially for both conditions. Yet only those pupils given decreasing guidance were able to develop transferable skills and present in-depth written explanation, coupled with justification. Adaptable skills feature within the integrated nature of the imminent curriculum for excellence (Scottish Executive, 2009a, 2010), indicating the relevance of such potential research to Scottish education. Pupils' ability to generalise skills may have particular relevance to higher education, where studies have yet to reach unequivocal conclusions regarding the gains stemming from engaging in group work (Cartney & Rouse, 2006; Johnson, Johnson, & Smith, 2007; Pauli, Mohiyeddini, Bray, Michie, & Street, 2008; Springer, Stanne, & Donovan, 1999).

Drawing together key points, the current research sets apart group work lessons from conventional whole-class approaches to teaching. Group work necessitates a wider conceptualisation of interaction: encompassing pupil interaction, the relationship between pupils and their teacher, and how teachers shape lessons to incorporate group work. Each of these elements needs to be addressed if pupils are to capitalise on the benefits stemming from participation in group work. The outcomes of these two put forward posit that central to pupils' perception of group work is the role of the teacher, particular of value are strategies for emphasising the value of interaction; by supporting group work teachers provide pupils with a wider frame of reference, contextualising their learning. Teachers have shown they value specific means of organising groups and when provided with guidance their practice and beliefs show a burgeoning relationship. In particular, the nature of the thesis must be noted, the scale of the first study allowed specific features of classroom interaction to be signalled. The second study built on these features of classroom group work, developing an intervention aimed at a single topic area. Despite its small scale the second study found by triangulating findings, investigated by different measures, that good practice could be operationalised for secondary teachers.

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Appendices

Appendix 1 - Study 1 approval letters

Request for approval from local authorities to conduct Study 1

Dear *local authority*,

I am a postgraduate student within the Department of Psychology at the University of Strathclyde and am seeking permission to conduct research within Secondary schools as part of my doctoral research programme. This observation- based study considers both typical and group work focused lessons within schools, and I am writing to ask whether your school would be willing to participate.

Group work is often relied upon within schools as a means of allowing pupils to interact, learn and consolidate work and improve social relations. However there has been little systematic research with secondary schools and there are uncertainties about many issues such as how group work is employed across the curriculum, the size and number of groupings, how groups are managed within classrooms. I hope to redress this situation using your school to form a group of secondary schools who participate.

This study will continue until late November 2007. Each English and Science (both general Science and Chemistry/Physics) S3 classroom would be observed on three separate occasions. Teachers and pupils will also be asked to complete brief questionnaires. If there are particular dates that are preferable - please let me know and we can arrange a mutually suitable time. Please distribute this letter to individual teachers, who may contact me for further information.

The educational value of such research must not be underestimated. A wealth of research has been performed within primary schools, but little is known about teachers' planning for and expectation of pupils groups in secondary school classrooms. Once this important knowledge has been collected it will directly contribute to the development of a group work based intervention designed to increase the benefits of group work and contribute heavily to my doctoral research.

This study has been approved by the University of Strathclyde's Departmental Ethics Committee. All the information collected will be treated confidentially, names of participants will not be collected and schools shall not be named in any report.

Please contact me if you require any further details.

I look forward to hearing from you shortly.

Yours sincerely,

Sarah MacQuarrie

Parental consent letter Study 1

Dear Parent/Guardian

I am a postgraduate student at the University of Strathclyde and will soon be undertaking research in your child's school as part of my doctoral research programme.

My supervisor at the university is Jim Boyle and you may contact him with any questions or queries regarding this research at the above address or on 0141 548 2584.

Group work is often relied upon within schools as a means of allowing pupils to interact, learn and consolidate work and improve social relations. However there has been little systematic research with secondary schools and there are uncertainties about many issues such as how group work is employed across the curriculum, the size and number of groupings, and how groups are managed within classrooms.

The research that I am conducting will take the form of classroom observation and I intend to observe what happens during the course of a lesson within English and Science S1 and S3 classrooms. I intend to observe pupils on three occasions. During the classroom observation the class will continue as normal; although I will be present within the classroom I will not disturb the lesson. Following the observation your child may be asked to fill out a short questionnaire during class investigating pupil opinions and attitudes towards Science and English subjects.

All information obtained will be confidential, all data will remain anonymous and both the schools' and participants' identities kept confidential at all times.

If you consent to your child taking part in this research, please return the slip below to the school.

Thank you. Sarah MacQuarrie

I (Parent/Guardian) …………………………

Do / Do Not (delete as appropriate) give permission for

………………………….

to participate in the research proposed by Sarah MacQuarrie.

Parent/Guardian Signature………………………….

Date …………

Appendix 2- Study 1 Lesson context sheet

Lesson Context

Observer: Date: Time: School:

Subject: Eng / Sci Year: S1 / S3

Teacher: M/F Other ads: Tch SEN TA Other…

N boys____ N girls___ N groups___ Set: HI/ MED/ LO/ MIXED Obs Session: 1 2 3 4

Resources:

Time (approx)	Organisation and Group Info	Main activity	E.g. teacher-led intro; Group discussion
		Whole class being taught by the teacher	
		Small groups being taught by the teacher	
		Individual Pupils talking with the teacher	
		Working in groups on a shared task	
		In dyads on a shared task	
		Working quietly on your own Sitting in groups but working individually on a task	

Classroom Map

Appendix 3 - Study 1 Teacher observation grid

DESCRIPTIVE STATEMENTS						
	CONNECTIONS MADE	DEVELOP IDEAS	CONSOLIDATE	EVALUATE	REVISE	SUMMARISE
1						
2						
3						
4						
5						
6						
7						
8						

LESSON/MATERIAL INTERPRETATION					DIALOGUE						
	PUPIL PLENARY	LINK TO PAST/FUTURE LESSONS	FEEDBACK TO PUPILS	LESSON PURPOSE DETAILED	INST	EXP	DISAGREE	RES	Q&A WC	Q&A INDI	OTH
1											
2											
3											
4											
5											
6											
7											
8											

Teacher Observation Codes

Descriptive Statements	Connections made	Relevant to material/stimulate pupils' thinking.
	Develop ideas	Promote/broaden understanding.
	Consolidate	Reiteration of statements.
	Evaluate	Reason material more explicitly.
	Revise	Rework material already expressed.
	Summarise	Reduce material/concepts further.
Lesson/ Material Interpretation	Pupil plenary:	Pupils point out differences in opinion or experiences and used to share group output.
	Link to past/future lessons:	Explicit connections made. Links can be regarding any content.
	Feedback to pupils:	Used to correct/evaluate or to support meaningful learning.
	Lesson purpose detailed:	Expectations of teacher and pupil roles or descriptions of lesson content. Teachers tend to stress learning objectives.
Dialogue	Inst	Detail given regarding specific actions to be carried out.
	Exp	Clarification given to detail/help interpret something.
	Disagree	Teachers signal inconsistencies in pupil reasoning.
	Res	Teachers involved/exemplify how to address misconceptions.
	Q&awc	Questions posed to whole-class.
	Q&aindi	Questions posed to specific individuals.
	Other	Not covered/inaudible.

Appendix 4 - Study 1 Pupil observation grid

Name/Subject/year____

	INTERACTION			Teacher Presence		TASK & GROUPING ARRANGEMENT						ACTIVITY LEVEL			DIALOGUE			
	NOT	COG	CDG	+T	+TI	ITD	ITS	GS	GD	WC	WCi	ON	TASK PREP	OFF	INFORM	ASK	RESOLVE	OTHER
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		

Pupil observation codes

INTERACTION	NOT	Working alone
	COG	Working with others seated close by.
	CDG	Working with others seated far away.
TEACHER PRESENCE	+T	Teacher present
	+TI	Teacher engaged with pupil.
TASK & GROUPING ARRANGEMENT	ITD	Pupils assigned different tasks.
	ITS	Pupils assigned the same task.
	GS	Groups assigned different tasks.
	GD	Groups assigned the same task.
	WC	Teacher leading the whole-class.
	WCI	Pupils and teachers involved in whole-clas interaction.
ACTIVITY LEVEL	AON	Engaged with task.
	ATASK PREP	Classroom preparation
	AOFF	Not engaged with task.
DIALOGUE	INFORM	Give explanation.
	ASK	Seeking help, direct questions.
	RESOLVE	Examines others' accounts. May point ou inconsistencies.
	OTHER	Not covered /inaudible.

Appendix 5 - Study 1 Teacher questionnaire

Consent Form

As an informed participant, I understand that:

My participation is voluntary and I may terminate my participation at any time.

My participation is confidential and a number will identify my results only. No information that identifies me will be included in any reports based upon this survey.

I am entitled to an explanation of the study upon completion.

I have read and understood all of the above and consent to participate

Please tick ☐

This questionnaire is part of a study looking at group work in Scottish secondary schools.

The main purpose of the questionnaire is to gather information about the nature and use of group work within schools. The questionnaire should take approximately 20 minutes to complete.

Firstly, some questions about the person completing this questionnaire:

Post: ____

School name: ____________________________________

To complete this questionnaire please focus on the agreed class within your teaching schedule, please detail this here, and with the class in mind complete the questionnaire:

Subject of Class: ___________________________________

Year of Class: _____________________________________

Contact Details:

Sarah MacQuarrie
University of Strathclyde,
Department of Psychology,
Graham Hills Building,
40 George Street,
Glasgow, G1 1QE

1) How long you have been teaching?

