

Improving Science and Emotional Development (The ISED project)

Emotional literacy, citizenship, science and equity
(Second edition)

Brian Matthews

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Education for relationships in science lessons; improving pupil's social and emotional skills

A project to assess the degree to which Personal, Social and Health Education in schools can be effectively incorporated into subject lessons. This is also known as the *Improving Science and Emotional Development* (ISED) project.

Brian Matthews with Tim Kilbey, Caroline Doneghan, and Suzanne Harrison.

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Further free copies of this report can be obtained by:

Brian Matthews,
Department of Educational Studies,
Goldsmiths College,
University of London,
New Cross,
London.
SE14 6NW
UK.

E-mail: b.matthews@gold.ac.uk giving your full postal address.

Gulbenkian Foundation,
United Kingdom Branch,
98 Portland Place,
London,
W1N 4ET
United Kingdom

Improving Science and Emotional Development (The ISED project): concerning citizenship, emotional literacy, science and equity.

[Please note that the data in this report has been extended and is part of the book by Brian Matthews: *Engaging Education. Emotional literacy, equity and co-education.* McGraw-Hill/Open University Press]

This project, for Year 7 (aged about 12) pupils, uses collaborative learning techniques combined with monitoring boys and girls working together in science lessons, in order to enhance both their learning and social and emotional development.

Summary of Results

- Pupils learn to get on with each other, but they do not find it easy
- The boys and girls talk more evenly to each other
- They develop socially and understand each other more
- Feel more confident about working with the same and other sex
- They support each other in their learning.
- They think that it is important that they learn together
- They enjoy science (more)
- They find group work increases their scientific understanding

Comments made by pupils from interviews and written sheets:

It's made it a lot easier because you mix with different people that you wouldn't usually mix with before, so you get to know them more (g)

I would say that science is a really good subject to do, especially when you're working in groups with other people because you get to know other people and do your practicals (g)
... it's better to work in groups, because you learn more when you work with other people
Science is enjoyable and it's fun when you work with people in groups, you socialise a lot.
... you get different opinions and different ideas for science and what we're doing. And if someone gets stuck you can help them out ... and they can help you out. You just mingle with each other and help each other.

'... because when I was telling the girls it got stuck in my head' (boy)

'... you get to hear what other people wanted to say. And you learn more' (boy).

'... ideally people will discuss it and the ones who understand one thing will explain it to the others and visa versa' (girl).

'... you expand your memory and learn more and find out stuff what you did not know'

"Because you work with different people you can learn more, also important because you can get a better job"

"Very important because other people's views matter just as much as yours"

"[You can learn to] listen to older people who have more experience".

'I think that in life it is very important because as we grow we will come across many different people and it's good to get along with them at an early age.'

Background:

There has been, and remains, a very heavy emphasis on cognitive learning in the National Curriculum for England and Wales. There have been calls for this emphasis to change, both within and outside Government ((NACCE, 1998; Park, 1999). Some change has occurred; David Blunkett set up committees to advise him on integrating citizenship into the National Curriculum (Crick Report).

The situation now exists where Citizenship is part of the National Curriculum for England and Wales (1999), alongside non-statutory guidelines for Personal, Social and Health Education (PHSE). One concern expressed is that Citizenship should be covered in a cross-curricular fashion and that all subjects play a part as well as subjects like Social Studies. The Gulbenkian Foundation has been concerned about the development of PHSE and commissioned *Passport*, a framework for Personal Social Development (PSD) to integrate the national initiatives (Lees and Plant, 2000). Clearly, then, it is important that we find ways to help pupils develop their social and emotional skills within subjects like science. Examples would include: to learn to resolve conflict fairly; justify their personal opinions orally; contribute to group and exploratory class discussions; use their imagination to consider other people's views; to negotiate, decide and take part in school-based activities; and to reflect on the process of participating (NC1999; p184 1g, 2b, c, 3a, b &c). There are convincing arguments for co-education and hence there is a necessity to find ways of developing understanding between boys and girls. In order to support secondary pupils in the development their social and emotional skills we felt that it was important to situate the pupils within the context of normal subject teaching. The reasons for this are as follows. Firstly, this is where pupils spend most of their time. Secondly, is that the cognitive, social and emotional are all intertwined. One aspect of promoting development in these areas is to acknowledge this, and to find ways of enhancing progress. With the present emphasis on academic development a focus on the social and emotional becomes more vital.