□ 0-5years □ 5-10 years □ 10-15 years □ 15-20 years □20years+

2) Are you □ Male □ Female

3) Have you had any specific training relating to group work?
No ☐ Yes ☐, if so please detail below

Please indicate your agreement with the following statements.
Tick one box for each question.

4) "Mixed ability groups have greater academic benefits than single ability groups":

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

5) "A teacher's presence during group work benefits the group"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

6) "In my class pupils always arrange their own groups"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

7) "I ensure there is a mix of ability levels within groups"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

8) "I ensure there is a balance of male and female pupils within groups"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

9) "Groups are always based on pupil friendships"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

10) "Group work is used as an activity separate from other forms of teaching"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

11) "Group work helps to consolidate pupil's understanding of material"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

12) "Group work is most often used to give examples of material"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

13) "Group work is most often used to verbalise pupil's thinking"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

14) "When pupils are grouped I do not disturb them and let them get on with their tasks"

Totally agree	Partially agree	Neither agree nor disagree	Partially disagree	Totally Disagree
☐	☐	☐	☐	☐

15) Please indicate how often you:

Please tick one box per row	Every Lesson	A few times per week	Once per week	Rarely	Almost Never
Example		√			
Teach the whole-class					
Teach small groups					
Talk to individual pupils					
Allow pupils to work in a group on a shared task					
Allow pupils working with a partner on a shared task					
Teach pupils who are sitting and working individually					
Teach pupils who are sitting in groups but working on their own on a task					
Organise pupils in groups and allow them to work cooperatively on a task (e.g. by sharing out different parts of the task without necessarily always working together collaboratively)					
Organise pupils in groups and allow them to work together collaboratively to solve problems					

Thank you for completing this questionnaire

Appendix 6 - Study 1 Pupil questionnaire

Your school recently agreed to participate in some research aiming to find out more information about how pupils' feel about specific subjects within Secondary school.

A short questionnaire is attached, and if you decide to complete it, your answers will remain confidential and will not be known to the school or any of your teachers. The questionnaire comes in three parts. The first two sections ask questions about two different subjects and the third part asks you to complete a table.

By ticking the box below, I am agreeing that:

● I wish to take part, but I know I may opt out at any time

● I understand that all my answers to the questionnaire and my name will be kept confidential

● I have read this sheet and I want to take part

Please tick ☐

1) Please print your name in **CAPITAL LETTERS**

____

2) Are you: ☐Male ☐Female

3) What year are you in? ☐First year ☐Third year

4) What secondary school do you attend?

____

5) What are **ENGLISH** lessons like?

Tick one of the boxes for each statement	All of the time	Most of the time	Some of the time	Rarely	Not Sure
We learn a lot of facts in English					
We are asked to explain our answers to questions during English lessons					
In English lessons we discuss interesting ideas and topics whenever they come up					
We help to plan what we are going to do next in English					
Pupils settle down quickly at the start of our English lessons					
Everyone has a chance to say what they think in English lessons					

6) In **ENGLISH** lessons, how often do you spend your time?

Tick one of the boxes for each statement	During most lessons	Once or twice a week	Once or twice each term	Rarely	Not sure
With the whole-class being taught by the teacher					
In a small group being taught by the teacher					
Talking on your own with the teacher					
Working in a group on a shared task					
Working with a partner on a shared task					
Working quietly on your own					
Sitting in groups but working on your own on a task					

7) What are your opinions about your **ENGLISH** lessons?

Example:
Jill does not often enjoy English lessons

I like English lessons	☐ ☐ ☐ ☐ ☒ ☐	I dislike English lesson

I like English lessons	☐ ☐ ☐ ☐ ☐ ☐	I dislike English lesson
Interesting lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Easy lessons	☐ ☐ ☐ ☐ ☐ ☐	Complicated lessons
I'd like to spend more time on them	☐ ☐ ☐ ☐ ☐ ☐	I'd like to spend less time on them
Enjoying lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Important lessons	☐ ☐ ☐ ☐ ☐ ☐	Unimportant lessons
Important for other school subjects	☐ ☐ ☐ ☐ ☐ ☐	Unimportant for other school subjects

8) How do you feel about your **ENGLISH** course at school?

I feel I am coping well	☐ ☐ ☐ ☐ ☐ ☐	I feel I am not coping well
I am enjoying the subject	☐ ☐ ☐ ☐ ☐ ☐	I am not enjoying the subject
I find it very easy	☐ ☐ ☐ ☐ ☐ ☐	I find it very hard
I am obtaining a lot of new skills	☐ ☐ ☐ ☐ ☐ ☐	I am not obtaining a lot of new skills
I am enjoying practical work	☐ ☐ ☐ ☐ ☐ ☐	I dislike practical work
I like the teacher	☐ ☐ ☐ ☐ ☐ ☐	I dislike the teacher
It is definitely "my" subject	☐ ☐ ☐ ☐ ☐ ☐	It is definitely not "my" subject
Relevant to getting a good job	☐ ☐ ☐ ☐ ☐ ☐	Not relevant to getting a good job

The following questions look at your feelings about teaching methods within **ENGLISH** lessons. Please tick one box of the boxes per question.

9) "I really enjoy working as a whole-class with the teacher"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

10) "I like to work in groups with other pupils"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

11) "I like to work by myself"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

12) Which teaching method allows you to learn the most within a lesson?

Group work	Individual work	Working with one other person	Working as a whole-class
☐	☐	☐	☐

<u>Part two</u>

13) What are **SCIENCE** lessons like?

Tick one of the boxes for each statement	All of the time	Most of the time	Some of the time	Rarely	Not Sure
We learn a lot of facts in Science					
We are asked to explain our answers to questions during Science lessons					
In Science lessons we discuss interesting ideas and topics whenever they come up					
We help to plan what we are going to do next in Science					
Pupils settle down quickly at the start of our Science lessons					
Everyone has a chance to say what they think in Science lessons					

14) In **SCIENCE** lessons, how often do you spend your time?

Tick one of the boxes for each statement	During most lessons	Once or twice a week	Once or twice each term	Rarely	Not sure
With the whole-class being taught by the teacher					
In a small group being taught by the teacher					
Talking on your own with the teacher					
Working in a group on a shared task					
Working with a partner on a shared task					
Working quietly on your own					
Sitting in groups but working on your own on a task					

15) What are your opinions about your **SCIENCE** lessons?

Example:
Jill usually enjoys Science lessons

I like Science lessons	☐ ☒ ☐ ☐ ☐ ☐	I dislike Science lesson

I like Science lessons	☐ ☐ ☐ ☐ ☐ ☐	I dislike Science lesson
Interesting lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Easy lessons	☐ ☐ ☐ ☐ ☐ ☐	Complicated lessons
I'd like to spend more time on them	☐ ☐ ☐ ☐ ☐ ☐	I'd like to spend less time on them
Enjoying lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Important lessons	☐ ☐ ☐ ☐ ☐ ☐	Unimportant lessons
Important for other school subjects	☐ ☐ ☐ ☐ ☐ ☐	Unimportant for other school subjects

16) How do you feel about your **SCIENCE** course at school?

I feel I am coping well	☐ ☐ ☐ ☐ ☐ ☐	I feel I am not coping well
I am enjoying the subject	☐ ☐ ☐ ☐ ☐ ☐	I am not enjoying the subject
I find it very easy	☐ ☐ ☐ ☐ ☐ ☐	I find it very hard
I am obtaining a lot of new skills	☐ ☐ ☐ ☐ ☐ ☐	I am not obtaining a lot of new skills
I am enjoying practical work	☐ ☐ ☐ ☐ ☐ ☐	I dislike practical work
I like the teacher	☐ ☐ ☐ ☐ ☐ ☐	I dislike the teacher
It is definitely "my" subject	☐ ☐ ☐ ☐ ☐ ☐	It is definitely not "my" subject
Relevant to getting a good job	☐ ☐ ☐ ☐ ☐ ☐	Not relevant to getting a good job

The following questions look at your feelings about teaching methods within **SCIENCE** lessons. Please tick one box of the boxes per question.

17) "I really enjoy working as a whole-class with the teacher"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

18) "I like to work in groups with other pupils"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

19)"I don't like it when I have to work by myself"

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

20) How do you learn best within a lesson?

Group work	Individual work	Working with one other person	Working as a whole-class
☐	☐	☐	☐

Thank you for answering this questionnaire. Please turn to the next page

Part three

Please circle which statement most closely matches your relationship with each pupil listed below.

For example, Jill thinks of Jack as a close friend: Jill therefore chose to circle number 2

		Would like to have her/him as one of my best friends		Don't mind him/her being in our class but I have no strong feelings towards them being in the class		Wish she/he weren't in our room
Example: Jill rating Jack		**1**	②	**3**	**4**	**5**
1		**1**	**2**	**3**	**4**	**5**
2		**1**	**2**	**3**	**4**	**5**
3		**1**	**2**	**3**	**4**	**5**
4		**1**	**2**	**3**	**4**	**5**
5		**1**	**2**	**3**	**4**	**5**

Appendix 7 - Three cluster solution.

Cluster Distribution

Cluster	N	% Of Combined	% Of Total
1	395	57.0	56.8
2	134	19.3	19.3
3	164	23.7	23.6
Combined	693	100.0	99.7
Excluded cases	2		0.3
Total	695		100.0

It is clear that the first cluster is the largest (57%); followed by the third cluster (23.7%) and the second cluster the smallest (19.3%). The contribution of each variable to each of the three clusters is presented in the following table.

Table of Cluster Frequency Profiles

	Cluster1		Cluster2		Cluster3	
Variables	Freq	%	Freq	%	Freq	%
No Interaction	**99**	**25.5**	**125**	**32.2**	**164**	**42.3**
Interaction with nearby pupils	**394**	**80.2**	**55**	**11.2**	**42**	**8.6**
Interaction with further away pupils	60	69.8	14	16.3	12	14.0
Teacher Present	54	67.5	17	21.3	9	11.3
Teacher Interaction	137	67.2	33	16.2	34	16.7
Different individual tasks	1	16.7	0	0	**5**	**83.3**
Similar individual tasks	**1**	**0.7**	**134**	**98.5**	**1**	**0.7**
Similar group tasks	**349**	**85.1**	**1**	**0.2**	**60**	**14.6**
Different group tasks	**44**	**91.7**	**0**	**0**	4	8.3
Whole-Class	**15**	**17.4**	14	16.3	**57**	**66.3**
Whole-class interaction	**3**	**4.2**	4	5.6	**65**	**90.3**
On task behaviour	364	56.3	131	20.2	152	23.5
Classroom preparation	60	75.9	**4**	**5.1**	15	19.0
Not engaged with task	120	66.3	29	16.0	32	17.7
Inform	**265**	**79.3**	**41**	**12.3**	**28**	**8.4**
Ask	**174**	**80.2**	33	15.2	**10**	**4.6**
Resolve	**115**	**78.8**	18	12.3	**13**	**8.9**
Other/inaudible	**123**	**78.8**	21	13.5	**12**	**7.7**

Note: items in bold contribute to the formation of the clusters.

When the contribution of each variable to each of the clusters is examined less distinct patterns are evident. Such overlap suggests the clustering may be incomplete and could become more intelligible following a subsequent stage.

Appendix 8 -Tukey by hand calculations

Equation to compute Tukey HSD by hand (reports absolute difference between means)

$$T = q_k(\sqrt{\frac{MSerror}{n}})$$

N.B. Harmonic mean was included in Tukey calculations to account for unequal sample size.

Example English attitude Scores Lessontype*Year				
n =41.5 MS error = 37.64 k = 4 df error = 156 q0.05 = 3.63		$T_{0.05}$ = 3.63 x √ (37.64/41.5) = 3.44 x 0.91 = 3.29		
T = 3.29	24.19	30.32	30.31	29.37
24.19	-	6.13*	6.12*	5.18*
30.32		-	.01	0.95
30.31			-	0.94
29.37				-

*exceeds the level of absolute difference

English self perception Score Lessontype*Year				
n =41.5 MS error = 42.49 k = 4 df error = 156 q0.05 = 3.63		$T_{0.05}$ = 3.63 x √ (42.79/41) = 3.63 x 1.04 = 3.76		
T = 3.76	29.26	34.4	38.13	35.16
29.26	-	5.14*	8.87*	5.9*
34.4		-	4.13*	0.76
38.13			-	2.97
35.16				-

*exceeds the level of absolute difference

Science self perception Score Lessontype*Year				
n =40 MS error = 45.98 k = 4 df error = 152 q0.05 = 3.63		$T_{0.05}$ = 3.63 x √ (45.98/40) = 3.63 x 1.15 = 4.17		
T = 4.17	39.14	34.26	39.38	36.94
39.14	-	4.88*	0.24	2.2
34.26		-	5.12*	2.68
39.38			-	2.44
36.94				-

*exceeds the level of absolute difference

Mean social distance rating Lessontype*Year				
n =49.75 MS error = .338 k = 4 df error = 128 q0.01 = 4.40		$T_{0.05}$ = 4.40 x √ (.338/49.75) = 4.40 x .001 = 0.03		
T = 0.03	2.59	2.36	2.11	2.48
2.59	-	0.23*	0.48*	0.11*
2.36		-	0.25*	0.12*
2.11			-	0.37*
2.48				-

*exceeds the level of absolute difference

Neutral ratings Gender*Year				
n =34 MS error = 4.28 k = 4 df error = 128 q0.01 = 4.40		$T_{0.05}$ = 4.40 x √ (4.28/34) = 4.40 x 0.13 = 0.55		
T = 0.47	4.17	3.58	3.53	5.8
4.17	-	0.59*	0.64*	1.63*
3.58		-	.05*	2.22*
3.53			-	2.27*
5.8				-

*exceeds the level of absolute difference

Neutral ratings Lessontype*Year				
n =34.25 MS error = 4.28 k = 4 df error = 128 q0.01 = 4.40	T0.05 = 4.40 x √ (4.28/34.25) = 4.40 x .12 = 0.55			
T = 0.55				
	3.24	3.05	4.46	6.33
3.24	-	0.81*	1.22*	3.09*
3.05		-	1.41*	3.28*
4.46			-	1.87*
6.33				-

*exceeds the level of absolute difference

Negative ratings Gender*Year*Lessontype								
n =34.25 MS error = 3.15 k = 8 df error = 128 q0.01 = 4.99	T0.05 = 4.99 x √ (3.15/34.25) = 4.99 x 0.09 = 0.46							
T = 0.39	2.4	0.7	2.09	1.8	1.13	2.18	2.29	1.24
2.4	-	1.70*	0.31	0.6*	1.27*	0.22	0.11	1.16*
0.7		-	1.39*	1.1*	0.43*	1.48*	1.59*	0.54
2.09			-	0.29	0.96*	0.09	0.20	0.85*
1.8				-	0.67*	0.38	0.2	0.56*
1.13					-	1.05*	1.16*	0.11
2.18						-	0.11	0.94*
2.29							-	1.05*
1.24								-

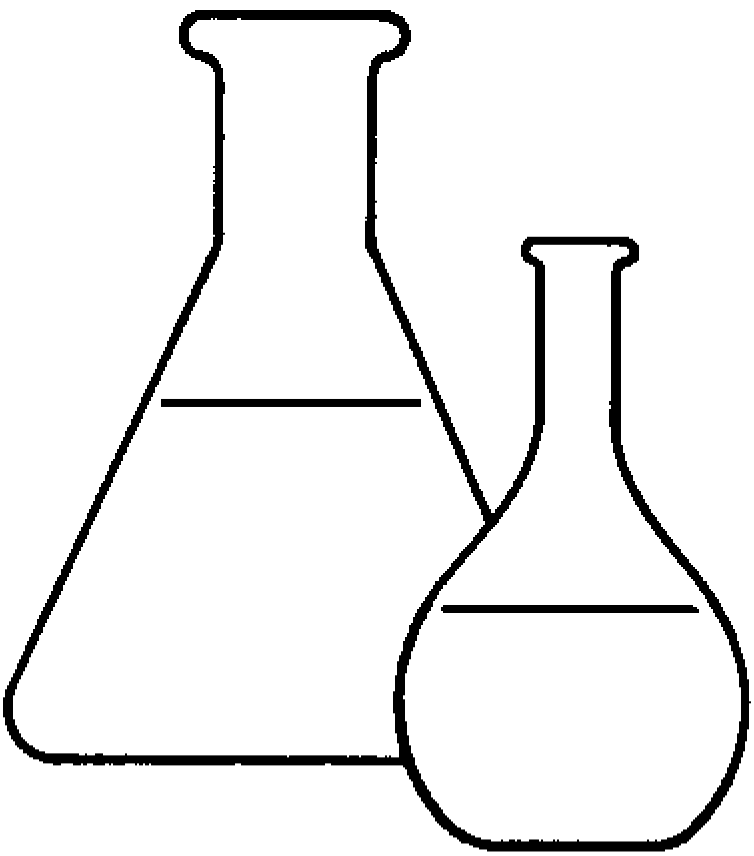
*exceeds the level of absolute difference

Appendix 9 - Teacher booklet

N.B. Abbreviated content presented – only lesson plans for the worksheets presented in Figure 6.2, 6.3 and 6.4 have been outlined – other sections of the teachers booklet have been kept intact.

Materials

Notes for Teachers



Orientation

This pack provides explanation and tips for completing the science group work activities.

The group work activities are designed to cover aspects of the 5-14 curriculum, and aim to support pupils' learning across a number of strands within the Environmental studies component of the curriculum.

We have summarised each activity in terms of the resources required within Table 1. Time required, group size and 5-14 Level are shown in Table 2. Finally, the group skills that may be integrated into each activity are presented in Table 3.

Each section of the Teacher's Notes has the same structure in that: it lists 5-14 science links; states the intended learning of the activity; indicates how long the activity should typically take; lists the resources required; indicates the teaching and learning sequence, typically – briefing, grouping instructions, activity, and debriefing information.

We fully expect you to make professional judgement decisions as you see appropriate for your class and hope that you will use your discretion to decide whether certain activities require more or less emphasis and more or less time than suggested within the booklet. A key feature of the lessons is that they include a maximum amount of pupil thinking and talking. Try to ensure that, as far as possible, time for this thinking is preserved.

The resources that you are likely to require for each activity are listed within Table 1. We hope that these resources will be commonly available to you in school. If you have trouble accessing the resources please contact Sarah MacQuarrie at the University of Strathclyde by phone on 0141 548 4392 or via email at sarah.macquarrie@strath.ac.uk for advice and help.

Approximately one week prior to teaching these lessons each pupil should complete the Materials pre-test. After teaching the topic (approx 2 weeks) they should complete the Materials post-test.