Lastly, science is a natural area for such work. Contrary to popular opinion, science is inherently a social activity. Science incorporates imagination, creativity and social and political values, and so our education system needs to change. To develop social and emotional understanding in science lessons could cover three areas concurrently: (i) greater interest in, and understanding of, the nature of science, (ii) developing positive methods of communication and so getting along with people, and feeling good, as well as (iii) maintaining academic success. A more detailed analysis is given in Matthews (2002). Clearly though, for pupils to progress emotionally they need to gain an understanding of each other, and in particular, to do so across gender divides. Hence co-educational schools, where the other sex is present to talk to, provide the greater opportunity to enhance social and emotional development. This context makes it possible to engage pupils in their emotions, rather than just be told about them and how they should change. Hence dialogue and the interactions are seen as central to helping pupils develop their sense of 'self' and 'other'. As a result, this project *Improving Science and Emotional Development (ISED)* project, with three teachers in two London comprehensive schools was instigated.

How this is done in the classroom

82 pupils in three Year 7 (11-12 years old) classes, with one male and two female teachers, in typical inner city state comprehensive schools were involved in the project. Another three parallel Year 7 classes were used as controls. The schools were typical multiethnic

comprehensives and the pupils were achieving under the national average in their end of primary school Standard Assessment Tasks (SAT). The national average for the percentage of pupils achieving 4+ in these tests was, in 1999, 78%. In the research group 73% achieved 4+. The number of pupils achieving a SAT's level 5 were over one third lower than the national average. Over 80 Year 7 (aged about 12 years) pupils were involved, with a further 80 Year 7 pupils acting as a control group. The pupils were those that resulted from the timetabling of the school as a whole and no groups were pre-selected.

Numbers of pupils involved	Research	Control	Total
Boys	45	46	91
Girls	37	37	74
Total	82	83	165

The project set out to test the hypothesis that pupils in co-educational schools could be helped to develop their communication, social and emotional skills using collaborative group work with feedback mechanisms.

The overall theme was for pupils to work in mixed sex groups, self-monitor and make written comments on their cognitive and social interactions. Having both aspects of development on the agenda the pupils were able to discuss issues, engage their emotions, and so, hopefully, mature.

The pupils, engaged in group work while learning the normal science curriculum, were monitored to see how each person had contributed to the task. They had been told that both listening and talking skills were regarded as important (Matthews, 1994).

The **chart 1.** on the page opposite gives the outline details of the year of research.

Instruments of assessment and procedures

Pre- and post- questionnaires

There were two questionnaires that were filled in by pupils at the beginning and end of the research period. The first was called the **Survey**, which was filled in by the pupils in the research and control groups. It included: i) opinion statements with an 8 point Likert scale response, ii) bipolar adjectives on a 8 point scale, and iii) short answer questions. Eight-point scales were chosen so that pupils were unable to select a neutral option. The **Survey** was given at the beginning and end of the academic year. On each question the pupils could choose answers on a scale of 1 to 8, where the most negative answers (e.g., I do not understand science lessons at all) were scored 1, and the most positive answers (e.g., I understand science lessons very well) were scored 8. This questionnaire covered three main areas: 1) how pupils got on with each other, 2) what they thought of science and scientists, and 3) how they viewed science lessons. The **Survey** was also given to equivalent pupils in an all girl's school, and an all boy's school.

The second questionnaire 'How you are feeling?' was given to the research and control groups and was designed to elicit data on statements the i) interpersonal, ii) intrapersonal, iii) school in general, and iv) science lessons. It contained statements on a 6 point Likert scale response. The data were obtained and treated in the same way to that of the **Survey** but with the scores being given from 1 to 6.

The data from both the **Survey** and **How are you feeling?** were put into a statistical package (SPSS) for analysis. A matched sample t-test was administered to find out the significance of any changes in the beginning and end of year scores.