We thank you for participating within this research. We hope it will help us develop ways to raise attainment and interest in science in Scottish secondary schools.

Activity - Particles in solids, liquids and gases

Page 25 of pupil workbook

- Scottish 5-14 Links

Materials from earth - Describe the particulate nature of solids, liquids and gasses and use this to explain their known properties (Level E).

- Intended Learning

  Pupils should understand the way particles are packed together and behave when a substance exists as a solid, a liquid or a gas.

- Time required – 20 minutes

<u>Teaching and learning sequence</u>

Briefing – 5 minutes
Ask the pupils to think about their ideas from the previous activity (Solids, liquids and gasses). Previous activities have considered the changing appearance of water in its 3 forms. How can you build on their observations about water in different states from these experiences?

Can they suggest ways in which the way particles move and are attracted to each other in solids, liquids and gasses. If any constraints on movements are given by pupils record these for use at the end of the lesson

Tell the pupils you will be looking to see how good the group was at taking turns and making group decisions and coming to consensus.

Grouping instructions
Get the pupils to work in groups of (about) 5. They need to be seated in such a way that they can all contribute to the discussion.

Activity – 10 minutes
The pupils should complete the activity.

Debriefing – 5 minutes
Have the groups been able to sort the descriptors of how the particles behave and are attracted to each other into the correct columns in the table?

The descriptors/phrases can be reviewed and compared to more clearly explain the differences between solids, liquids and gases. If constraints were noted earlier they can reused or introduced at this point

Was the group able to take turns and make group decisions and come to consensus? How could they be encouraged to enhance this aspect of their group work?

Activity - Diffusion

Page 28 of pupil workbook

- Scottish 5-14 Links

Materials from earth - Describe the particulate nature of solids, liquids and gasses and use this to explain their known properties (Level E).

- Intended Learning

  Pupils should understand that particles can spread through a liquid through diffusion.

- Time required – 40 minutes total

<u>Teaching and learning sequence</u>

Briefing – 5 minutes
Talk about diffusion in liquids. Can the pupils give examples of diffusion in liquids? What happens when diluting juice is added to water? If they add bubble bath to water what happens to the bubble bath liquid? How does it spread through the water?

Tell the pupils you will be looking to see how good the group was at active listening and summarising conversations.

Grouping instructions
Get the pupils to work in groups of (about) 5.
One pupil per group will need to record the appearance of the liquid in the boiling tube on four occasions.

Activity – 10 minutes + three lots of 5 minutes observation and recoding
This is an activity that requires setting up and then minimal time to make observations over an extended period of time. You will need to plan to occupy the pupils with alternative activities when there are gaps in this experiment. Ensure the pupils take care when handling the food colouring. It can stain clothing if spilled. We also recommend that you set up a demonstration tube of water in a large gas jar. This can be lead to a very effective demonstration of diffusion in liquids.

Debriefing – 10minutes
Some background detail may need to be revised before debriefing is begun, as the activity takes place over two lessons.

Were the groups able to trace the slow spread of food colouring particles through the water?

Can they explain the spread in terms of the slow movement of the molecules through the water? Can they imagine how the water particles have contributed to the diffusion? Allow pupils to refer to their summary within their workbook to help express their ideas. Comparisons of these summaries may also be beneficial.

Was the group able to actively listen and summarise conversations? How could they be encouraged to enhance this aspect of their group work?

Activity - Changing temperature to alter reaction speed

Page 46 of pupil workbook

- Scottish 5-14 Links

Attainment Targets-Knowledge and Understanding- Changing materials
Give examples of the ways in which the rates of chemical reactions can be changed (Level F).

- Intended Learning

After undertaking the activity the pupils should know that changing the temperature can alter the rate of a chemical reaction.

- Time required – 30 minutes

<u>Teaching and learning sequence</u>

Briefing – 5 minutes
Talk about how heat can be used to promote chemical changes. At this point relate back to the previous activity where solution strength was used to illustrate a chemical change – important at this point to inform pupils that this activity builds on the previous one – in other words we are extending their knowledge of chemical changes, they are learning the various ways that such changes can take place.
Can the pupils think of any activities where heat does this? How about the baking of cakes or the cooking of food? If inappropriate examples are provided, try to explain or ask pupils to reason why these examples are inappropriate.

Review with pupils how to read the scales on the thermometers.

Tell the pupils you will be looking to see how good the group was at making group decisions and coming to consensus, and giving and asking for help. Safety – ensure the pupils wear goggles, gloves and a lab coat.

Grouping instructions
The pupils should work in groups of (about) 5.
It may be an idea to appoint roles during this experiment. The roles may include those of equipment preparation, chemical preparation, timer, temperature taker, recorder and reporter.

Activity – 15 minutes
Whilst knowledge of the chemical composition and molarities of the solutions are not required by the pupils, the solutions need to be prepared with the following strengths and chemicals:

Solution A - A saturated solution of Calcium hydroxide
Solution B – 0.5 molar Sodium hydrogen carbonate (Sodium bicarbonate)

Get the pupils to complete the activity in their groups.

Debriefing – 10 minutes
Have the pupils been able to think about how heat may put more energy in the beaker containing the chemicals that reacted quickest? Try to make connections during interpretation of the activity to the examples provided by pupils and also to make connections to the previous lesson involving chemical reactions.

With more energy then the molecules move around more and are therefore more likely to react with each other. The heat also means that the molecules are in a more excited state and that the chemical reactions are more likely to start. Possible links could be made to “the balloon’s going up” activity – particularly as pupils will have observed the balloon inflating and later deflating when heat has dispersed: begin to develop the ideas that chemical reactions can be temporary.

Was the group able to make group decisions and come to consensus, and give and ask for help? How could they be encouraged to enhance this aspect of their group work?

Table 1: Resource list for the science activities

Activity	Resources required
Changing States – Solid to liquid	A bowl Ice A thermometer
Solids, liquids and gases	A clear plastic kettle (or some alternative safe means of boiling water) A thermometer that can read up to 100˚C.
Changing materials	A lighted candle Pasticene Water bath A jar that is longer in length than the length of the candle Safety equipment
Evaporation	Saucers that have concentric numbered rings drawn radiating out from the saucer's centre Water Salt
Boiling and Evaporation	A heat source Salt Water A container for heating the salt water A spatula A cool surface on which to condense the steam
Water as a solid, liquid and gas	Worksheet Ice, water and a boiling kettle Molecular modelling equipment
Particles in solids, liquids and gases	Worksheet Molecular modelling equipment
Diffusion	A boiling tube A boiling tube holder A bottle of food colouring
Gases on the move	A bottle of perfume
The balloon's going up	A container Hot water A balloon A conical flask
Changing solution strength to alter reaction speed	Solution 'A' – saturated solution of Calcium hydroxide Water 200 ml measuring cylinder Four 250ml Perspex beakers Paper A stopwatch Dilute acid solution 'B' – 0.5 Molar Sodium hydrogen carbonate 10ml measuring cylinder
Changing temperature to alter reaction speed	Solution 'A' – saturated solution of Calcium hydroxide 50ml ice cold water 50ml tap water 50ml warm water A thermometer 200 ml measuring cylinder Three 250ml Perspex beakers Paper A stopwatch Dilute acid solution 'B' – 0.5 Molar Sodium hydrogen carbonate 10ml measuring cylinder
Changing particle size to alter reaction speed	Small lumps of marble Three large lumps of marble Powdered marble Water 200 ml measuring cylinder Three 250ml Perspex beakers Dilute acid solution 'C' – distilled vinegar (non-brewed condiment) – 5 % acetic acid 10ml measuring cylinder
Using a catalyst to alter reaction speed	Four 250ml beaker 400ml of 5 Volume Hydrogen peroxide Manganese dioxide Copper wire Freshly cut potato

Table 2: Suggested 5-14 Level, time required and group size for the activities

Activity	5-14 Level	Time required (minutes)	Group size
Changing States – Solid to liquid	E	30	5
Solids, liquids and gases	E	40	5
Changing materials	E	20	5
Evaporation	E	30	5
Boiling and evaporation	E	30	5
Water as a solid, liquid and gas	E	25	5
Particles in solids, liquids and gases	E	20	5
Diffusion	E	40 in total	5
Gases on the move	E	25	5
The balloon's going up	E	25	5
Changing solution strength to alter reaction speed	F	30	5
Changing temperature to alter reaction speed	F	30	5
Changing particle size to alter reaction speed	F	30	5
Using a catalyst to alter reaction speed	F	30	5

Table 3: Group work skills covered in each activity

	Group work skills (see key below)											
Activity	1	2	3	4	5	6	7	8	9	10	11	12
Changing States – Solid to liquid								X				
Solids, liquids and gases				X								
Changing materials			X									
Evaporation					X							
Boiling and evaporation									X			
Water as a solid, liquid and gas	X									X		
Particles in solids, liquids and gases	X									X		
Diffusion		X									X	
Gases on the move						X						
The balloon's going up					X		X					
Changing solution strength to alter reaction speed										X	X	
Changing temperature to alter reaction speed							X			X		
Changing particle size to alter reaction speed										X	X	
Using a catalyst to alter reaction speed								X				X

Group work skills key

1. taking turns
2. active listening
3. asking and answering questions
4. making and asking for suggestions
5. expressing and requesting ideas and opinions
6. brainstorming suggestions, ideas and opinions
7. giving and asking for help
8. giving and asking for explanations
9. explaining and evaluating ideas
10. making group decisions and coming to consensus
11. summarising conversations
12. persuasive talk

Guidelines for classroom group work

Group size

- Small groups are reported by teachers as being easier to manage. Additionally small groups lead to more successful and sustained discussions. Groups of 4 or 5 encourage pupils to engage with each other in order to give an explanation or clarify their thinking. Within such groups pupils are more likely to be focused on completing and understanding the activity.