Chart 1. Data collection and intervention cycle

Beginning of year 7.	
<p>Data collection Pupils from two co-educational comprehensive schools, in three research classes and three parallel control classes, given two Lickert type questionnaires; the Survey and How are you feeling? Pupils fill in the Survey, which has questions on what they think about science, science lessons and how well they get on with boys and girls. The Survey is also given to pupils in both an all girl's and an all boy's school. How are you feeling? asked questions about how they feel about a) themselves, b) other pupils, c) school and d) aspects of their science lessons. The data put into a statistical package.</p>	No intervention
During the first 6 weeks of Y 7: Group activity to raise issues on social and emotional factors involved in learning.	
<p>Data collection Discussion Assessment sheets collected and analysed.</p>	<p>Intervention Pupils put into groups of two boys and two girls, usually by teachers. Another pupil is appointed as an observer. 1. Pupils put into groups of 4 do some science activity for 10 minutes or more. The pupil-observer fills in the Discussion Assessment sheet which indicates how much the pupils talked, listened, supported each other and learnt. 2. Pupils in the group fill in, by themselves, how well they thought they, and the other members of the group, learnt, talked, listened, helped each other and learnt. 3. Led by the observer, the pupils discuss the results of the sheets to raise cognitive and emotional factors. Through comparing the sheets they can also learn to realise how the different members of the group felt. This will contribute to them learning to empathise.</p>
Week 6 onwards: Collaborative learning.	
<p>Data collection Data from the Opinion sheets are put in a specially written data-analyser.</p>	<p>Intervention The observer is removed. Once the pupils are used to the procedures, they all work in groups of four so that all the class is involved in learning science. Now only Opinion sheets are used. There are different sheets, each one with a different focus. These include ones on: group-learning; getting on with others in the group; group work and science; teaching and learning in groups; conflict; and social skills. The same procedures as above are used, except the group organises its own discussions.</p>
Continuation of the research	

<p>Data collection Opinion sheets analysed. Also further data were collected through homeworks and class tasks. These were open-ended questions to cross check other data sources and to elicit:</p> <ul style="list-style-type: none"> a) how pupils were Getting on with each other and the other sex. b) how the pupils felt about learning with each other and the other sex called Learning with other pupils. c) aspects of their learning, called Thinking about your learning. <p>Another task was a ranking exercise on Why do mixed-sex collaborative work in science? and the questions were on; i) learning science, b) inter-gender social skills, c) life social skills.</p>	<p>Intervention</p> <p>Collaborative learning tasks with Opinion sheets used every three weeks throughout the year.</p> <p>Homeworks and class tasks set.</p>
<p>End of Year 7 Data collection: Questionnaires and interviews</p>	
<p>The research and control pupils were given the Survey and How are you feeling? again. 40% of the pupils interviewed by independent evaluator. Data analysis of the Survey, How are you feeling? Opinion sheets, interviews and all other data.</p>	<p>No intervention</p>

This report does not cover all the details outlined in this chart.

Measures during classroom intervention

The intervention involved the use of questions on pro-formas, followed by discussions around the pupil-responses to those questions, to help the pupils become more self-aware and so have the potential for changing gender interactions and attitudes to science education (Matthews 1994; Matthews and Sweeney, 1997). The intervention materials were used with the research groups. The research and control classes were taught using the same schemes of work and so experienced very similar scientific content and practical work. Thus the only difference between the two groups was the research intervention of collaborative group work. Boys and girls, as they engaged in collaborative group work while learning the normal science curriculum, were regularly monitored for their science learning. Typical activities for the group work will be described later.

In the research classes pupil-observers monitored a group of two boys and two girls who were working on a collaborative learning task and filled in a **Discussion Assessment** sheet (Appendix 1) (Matthews 1994). The monitoring criteria were (1) the amount of talking, (2) the extent of listening, (3) interrupting, (4) being supportive and (5) how much they learnt. At the end of the collaborative learning the four members of each group were required to fill in a **Guesses sheets** (Appendix 2) and estimate, without consulting anyone, how well they and the other three in the group had performed. They estimated how well they had done, using the same categories in the **Discussion Assessment** sheet, and hence provided data for research questions (A) and (B). The observer would then use the data to compare the differing viewpoints and run a discussion so pupils would be engaged in a feedback process on their social and cognitive performance. These sheets, with their different pupil-perceptions, were designed to encourage a dialogue between the pupils, run by the pupil-observer.

The **Discussion Assessment** (Appendix 1) and **Guesses** (Appendix 2) sheets were used for the first six weeks of the research intervention cycle. The data obtained were put into a spreadsheet for analysis of the monitoring criteria. This was the first stage of monitoring pupils while engaged in learning in a social situation.

When the pupils were familiar with the procedures, and understood that social aspects of their learning were seen as important, the observer was removed and the above two sheets were

replaced with **Opinion Sheets**. These sheets were given to pupils after they had completed a collaborative task and were filled in individually. The pupils could then look at each others sheets and discuss the results. The **Opinion sheets** were pro-formas with between eight and ten open and closed short-answer questions to elicit responses on: i) how well they perceived themselves to be learning science; ii) attitudes to each other; and iii) feelings about group work. Each sheet focused on a different area, see Appendix 3 and 4 for samples. The **Opinion Sheets** were administered about every 3 weeks through the rest of the research period.