Group Composition (Try to include these features when constructing groups)

- Incorporate both male and female pupils
- Include pupils who have different strengths and abilities (this includes different personalities)
- Think about pupil friendships. Although some friends can work well together they can also inadvertently minimise productive interaction and what the group achieves.
- Whenever possible try to ensure that pupils work in the same groups within lessons.

Pupils' Skills

- Depending upon the classroom behaviour rules within your school, your may find the following table useful; its content clearly sets out what we expect of pupils and how they can achieve these goals. As pupils may experience different forms of group work within the school, it is important to establish what is expected during your lessons.

- These guidelines can help establish group interdependence: the concept that each individual within a group has an equal role and therefore is equally responsible for what their group can achieve.

Rights and responsibilities of Group Members	
Rights to learn	**Responsibilities in learning**
I have a right to learn	I have a responsibility to help others learn
I have a right to contribute	I have a responsibility to help others contribute
I have a right to receive respect	I have a responsibility to respect others
I have a right to ask for help	I have a responsibility to give help to others
I have the right to be able to do the best I can.	I have a responsibility to help others produce the best they can

Think and Share

- A number of the group work activities feature "Think and Share". The think aspect encourages pupils to reflect on their own thoughts and opinions, whilst Share asks group members to compare, explain and discuss their ideas.

- Some activities pupils are asked to discuss and agree upon an answer to a question – the use of consensus encourages pupils to explain their reasoning to fellow pupils.

Teacher's role at the beginning of lessons – 2 parts

Setting up the classroom VS Setting up the lesson

Setting up the classroom

- Think about the classroom seating layout - if the classroom seating arrangements need to be altered before every group work lesson, get the pupils used to this. The more often they are involved in the changes, the quicker and easier setting up the classroom will become.

- Are pupils facing each other – regularly when pupils seat themselves in groups they will make sure that they can view you – the teacher. A reminder to face other members of the group can be very useful following a lesson introduction.

- One workbook per group (where possible). Generally one workbook forces pupils to face each other and cooperate. Restricting resources during group work discussions is known to encourage interaction and is feasible when small groups are used.

Setting up the lesson

- Contextualise material – at the outset of the lesson how you can contextualise material may take on a slightly different role than during the end of a lesson. When introducing material, making links to other lessons, and determining real life examples are two possibilities, which can gain pupils' attention and more importantly help establish the activity within pupils' knowledge. See teacher's role at the end of the lesson for more detail.

- Reminder of group work rules. When pupils are working within groups they will utilise a variety of skills. This is where your role as the teacher is crucial. It is worthwhile revising or listing the skills that pupils can expect to use within a given lesson. Worthwhile making time to include this important step during the lesson introduction – your enthusiasm for pupil interaction is also important as it shows to pupils that you support an important factor at this stage.

- Reminder of any health of safety guidance (if relevant).

Teacher's role during group work

- Whilst pupils are working together to complete a task – we need to think about your role as the teacher and how you function within a classroom.

- Try to let pupils get on with it! – groups tend to go through a number of processes particularly when pupils are getting used to working as a group – at such times adopting a background role and covertly monitoring groups is beneficial rather than being directly involved.

- When necessary adopt the role of a coach – guide pupils towards appropriate reasoning strategies, rather than providing an explanation. Coaching includes "modelling" - phrases such as "what do you think", "Can you give a reason for that?" can help encourage dialogue if pupils are refraining from speech.

- Modelling and coaching – are indirect means of being involved with groups: try to refrain from giving "correct or incorrect" when asked directly about the task that pupils are completing. Encouraging pupils to give their own thoughts also helps to emphasise that you attribute worth to their contributions.

Teacher's role at the end of lessons

Feedback regarding Group work

- Some feedback needs to be given regarding how pupils have worked within groups during that lesson. This can easily be prompted by asking pupils or groups to think about what they liked about working in a group and what would they change or improve. Giving pupils the opportunity to reflect on their behaviour provides another opportunity for them to develop connections between newly acquired information and prior knowledge and allow the teacher to give some constructive insight.

- Make sure to give your perspective to pupils about how they have worked within groups during that lesson. Point out instances of good work to demonstrate when pupils have worked well together. Pupils will attend and respond to a teacher who appreciates the effort and provides feedback regarding attempts that pupils have made during the course of a lesson. Friendly dialogue during such pupil-teacher interaction can really boost the classroom environment.

- A few words relating to how pupils have been capable using specialised equipment may be beneficial within particular activities.

Contextualise material

- Aim to incorporate material that pupils have developed within groups – this is perhaps one of the fundamental points! A teacher led plenary session can help to acknowledge the variety of answers/points made by pupils; making comparisons and contrasts more feasible. Similarly when such information is recorded onto a blackboard it creates a real impact – and can help make pupils realise the diversity of their knowledge and can flag up the point that different groups came up with different information.

- A pupil focused plenary is another format that can be used effectively following group work. It encourages pupils to comment on each others practices; and allows pupils to share knowledge, and be supportive of each other. Let pupils develop the interaction within this type of feedback session, perhaps recording pupils' responses onto the classroom board whilst facing away from class can encourage pupils to voice their ideas.

- Helping pupils to link material from previous lessons with current information is vital. Pupils need to be able to integrate new and old information in order to put their learning into context, which will enable them to make connections so that they can construct their own interpretations.

Teacher rating scale

Name:

School:

<u>Time 2 – this form should be completed within the same day/week as pupils complete Test 2.</u>

	Most				Least
Pupil Name	5	4	3	2	1
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					

Please rate each pupil according to the number of positive interactions they experience with their peers during your lessons:

Appendix 10 – Study 2 approval letters
Request for approval from local authorities

Dear *local authority,*

Request to undertake research in Schools

I am a postgraduate student working in collaboration with Mr Jim Boyle, University of Strathclyde and Professor Christine Howe, University of Cambridge and am seeking permission to conduct research within Secondary schools as part of my doctoral research programme. I am writing to ask whether you would be willing to approve this research so that I am able to contact schools within your authority.

Background:
Group work is relied upon within schools as a means of allowing pupils to interact, learn, consolidate work, and improve social relations. However there has been little systematic research with secondary schools and there are in particular uncertainties regarding how to optimise group work at this level. The aim of the proposed study is to introduce a group work classroom based initiative, involving both pupils and their teacher within secondary schools. Research has focused on physics and chemistry based lessons, the observation study followed such research and it is anticipated that the group work initiative should also concentrate on these teaching areas.

Summary of the proposed study:
Teachers will be directly involved in the introduction of a group work based initiative, which will concentrate on a particular topic area taken from the 5-14 curriculum. Schools and teachers who are interested in contributing and committing to using a group work initiative within S1 science classrooms are the focus of this initiative. Cooperation with the teachers involved will be necessary to determine when the particular topic will be covered during the school year (early 2009 is anticipated to be the most appropriate time) and to ensure the smooth running of the research.

Approximately six teachers, and the pupils within the classrooms that they teach, will be needed to participate in the proposed study. Ideally, three schools (up to a limit of five) would be recruited, two teachers coming from each school. In addition to observations being taken of group work lessons, pupils will be asked to complete specific measures (attached). The study aims to maintain a whole school approach in that the Science department of a school adopts the group work initiative and informs parents of such approaches being implemented within its classrooms. Science lessons within initiative classrooms use both group work and whole-class approaches and replace conventional approaches to the teaching of a topic area. Therefore, irrespective of whether pupils are learning within initiative or conventional classrooms they are given equal opportunities to learn; as the same material will be covered in both types of classrooms. Consent from parents will therefore only relate to whether their child is given the opportunity to complete self-report measures. Within the self-report measures given to pupils, the first page will clearly outline that participation is voluntary and participants may withdraw their participation in relation to the questionnaire at any time.

Previous research:
This project is based on two previous studies. 15 schools within 7 education authorities participated within a survey, which gauged teachers' usage of group work. The results indicated that English and Science teachers within the first and third years of secondary education, in particular, utilised a variety of group work methods. Systematic observations of classroom interaction within both these subject areas were conducted within 10 schools of 6 local authorities (Study 1 of Doctoral research). Observations took place during group work and conventional lessons and the findings suggest that first year Science lessons are a suitable environment, within which a group work initiative could be based.

Implications of Research
This study would support schools looking to encourage productive classroom interaction or strengthen the group work practices currently used within lessons. Additionally it would provide an opportunity for pupils to gain a range of thinking and reasoning skills and use these in addition to receiving guidance from their teacher. These skills can help support learning when pupils are working with others or working individually. More generally this
study will have devised a group work initiative, based on research evidence, tailored specifically for use within first year Science classrooms.

This study has been approved by the University of Strathclyde's Departmental Ethics Committee. All the information collected will be treated confidentially, names of participants will not be collected and schools shall not be named in any report.

Please contact me if you require any further details.

I look forward to hearing from you shortly.

Yours sincerely,

Sarah MacQuarrie

Study 2 – Parental consent letter

Dear Parent/Guardian

I am a postgraduate student at the University of Strathclyde and will soon be undertaking a study in your child's school as part of my doctoral research programme.

My supervisor at the university is Mr. Jim Boyle and you may contact him with any questions or queries regarding this research at the address below or on 0141 548 2584.

I am writing to ask for your permission for your child to take part in this study. Pupils within Science lessons will be asked to complete questionnaires on two occasions between January and April 2009, which ask them to think about their ideas and learning within Science lessons.

This study is approved both by the University of Strathclyde, the local authority and the school. All information obtained will be confidential, all data will remain anonymous and both the schools' and participants' identities kept confidential at all times.

The more children who participate and complete these questionnaires the more meaningful this research will become. Therefore, I hope you will consent to your child taking part in this study, by returning the slip below to the school.

Thank you in advance for your help with this matter.

Yours sincerely, Sarah MacQuarrie

I (Parent/Guardian) ……………………………

Do / Do Not (delete as appropriate) give permission for

……………………………

to participate in the research proposed by Sarah MacQuarrie.

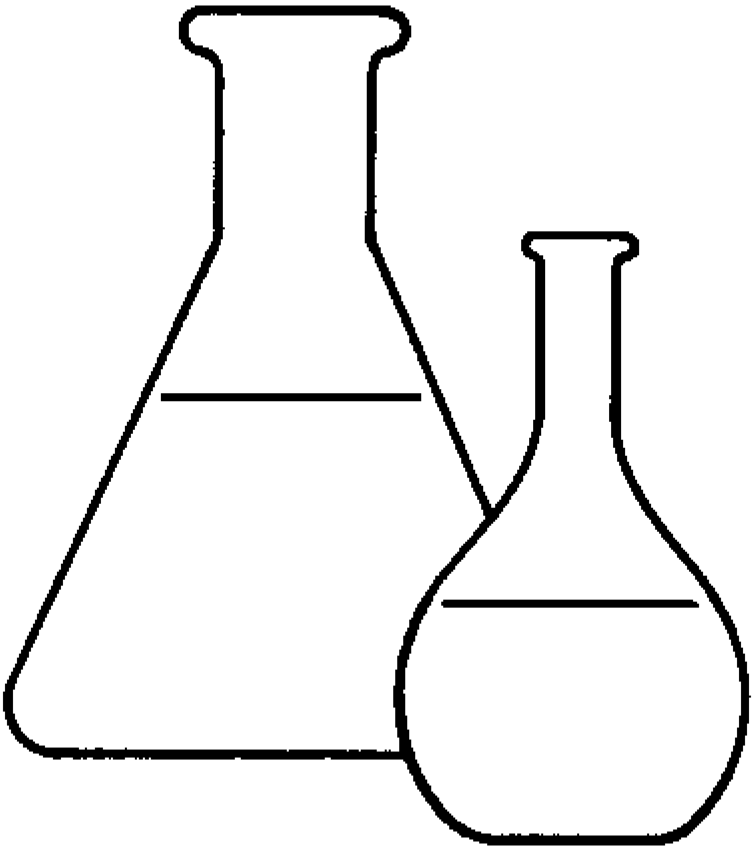
Parent/Guardian
Signature…………………………………………………

Date …………

Appendix 11 - Pupil pre- and post-tests

Academic Test

Materials Knowledge Test



You will have 30 minutes to complete the test.

This is what to do:

In this booklet there are a number of questions for you to answer.

Start at question 1 and work your way through the booklet.

If you find a question too hard, miss it out and go on to the next one.

Try to answer as many questions as possible.

Do your best work.

Write your name and the other information needed in the boxes below.

First name	Surname	Age
Name of School	**Male or female**	**Date**

Materials

Place a tick (✔) in the box next to the answer you think is right for each question. Please only tick ONE box per question.

Example

Which of the following animals is a reptile?

- a) brown bear ☐
- b) great white shark ☐
- c) pigeon ☐
- d) common toad ☑
- e) rattle snake ☐

1. When water evaporates from a saucer where does it go?

- a) It has vanished. ☐
- b) It has soaked into his clothes and hair. ☐
- c) It has gone up into the sun. ☐
- d) It has gone into the air. ☐
- e) Somebody took it. ☐

2. When water evaporates from a saucer what happened to it?

- a) Nothing. ☐
- b) It became a liquid. ☐
- c) It became a gas. ☐
- d) It disappeared. ☐
- e) It became a cloud. ☐

3. What happens to the molecules in water when it evaporates?

a) They have moved very close together and are very still. ☐

b) They have moved far apart and are very still. ☐

c) They are quite close to each other and are moving about. ☐

d) They have disappeared. ☐

e) They have moved far apart and are moving very quickly. ☐

4. If clothes on a washing line dry very quickly what is the best explanation for this?

a) It was probably cold and windy. ☐

b) It was probably hot and windy. ☐

c) The sun was probably out. ☐

d) The water just disappeared. ☐

e) There were probably lot of clouds about. ☐

5. What do you think happens to the molecules of water when clothes dry?

a) They just disappeared. ☐

b) They had a lot of energy and stayed quite close together. ☐

c) They had a lot of energy and moved away from each other quickly. ☐

d) They had little energy and moved away from each other quickly. ☐

e) They had a medium amount of energy and stayed quite close together. ☐

6. What is the process called when the water dries out?

a) Freezing. ☐

b) Disappearing. ☐

c) Melting. ☐

d) Evaporation. ☐

e) Condensation. ☐

7. What kind of surface would be best to reverse the process of water drying up?

a) Really cold. ☐

b) Cold. ☐

c) Warm. ☐

d) Hot. ☐

e) Really hot. ☐

8. In winter sometimes water appears on the INSIDE of windows. This rarely happens in summer. Can you explain why?

a) Rain soaks through the windows in winter. ☐

b) The cold windows make the water turn into gas. ☐

c) Frozen water melts onto the windows. ☐

d) The cold windows make water vapour turn into liquid. ☐

e) The cold windows make the water freeze. ☐

9. Can you explain what happens to the water molecules when the water appears on the inside of the windows?

a) Nothing. ☐

b) They lose energy and move closer together. ☐

c) They gain energy and move closer together. ☐

d) They gain energy and move apart. ☐

e) They lose energy and move apart. ☐

10. What is the process called when water appears on the inside of windows?

a) Condensation. ☐

b) Evaporation. ☐

c) Disappearing. ☐

d) Freezing. ☐

e) Appearing. ☐

11. What temperature does ice melt at?

a) 0^{o} Celsius. ☐

b) 25^{o} Celsius. ☐

c) 50^{o} Celsius. ☐

d) 75^{o} Celsius. ☐

e) 100^{o} Celsius. ☐

12. In which state are the bonds between particles strongest in water?

a) Ice. ☐

b) Water. ☐

c) Steam. ☐

d) Gas. ☐

e) Liquid. ☐

13. In which state are the bonds between particles weakest in water?

a) Ice. ☐

b) Water. ☐

c) Steam. ☐

d) Solid. ☐

e) Liquid. ☐

14. When water boils what are the bubbles produced composed of?

a) Oxygen. ☐

b) Air. ☐

c) Hydrogen. ☐

d) Oxygen and hydrogen. ☐

e) Steam. ☐

15. What gas is used up in the air when something burns?

a) Nitrogen. ☐
b) Carbon dioxide. ☐
c) Argon. ☐
d) Oxygen. ☐
e) Water vapour. ☐

16. What products are released when a candle burns?

a) Hydrogen and water. ☐
b) Oxygen and water. ☐
c) Carbon dioxide and water. ☐
d) Carbon dioxide and oxygen. ☐
e) Carbon dioxide and hydrogen. ☐

17. How could you separate salt from the water that it is dissolved in?

a) Filter it. ☐
b) Pour it. ☐
c) Mix it. ☐
d) Skim it . ☐
e) Boil it. ☐

18. How can a perfume particle spread through air?

a) Pickling. ☐

b) Floating. ☐

c) Effusing. ☐

d) Diffusing. ☐

e) Particlising. ☐

19. Which sentence best describes how particles are packed together in an ice cube?

a) The particles are held tightly and packed fairly close together. ☐

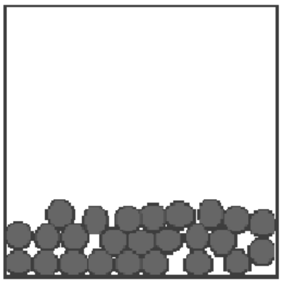
b) The particles have little attraction and are spread out. ☐

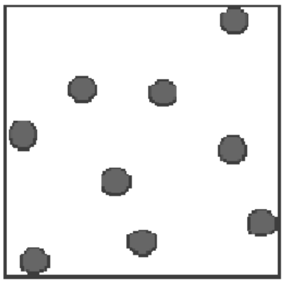
c) The particles are free to move in all directions. ☐

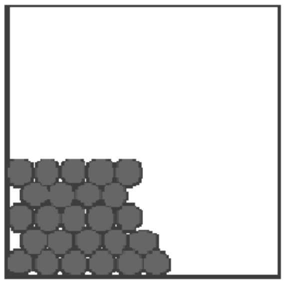
d) The particles are pushed away from the surface of the ice cube. ☐

e) The particle spread out as far as they can. ☐

20. What is the correct labelling of state for water in the following particle models?







Particle model x Particle model y Particle model z

a) x=water, y= ice, z=steam. ☐

b) x=water, y=steam, z=ice. ☐

c) x=ice, y=water, z=steam. ☐

d) x=ice, y=steam, z=water. ☐

e) x=steam, y=water, z=ice. ☐

21. In which beaker would a reaction between an alkaline and an acid solution be quickest?

Solution strength

a)  250 ml alkaline + 10 ml acid. ☐

b)  200 ml alkaline + 50 ml water + 10 ml acid. ☐

c)  150 ml alkaline + 100 ml water + 10 ml acid. ☐

d)  100 ml alkaline + 150 ml water + 10 ml acid. ☐

e)  50 ml alkaline + 200 ml water + 10 ml acid. ☐

22. In which beaker would a reaction between an alkaline and an acid solution be quickest?

		Temperature	
a)		20^{o} Celsius.	☐
b)		30^{o} Celsius.	☐
c)		40^{o} Celsius.	☐
d)		50^{o} Celsius.	☐
e)		60^{o} Celsius.	☐

23. In which beaker would a reaction between an acid solution and marble be quickest? The same mass of marble is added to the beaker in each instance and only the particle size is changed.