The pupils were asked about **Learning with other pupils**, and in particular how they felt about working the same and the other sex. They were also asked how they were **Getting on with pupils**, and especially with the other sex. The pupils were also asked to do a ranking exercise on why they thought doing group work in mixed sex groups might be important. This was to ascertain if they felt that the development of a) learning, b) inter-personal skills, or c) intra-personal skills were most important. The **Opinion Sheets** were administered about every 3 weeks through the rest of the research period.

The data were analysed as follows:

The pupils' responses were looked over by the teacher taking the class, and any particular points noted. A researcher analysed the replies and put them into 3 categories. These were:

- a. Positive (or supportive of the question), where one, two or more positive statements were being made;
- b. Neutral, or contradicted itself;
- c. Negative where one, two or more negative points were made in response to the question.

This data were then put into a spreadsheet that calculated the percentages of responses in each category. The class teacher then reviewed the data entry and results;

The pupils reflected on their classroom performance using **Opinion** sheets about every three weeks. This enabled their meta-cognitive and what I call their 'meta-social' skills to be developed. These procedures were designed to legitimate pupil-pupil and pupil-teacher discussions around social and emotional issues as well as cognitive ones. In essence, the aim was to enable pupils to develop social coherence based on mutual acceptance of each other and their differences. Since the pupils had to write down their feelings on questions this formed part both of data collection, and of getting them to think about the relevant issues.

Another task was a ranking exercise on **Why do mixed-sex collaborative work in science?** and the questions were on; i) learning science, b) inter-gender social skills, c) life social skills. The results of this exercise have been reported on in Matthews et al 2002.

Audio tapes of lessons

Pupils were recorded while they were involved in a collaborative exercise.

Interviews

A sample of over 40% of the 82 pupils was interviewed at the end of the project. The pupils were selected so that from each class there were boys and girls who had good, medium and poor social skills. An independent evaluator interviewed pupils in groups that comprised four boys, two boys and two girls, or four girls, and provided evidence on all three research questions.

Also, all the teachers were interviewed.

Field notes

The teachers and researcher made field notes throughout the year.

This multi-layered approach enabled the considerable amount of data, especially that written, to be cross-checked and to be analysed in depth.

Practice in the classroom

Here is a more detailed outline of what occurred in the first six weeks of the research:

1. The teacher formed the groups so that there were two girls and two boys in each group. Where there were uneven numbers, single-sex groups were used to avoid a ratio of three to one.
2. The pupils then completed a science activity from the Science National Curriculum. Typical activities for the group work would be the completion of a worksheet on some aspect of science, but where they had to agree their answers. Alternatively, other work related to text was used (Henderson and Wellington 1998). For example, (a) The pupils were given a series of questions, requiring short answers, on radiation. They were only given one copy of the sheet so they had to agree their answers. (b) The pupils had to jointly decide how they were going to do a practical and fill in details on a sheet, (c) a Directed Activity Related to Text activity on electricity. The control groups covered the same scientific content, but without the intervention techniques.
3. A pupil-observer watched a group of four pupils involved in a discussion of a science topic, and filled in a **Discussion Assessment sheet** (Appendix 1) while the pupils talked carried out external monitoring of the pupils as they talked. The observer filled in the chart using the following notation: a tick for when a pupil talked: an extended tick if they interrupted someone; and a vertical tail if interrupted while talking.
4. At the end of the discussion each of the four members of the group were required to estimate, without consulting anyone, how well they and the other three in the group had performed. The criteria were: the amount of talking, extent of listening, interrupting and of being supportive. These estimates were filled in on a **Guesses sheet** (Appendix 2). Space for any additional comments were included. This stage is intended to make visible any gap between what one thinks happened, and what others think happened, so that consciousness might be raised. The observer wrote down any comments s-he considered relevant.
5. The pupil-observer then discussed the results with the group in order to bring attention to the different ways the pupils had interpreted the talk, and to raise questions about the patterns of talk. In general it was useful for the observer to get the members of the group to go over their estimates and to see the extent to which they correlated. This was to make evident any gap between what each member who talked thought had transpired and what the observer had found. The purpose here was to promote a discussion on how people felt about the processes of learning, and to have some evidence on which to base the debate.

Once the pupils were familiar with the procedures, the observer was not used, and pupils worked in groups of 4. Then the **Guesses Sheet** (Appendix 3) was replaced and a range of **Opinion** sheets (Appendix 4) were used which asked them to fill in similar items to those

above and additional questions on how they were learning or feeling: Here, to indicate the range of questions, is a selection from the six different sheets:

- Who do you think suggested useful things to do:
- When I was working in my group I felt
- How well did you get on with the rest of your group? Were there any differences with sex or 'race'?
- Did someone in the group help you learn?
- Does group work affect how you feel about science? Does it make it more social? more disagreements or arguments? more relevant? harder? easier? interesting? boring? etc..
- How did you settle any arguments?