Particle size

a)  Large pieces. ☐

b)  Medium pieces. ☐

c)  Small pieces. ☐

d)  Fine powder. ☐

e)  Large strips. ☐

24. Which of the following sentences about a catalyst is true?

a) A catalyst slows down a chemical reaction and is not used up during the reaction. ☐

b) A catalyst speeds up a chemical reaction and is used up in the reaction. ☐

c) A catalyst does not alter the rate of a chemical reaction and is not used up during the reaction. ☐

d) A catalyst slows down a chemical reaction and is used up in the reaction. ☐

e) A catalyst speeds up a chemical reaction and is not used up during the reaction. ☐

25. Here are some everyday changes. Which one is a chemical change rather than just a change of state in a chemical?

a) Ice cream melting. ☐

b) Water turning to steam in a kettle. ☐

c) Butter melting. ☐

d) The body of a car rusting. ☐

e) A puddle evaporating in the sun. ☐

26. During an experiment, a teacher takes the top off a small bottle of perfume. The scent of the perfume is detected within a few minutes by pupils at the other end of the classroom.

Which of the following is the most accurate explanation of how the scent moved across the classroom?

a) The scent travelled through the classroom like sound waves. ☐

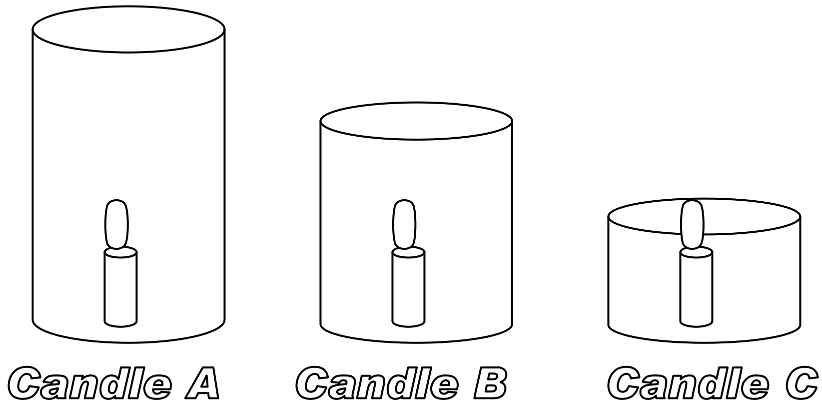
b) The scent floated through the classroom as droplets of liquid. ☐

c) The perfume evaporated and its particles mixed with air particles throughout the room. ☐

d) Particles of perfume travelled quickly towards the pupils in straight lines. ☐

e) Particles of perfume travelled through the classroom like light waves. ☐

27. Jars were placed over identical candles at the same time.



Which of the following statements is true?

a) Candle A will burn longest followed by candle C and then candle B. ☐

b) Candle A will burn longest followed by candle B and then candle C. ☐

c) Candle C will burn longest followed by candle A and then candle B. ☐

d) Candle C will burn longest followed by candle B and then candle A. ☐

e) Candle B will burn longest followed by candle C and then candle A. ☐

28. Think about candle A above. What has happened to the composition of the gas in the jar of candle A when the candle has gone out?

a) The gas inside the jar of candle A is unchanged. ☐

b) Water is used up inside the jar of candle A. ☐

c) Carbon dioxide is used up inside the jar of candle A. ☐

d) Oxygen is used up inside the jar of candle A. ☐

e) Nitrogen is produced inside the jar of candle A. ☐

29. In which beaker would the reaction between an alkaline solution and an acid solution take place quickest?

Solution strength

a)  250 ml alkaline + 10 ml acid at 10^{o}Celsius. ☐

b)  250 ml alkaline + 10 ml acid at 30^{o}Celsius. ☐

c)  150 ml alkaline + 100 ml water at 30^{o}Celsius. ☐

d)  150 ml alkaline + 100 ml water at 10^{o}Celsius. ☐

e)  200 ml alkaline + 50 ml water at 30^{o}Celsius. ☐

30. In which beaker would a reaction between an acid solution and marble be quickest? The same mass of marble is added to the beaker in each instance and only the particle size and temperature are changed.

Particle size

a)  Large pieces at 30°Celsius. ☐

b)  Fine powder at 10°Celsius. ☐

c)  Fine powder at 30°Celsius. ☐

d)  Large pieces at 10°Celsius. ☐

e)  Large strips at 30°Celsius. ☐

Recall Test

Within this section please write down the thoughts and ideas that were discussed in your group.

Write down **all** the ideas given by your group when you tried to explain:

a) What happens to the energy from a burning fuel when water is boiling but the temperature of the water remains at 100°C?

b) What are the bubbles that appear whilst water boils?

c) Does water undergo a chemical change as it turns to steam? Please explain:

d) Write down **all** the ideas shared within your group to explain the disappearance of water (for example when it is left on a windowsill).

e) Please write down what your group agreed was the best explanation for why salt was left in the saucer when water had disappeared.

f) Write down **all** the ideas discussed by your group, which explains how perfume particles travel through the air.

g) Write down **all** the ideas discussed in your group, which explains how a balloon fills with air.

h) Write down the idea that your group agreed best explained how a balloon fills with air.

i) Write down **all** the ideas discussed in your group when trying to explain what happened to water once a drop of food colouring was added.

j)

k) Write down all the ideas given by your group to explain why particular chemicals can be recognised as catalysts.

Study 2 Pupil questionnaire

Your school recently agreed to participate in some research aiming to find out more information about how pupils' feel about specific subjects within Secondary school.

Some statements have been written down, and we are looking for your opinion. There are no right or wrong answers. What you write down will remain confidential and will not be known to the school or any of your teachers.

By ticking the box below, I am agreeing that:

● I wish to take part, but I know I may opt out at any time

● I understand that all my answers to the questionnaire and my name will be kept confidential

● I have read this sheet and I want to take part

Please tick ☐

1) Please print your name in **CAPITAL LETTERS**

____

2) Are you: ☐Male ☐Female

4) What secondary school do you attend at the moment?

____

1. What are **SCIENCE** lessons like?

Tick one of the boxes for each statement	All of the time	Most of the time	Some of the time	Rarely	Not Sure
We learn a lot of facts in Science					
We are asked to explain our answers to questions during Science lessons					
In Science lessons we discuss interesting ideas and topics whenever they come up					
We help to plan what we are going to do next in Science					
Pupils settle down quickly at the start of our Science lessons					
Everyone has a chance to say what they think in Science lessons					

2. What are your opinions about your **SCIENCE** lessons?

Example:
Jill usually enjoys Science lessons

I like Science lessons	☐ ☒ ☐ ☐ ☐ ☐	I dislike Science lesson

I like Science lessons	☐ ☐ ☐ ☐ ☐ ☐	I dislike Science lesson
Interesting lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Easy lessons	☐ ☐ ☐ ☐ ☐ ☐	Complicated lessons
I'd like to spend more time on them	☐ ☐ ☐ ☐ ☐ ☐	I'd like to spend less time on them
Enjoying lessons	☐ ☐ ☐ ☐ ☐ ☐	Dull lessons
Important lessons	☐ ☐ ☐ ☐ ☐ ☐	Unimportant lessons
Important for other school subjects	☐ ☐ ☐ ☐ ☐ ☐	Unimportant for other school subjects

3. How do you feel about your **SCIENCE** course at school?

I feel I am coping well	☐ ☐ ☐ ☐ ☐ ☐	I feel I am not coping well
I am enjoying the subject	☐ ☐ ☐ ☐ ☐ ☐	I am not enjoying the subject
I find it very easy	☐ ☐ ☐ ☐ ☐ ☐	I find it very hard
I am obtaining a lot of new skills	☐ ☐ ☐ ☐ ☐ ☐	I am not obtaining a lot of new skills
I am enjoying practical work	☐ ☐ ☐ ☐ ☐ ☐	I dislike practical work
I like the teacher	☐ ☐ ☐ ☐ ☐ ☐	I dislike the teacher
It is definitely "my" subject	☐ ☐ ☐ ☐ ☐ ☐	It is definitely not "my" subject
Relevant to getting a good job	☐ ☐ ☐ ☐ ☐ ☐	Not relevant to getting a good job

4) For each science activity, put a tick in one of the boxes on the 5 point scale to show how much you like it or don't like it

	I like it ☺				I don't like it ☹
	5	4	3	2	1
Example: Watching TV on a Saturday morning				✓	
Watching the teacher do an experiment					
Working out what to do yourself					
Teacher telling you what to do					
Choosing your own equipment					
Finding out what happens yourself					
Working by yourself					
Working with friends					
Finding out why the experiment works					
Telling teacher what you have done					
Telling friends what you have done					

5) Just put a tick in the box that is closest to what you think or feel for each statement

Statement	**Strongly agree**	**Agree**	**Not sure**	**Disagree**	**Strongly disagree**
I get more work done when in a group					
Learning is more interesting in groups					
Group work is fun					
Groups encourage you to work hard					
You get to think more in groups					
When working in a group we always get on well together					

Please turn to the next page

6) Please circle which statement most closely matches your relationship with each pupil listed below.