The above procedures were done with collaborative learning exercises, and also alongside normal teaching, for example, during practical work or completing a worksheet.

A special database was developed to analyse these returns to find out patterns and to look at how good the pupil's predictions are of how much they talked and listened. These research lessons were implemented about once every three weeks. The original idea was that the pupils would then discuss how well they got on and learnt using the **Opinion** sheets as a basis. However, pressure of time due to the National Curriculum meant that this could not be done except occasionally. As it happens, this had a silver lining; it emerged from the interviews with the pupils that because the others in the group were unlikely to see them, they felt that they could be honest about what they wrote.

These procedures were designed to legitimate pupil-pupil and pupil-teacher discussions around social and emotional issues as well as cognitive ones. In essence, we were trying to encourage pupils to develop a social coherence based on accepting; a) each other, and; b) differences. They need to value each other for those differences.

Results

Summary

In brief, the boys and girls were generally keen on the research. They have indicated clearly that as this sort of work continues so they gain a greater understanding of each other. Also, as one would expect, they often do not find it easy to work together, but realise how important that it is that they develop the necessary skills.

Nevertheless, the results were positive and indicate that the pupils feel more confident about:

- talking to each other,
- getting one's views across to the other sex
- being able to work with the other sex
- of getting help from other pupils

Overall the pattern of talking, while varying considerably from group to group and with time, indicates a good balance between contributions from both boys and girls, with, if anything, girls saying slight more. It is worth noting that throughout the project it is common for the overlap between boys and girls to be much greater than the differences between them.

Interaction patterns

The **Discussion Assessment** and **Opinion** sheets filled by the observers and pupils (for pupils aged 12 & 13) showed that in general the amount of speech was distributed fairly evenly between girls and boys. In the groups where there were two boys and two girls the speaking

order could have been that a male spoke the most, then the next male, and the two females speaking the least. This order would be coded as MMFF. If both girls dominated the discussion then the code would be FFMM. The distribution of speech amongst boys and girls when monitoring and feedback is used was as follows:

Table 1:	Number of times this pattern was obtained in the classes over the research period.
MMFF	12 (male dominated)
MFMF	20
MFFM	15 (even distribution of talking)
FMMF	8 (even distribution of talking)
FMFM	22
FFMM	23 (female dominated)

Overall it is evident that the extent of talking between boys and girls was more balanced than other studies have indicated. For example, some studies have indicated that the boys dominate, taking up to two thirds of the time (Stanworth, 1981; Holden, 1993). This could suggest that the monitoring and feedback discussions in our research are having a beneficial effect. However, there are two further points to be taken into consideration:

- a) The figures above only refer to the quantity of talk, rather than its quality. The pupils were also asked who helped others learn the most and who suggested useful things to do. This pattern was similar to the pattern of talking, but this may be because the pupils are associating these factors with the person who talked the most. Further research is needed to clarify this point.
- b) Sometimes the pattern of talk appears balanced because the two boys talked to each other all the time, as did the two girls. It helped to arrange the seating so those pupils of the same sex were not next to each other.

Importance of developing social skills in science

The pupils were asked in the **Survey** how important they felt it was that, in science lessons, they were enabled to develop their social abilities. They could indicate this on a scale so that if they said it was very important it gave a score of 8. The average score for the pupils was 7, with no significant differences between the boys and the girls.

How well do the boys and girls get on with each other?

The picture here is very varied, with some boys and girls reporting that they got on very well, and others not. Many reported changing for the better as the year went on. To gain an in depth analysis, I will look firstly at the results of the **Survey**, and then analyse the data from the pupil classroom-based materials, along with interviews of the pupils.

At first sight the overall statistics from the **Survey** are very promising. Both boys and girls indicated that they, after a year, are happier to work with the other sex, look forward more to working with them, understand the other and the same sex better, are more confident about working with the same and the other sex, that they can more easily put their views across to the other sex, feel that the other sex will understand them better, be liked more by the other sex, and that the other sex will help them learn. See tables 1 to 6.

There were no changes in the scores that indicated other sex are: sensitive to feelings; very friendly and that they get on well with them.

Only one score went down and it indicated that the pupils felt that the other sex more aggressive at the end of the year. As the duration of the project was only for 12 months we expected only limited changes in the girls and boys reported attitudes. These results are better than and were therefore very pleasing.

However, when the figures for the control groups were looked at it was found that in many cases the change was even greater. Clearly a deeper analysis was required, and this produced some very interesting results. Before embarking on this analysis it is worth pointing out that the research and control classes had matched science experiences, but experienced different modes of learning. The research groups were mixed up for collaborative learning. Hence they had to work with the other sex, with pupils of the same and other sex that they both liked and did not like, and by the end of the year had worked with everyone in the class.

On the other hand the control groups worked in friendship groups nearly the whole time, usually in pairs. These groups were mainly single-sex. Any variation from this was due to pupil absences. At the end of the year the pupils would not have worked with many other members of the other sex, although, in the normal course of events, they will have talked to them. There were, of course, the conflicts between pupils that are always evident. Many of the positive interactions would be with pupils who they liked.

Firstly, the questions were put into two categories, those that were mainly about social factors (e.g., working with the other sex), and those that were more intra-personal, or emotional, (e.g., confidence in talking to others).

Interpersonal; social factors

The pupils answered questions in the **Survey** at the beginning of the year (called Y6 in the following tables as they had just come from primary school), and at the end of the year (called Y7). The pupils could select from an eight point scale. The change over the year has been calculated. Three of the questions were: if they would be happy to work with the other sex; if they would look forward to it, and how they would feel about working with 3 pupils of the other sex (Table 1). In all cases throughout this document the figures have been quoted to the nearest 0.1 or 1%, whichever is relevant. The change in the year has been calculated, along with the significance of the changes, using a matched t-test. Since the research period was only a year, small changes were expected, it being accepted that changes in personal skills take a long time to develop. As will be seen, this was the case and this analysis is concerned with how the changes, from different sources, relate to each other, and the consistency of the directions of those changes. Hence, in the charts below, $p < 0.05$ is indicated by *; $0.1 > p > 0.05$ by # and $p > 0.1$ is left blank. The results are one tailed.

Table 1. Questions from The Survey to research and control groups	At start of year. Research groups	At end of year. Research groups	Change over the year	At start of year. Control groups	At end of year. Control groups	Change over the year
I would be happy to work with the other sex.	5.2	5.3	0.1 boys: 0.0 girls: 0.2	5.1	5.4	0.3 boys: 0.5# girls: 0.2
I would look forward to working with the other sex	4.8	4.9	0.1 boys: 0.2 girls: 0.0	4.9	5.1	0.2 boys: 0.0 girls: 0.5*
I would be happy to	4.9	5.1	0.2 boys: 0.3	4.5	4.8	0.3 boys: 0.0

work with 3 of the other sex.			girls: 0.2			girls: 0.7*
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NOTE: some of these results may appear anomalous. This is due the to rounding to the nearest 0.1.

These results can be interpreted in two ways.

1. The results show that when the pupils work together with pupils of the other sex, they get on better with them as all scores have increased. However, they get on better when not made to work together as they were in the research groups.

2. The research groups were working with the other sex, and so this was normal. For the control group, however, it was not normal, and so they would probably be keener to get together, especially since most of their interactions with the other sex were with people who they liked. I do not know the degree to which they answered the above questions on the assumption that they would be working with those who they wanted to, rather than those they disliked.

Further support for the latter explanation comes from the results from single-sex schools where the **Survey** was completed (Table 2). In every case, with the one exception of the girls' school (second question, below), the changes are higher than in either the research or the control. Also, generally, the control group changes are *in between* the research and the single-sex schools.

Table 2. Questions to single-sex schools	Boy's school. At start of year.	Boy's school. At end of year.	Change over the year	Girl's school. At start of year.	Girl's school. At end of year.	Change over the year
I would be happy to work with the other sex.	5.3	6.0	0.7*	4.7	5.2	0.5*
I would look forward to working with the other sex	5.5	6.2	0.7*	5.0	5.1	0.1
I would be happy to work with 3 of the other sex.	5.0	5.7	0.7*	4.4	4.8	0.4#

p<0.05 is indicated by *; 0.1>p>0.05 by # and p>0.1 is left blank.

The order in which one would expect pupils to communicate with pupils of the other sex would be single-sex the least, then the control groups and the research groups the most, it seems probable that the results could be due to a case of 'absence makes the heart grow fonder'. These results could be seen as evidence of an unfulfilled desire to know the 'other', and as such indicates that the research groups are in fact learning to get to know the 'other'. In more psychoanalytical terms, fantasy becomes stronger when the 'other' is not present.

Intra-personal

Another clue to the mystery as to why the control group showed greater changes comes from the questions that asked about the other sex *and* the same sex (table 3).