For example, Jill thinks of Jack as a close friend: Jill therefore chose to circle number 2

		Would like to have her/him as one of my best friends		Don't mind him/her being in our class but I have no strong feelings towards them being in the class		Wish she/he weren't in our room
Example: Jill rating Jack		**1**	②	**3**	**4**	**5**
1		**1**	**2**	**3**	**4**	**5**
2		**1**	**2**	**3**	**4**	**5**
3		**1**	**2**	**3**	**4**	**5**
4		**1**	**2**	**3**	**4**	**5**
5		**1**	**2**	**3**	**4**	**5**

Appendix 12 - Study 2 teacher and pupil observation grids

Teacher Observation

	A Deep Prob e	B Shallow Probe	C Process related content	D Contextualising behaviours	E Fully attend to pupil responses	F Acknowledge pupil responses	G Class set up	
							Wc	Pupil plenary
1								
2								
3								
4								
5								
6								
7								
8								

Description of teacher observation categories

Questioning behaviour	A) Deep Probe	Probes students' explanations to uncover details or further thinking about their problems solving strategies (asks specific questions about details in a student's explanation). This category relates to "deep" probes where information produced within groups is attributed value and incorporated into both the main lesson objective and more generally tied to subject knowledge. Teachers would be likely to use several questions to elucidate how a problem was approached, in addition to establishing pupils' ideas/answers.
	B) Shallow Probe	Engages with students around their work on the problems (either an answer or an initial explanation) but does not probe the details of student thinking about their problems solving strategies (typically repeats or reiterates, the students' work without asking any further questions).
Type of talk	C) Process related Content	Teacher revises/gives feedback on processes – e.g. comments given relating to group work behaviours, interaction, classroom management or health and safety. Encompasses how teachers communicate with pupils about their expectations or standards of work during lessons.
	D) Contextualising behaviours	Talk may relate to lesson objectives but should also include attempts to frame knowledge covered during the lesson. Examples include connections being made with real life examples, or pupils' ideas being developed through establishing links to previous lessons.
Responding to pupil contributions	E) Fully Attend	Teacher integrates statements/group answers within his/her speech. Teachers' behaviour provides indicators of the importance assigned to pupil contributions. Includes occasions when teachers address misconceptions: for example by probing pupils' thinking, asking for additional explanations and then moving to examining the correct answer.
	F) Acknowledge	Records the occasions when teachers merely acknowledge contributions made by pupils. Also includes occasions when inconsistencies are ignored and focus turns to the correct answer rather than providing an opportunity for sustained/extended discussion.
Class set up	WC Pupil plenary	

Pupil Observation

Pupil Name ____

	INTERACTION				GROUP SET UP				ACTIVITY LEVEL			DIALOGUE			
	NOT	COG	CDG	+T	Alone	Group	WC	WC	ON	TASK PREP	OFF	INFORM	ASK	RESOLVE	OTHER
1															
2															
3															
4															
5															
6															
7															
8															

Description of pupil observation categories

Interaction	
Not	Working alone
COG	Interacting with their own group
CDG	Interacting with someone external to their group
+T	Teacher present and/or interacting
Group set up	
Alone	Seated individually
Group	Seated in groups
WC	Sitting in typical classroom layout
Activity level	
On	Working on task
Off	Not focused on task
Task Prep	Task related preparatory activity
Dialogue	
Inform	Give explanation.
Ask	Seeking help, direct questions
Resolve	Examines others' accounts. May point out inconsistencies
Other	Inaudible/uncodable

Appendix 13 - Evaluation questionnaire for teachers

University of Strathclyde Glasgow

Introduction

Thank you for the commitment you have shown in including the group work activities within your science lessons. We would very much appreciate feedback from you about key aspects of the study. We would, therefore, be very grateful to receive your answers to the following questions, which will provide us with important information for the overall evaluation of the project. All information provided will be treated confidentially and no individual or school will be identified in any report.

Section A: Training, Support and Resources

Please rate how valuable you found each of the aspects of the Group Work Project on the following scale:

(very valuable) 4 - 3 - 2 - 1 (not at all valuable)

(Please circle the appropriate number)

1. Guidance received regarding your roles in the study 4 3 2 1

*Please indicate by writing in the space provided what you especially **liked** about this.*

____

Please explain why ____

*Please indicate anything you particularly **disliked** about the first in-service day*

____

Please explain why ____

(Please circle the appropriate number)

2. Guidance/Coaching received regarding the role of teaching within classrooms using group work **4 3 2 1**

Please indicate by writing in the space provided what you especially ***liked*** *about this.*

____

Please explain why ____

Please indicate anything you particularly ***disliked*** *about the second in-service day*

____

Please explain why ____

(Please circle the appropriate number)

3. Observation visits by the researcher **4 3 2 1**

Please indicate by writing in the space provided what you especially ***liked*** *about these.*

____

Please explain why ____

Please indicate anything you particularly ***disliked*** *about the observation/assessment visits.*

____

Please explain why ____

(Please circle the appropriate number)

4. Advice and support provided by the researcher during implementation of the classroom activities **4 3 2 1**

Please indicate by writing in the space provided what you especially ***liked*** *about these.*

____

Please explain why ____

Please indicate anything you particularly ***disliked*** *about the advice and support provided*

____

Please explain why ____

(Please circle the appropriate number)

5. Teaching and learning unit "Materials"

(a) Teacher notes	**4**	**3**	**2**	**1**
(b) Pupil workbook	**4**	**3**	**2**	**1**

*Please indicate by writing in the space provided what you especially **liked** about these documents.*

____

Please explain why ______________________________

*Please indicate anything you particularly **disliked** about these documents*

____

Please explain why ______________________________

6. Please use the space below to indicate any changes you would suggest should be made to the training, support or resources provided.

____

____

____

____

____

____

____

7. Within the following table please indicate which activities you implemented within your first year Science class:

Activity	**Yes**	**No**
Example	✓	
Changing States - Solid to liquid		
Solids, liquids and gases		
Changing materials		
Evaporation		
Boiling and Evaporation		
Water as a solid, liquid and gas		
Particles in solids, liquids and gases		
Diffusion		
Gases on the move		
The Balloon’s Going Up		
Changing solution strength to alter reaction speed		
Changing temperature to alter reaction speed		
Changing particle size to alter reaction speed		
Using a catalyst to alter reaction speed		

Section B: Overall impact of involvement in the project

8. *Please indicate the extent to which you agree with the provided statements about your involvement and the involvement of your class in the group work project by using the following scale:*

(Completely agree) 4 - 3 - 2 - 1 (Completely disagree)

Statement	Agreement (Please circle the appropriate number)
Involvement in the study has been useful to me professionally.	**4 3 2 1**
Involvement in the study has placed an excessive burden on me professionally.	**4 3 2 1**
In general pupils responded well to the group work activities.	**4 3 2 1**
Pupils have been able to apply their group work skills to their work in science.	**4 3 2 1**
Only a small number of pupils acquired new group work skills through involvement in the project.	**4 3 2 1**
Involvement in the project will have an influence on my future teaching and learning strategies.	**4 3 2 1**
Involvement in the science group work activities enhanced pupil's knowledge and understanding.	**4 3 2 1**
The activities of the project have not had any beneficial impact on pupil's personal and social development.	**4 3 2 1**
In general the pupils responded well to the science group work activities.	**4 3 2 1**
There have been noticeable improvements through the project in pupil's willingness to talk and interact with their peers.	**4 3 2 1**
There have been noticeable improvements through the project in pupil's confidence and self-esteem.	**4 3 2 1**

9. Please use the space below to explain, or add comments to your responses to any of the above statements.

10. To what extent did you manage to build into the group work lessons time for briefing and debriefing to focus pupils on their group work performance? (Please tick the appropriate box.)

I was unable to find any time for briefing and debriefing

I occasionally found time for briefing and debriefing

I usually found time for briefing and debriefing

I always found time for briefing and debriefing

Comment

____

____

11. To what extent did the composition of the pupil groups remain the same over the duration of the project? (Please tick the appropriate box.)

Group composition was changed for every lesson

Group composition was sometimes kept the same for more than one lesson

Group composition was usually kept the same from lesson to lesson

Group composition was kept the same throughout the entire project

Comment

____

____

12. Having implemented the activities within lessons, to what extent would you say your effectiveness in fostering group work has improved? (Please tick the appropriate box.)

Improved substantially

Improved to a reasonable extent

Only improved a little

Did not improve at all

Comment

____

____

13. Thinking back, to what extent would you say the children in your class have benefited from participation in the study? (Please tick the appropriate box).

Benefited substantially

Benefited to a reasonable extent

Only benefited a little

Did not benefit at all

Comment

____

____

14. Please use the space below or attach further sheet to add any further comment you would like to make about any aspect of the project.

Thank you very much for taking the time to complete this questionnaire.