Table 3. Questions to research and control groups	At start of year. Research groups	At end of year. Research groups	Change over the year	At start of year. Control groups	At end of year. Control groups	Change over the year
I understand the	5.2	5.9	0.7 *	5.1	5.4	0.4 #

other sex very well.			boys: 0.7 girls: 0.7			boys: 0.3 girls: 0.4
I understand the same sex very well.	7.2	7.4	0.2 boys: 0.3 girls: -0.1	7.6	7.67	0.0 boys: 0.0 girls: 0.0
I am confident of saying what I want when work with the other sex.	5.2	6.2	1.0 * boys: 0.8 girls: 1.3	5.3	6.27	0.9 * boys: 0.7 girls: 1.1
I am confident of saying what I want when work with the same sex.	6.6	7.0	0.4 # boys: 0.3 girls: 0.4	6.4	7.0	0.6 * boys: 0.5 girls: 0.8

p<0.05 is indicated by *; 0.1>p>0.05 by # and p>0.1 is left blank.

What is noticeable here is that the research groups have undergone *larger* changes than the control group, with the exception of the last question. Also, that both groups have changed *less* for the same-sex. This result needs to be explained. Part of the reason could be that the raw scores for same sex (6's and 7's) are higher than for the other sex (5's and a 6), and so are less likely to change. However, more light is shed on this when the results from the single-sex schools are studied (Table 4).

Table 4. Questions to single-sex schools	Boy's school. At start of year.	Boy's school. At end of year.	Change over the year	Girl's school. At start of year.	Girl's school. At end of year.	Change over the year
I understand the other sex very well.	4.8	5.2	0.4 #	4.9	5.6	0.7 *
I understand the same sex very well.	7.3	6.6	-0.6 *	7.2	7.3	0.1
I am confident of saying what I want when work with the other sex.	6.0	6.0	0.0	5.0	5.3	0.2
I am confident of saying what I want when work with the same sex.	6.8	6.3	-0.5 #	7.00	7.0	0.0

Again, what may seem strange here is that both the boys and the girls have indicated that they understand the **other** sex **more** than the sex they have been communicating with in school! Also, just being together with the same sex has **not** resulted in much greater understanding in all situations except the research group. Similarly, the single-sex pupils indicated that they are more confident of saying what they want to to the other sex than they are to the sex they have been working with. Boys in single-sex have got worse; this could show the difficulties that boys can experience in coming to terms with social and emotional factors. The boys in the research group, on the other hand, improved (0.7, 0.3). Similarly, the girls in the single-sex schools have indicated less improvement with girls (0.1 and 0.0) than the girls in the research group (0.7, 0.3). How can this be? Here are 2 possibilities:

1) When pupils work with pupils of the same or different sex they have to communicate and so realise the difficulties, but at the same time come to gain a greater, more realistic, picture of what those people are actually like. The pupils have come from different schools, and so they have to learn to make friends. This is not an easy period for pupils and their social and emotional skills are called on. Hence, in general, pupils in single-sex schools

have to come to terms with the difficulties of getting to know new people of the same sex, and in doing so build up a realistic psychological base about them. However, they can still draw on fantasy of the other sex, and so, because it is not grounded in the reality of the other sex, believe it to be easier than it really is. In making this statement I do not forget that pupils will mix with siblings and peers of the both sexes outside school, but would point out that these are usually chosen interactions for social reasons and so do not impact in the same way as in school.

2) That the statistics should be read at face value, and that pupils improve their social and emotional interactions with the sex that they have less contact with. Not only is this counter intuitive, but also there are good theoretical reasons why this is unlikely; namely that to be grounded in reality we need to have our conceptions and pre-conceptions challenged or confirmed by interacting and having dialogue with people. (Kegan, 1982).

Additionally, we can note that research groups indicate that they believe they get on better with **both** same and opposite sex. This is supporting evidence that the pupils are in fact developing their social and emotional skills, since if they do get better it is only to be expected that this improvement will apply to both sexes (even if not to the same degree).

Evidence that the research groups are at least beginning to develop realistic and grounded views of each other is supported by their responses to questions about further group work and how much the other sex would like them (table 5):

Table 5. Questions from The Survey on groups	At start of year. Research groups	At end of year. Research groups	Change over the year	At start of year. Control groups	At end of year. Control groups	Change over the year	<i>Single sex schools</i>
I prefer to work in a group rather than on my own	6.0	6.1	0.1 boys: 0.1 girls: -0.2	6.4	6.4	0.0 boys: 0.3 girls: -0.4	boys <i>-0.1</i> girls <i>-0.3</i>
I prefer to work in a mixed-sex group rather than single-sex	5.8	6.0	0.2 boys: 0.2 girls: 0.2	5.8	5.6	-0.2 boys: -0.1 girls: -0.3	boys <i>0.7 *</i> girls <i>-0.4#</i>
The other sex will like you	4.7	5.0	0.3 # boys: 0.2 girls: 0.5 #	4.9	5.1	0.2 boys: 0.0 girls: 0.4	boys <i>0.0</i> girls <i>0.0</i>
The other sex will help you learn	4.3	4.9	0.6 * boys: 0.6 # girls: 0.4	4.4	4.4	0.0 boys: -0.2 girls: 0.2	boys <i>0.6 *</i> girls <i>0.0</i>

These results indicate that the research groups want to work more with the other sex, even though they are aware of the difficulties of having to work with people who are not necessarily your friends. The fact that there has been a slight increase in the research groups wanting to work as a group indicates again that they are tending to be more social in general. Again, part of the reason could be that they believe that the other sex will both like them and help them learn: a result that is confirmed later in the interviews.

One piece of evidence does not fit this pattern. When asked if the other sex would understand you, the control groups' responses show the most change (table 6):

Table 6. Understanding the other sex	At start of year. Research groups	At end of year. Research groups	Change over the year	At start of year. Control groups	At end of year. Control groups	Change over the year	<i>Single sex schools</i>
The other sex will	4.6	4.9	0.3	4.1	4.6	0.5 *	boys <i>-0.8*</i>

understand you			boys: 0.0 girls: 0.5 #			boys: 0.6 * girls: 0.4	girls -0.2
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While this is an interesting analysis, we must remember that it is based on a few questions and needs confirming evidence. However, it indicates the importance, in future research, of asking questions about both sexes to both sexes, even if it does not, at first sight, appear relevant.

Overall, the information from the **Survey** indicates that the pupils in the research group report having developed their intra-personal (emotional) skills to a greater degree than the control groups. This, if true, is particularly significant. Now I will turn to look at the classroom-based evidence.

Classroom-based evidence

Inter-gender improvement

Although the pupils have not found it easy to work together they recognise how important it is that they develop the necessary skills and learn to co-operate with the other and the same sex. Here are some quotes from the **Opinion** sheets: ‘Sometimes it [group work in science] makes you get on better with people but sometimes they disagree but I think that is good for girls to work with boys and boys to work with girls because it will probably help you to understand the other sex and race’ (girl). ‘You get to know people who I never worked with [until we did group work]’ (boy). One girl said of working with boys ‘Sometimes they’re silly, but once we shout at them there’re quite alright’! Another said ‘The advantages of working with boys is sometimes they make you laugh and also you have experiences with boys so you’re not so un sure (sic) in later life’. The majority of boys are aware of the social process: ‘I have noticed that some boys only share ideas with boys, and girls share ideas with girls’; ‘Sexist people don’t know that some girls have the capability to keep up with boys’.

Written material completed by pupil both inside and outside the classroom indicated that they get to know each better as time goes on: only 11% disagreeing, with 22% making neutral statements and 67% agreeing. The interviews at the end of the year indicate how far some pupils had moved:

Charlotte: As for starters, when we first started school in year seven I didn’t want to be near a boy, and then when I met, I got to know them, I thought ‘right, I don’t really care any more, if I work with them, I work with them,’ I’m still doing my work, they’re a boy, so what. Then I realised that it did not matter if it was a boy or a girl. You got to know them. You might as well do your work.

Tom: But in Primary School it was just like ‘arrgh I hate girls, or, I hate boys’ it was just everyone hated them, but now it’s Secondary School, it’s all the emotions are coming together.

Sarah: It’s made it a lot easier because you mix with different people that you wouldn’t usually mix with before, so you do get to know them more.

George: You could discover things about different people that if you’re with boys and girls in a class you could discover about girls, and when you’re with friends, you know about girls, ..

Of course, in some groups, and with some pupils, the story is different; the groups did not work well, and did not talk together properly. Some pupils did not change over the year and

still did not get on with the other sex, or come to that matter, with the same sex. As one pupil (girl) said during an interview, “Why aren’t we just left alone, I don’t need to talk to anyone, just my friend’. A boy said “I hate working in groups and learn more by myself”. However, as indicated by written replies in the **Opinion** sheets, the **Survey** and interviews, the majority of pupils were not of this opinion. For example, one girl’s comments on the **Opinion** sheets were tracked. She wrote at the beginning of the year (September) “Being in a group with boys is so annoying and I wouldn’t ever [want to work with boys] again”. In February she named a boy as one who she worked well with, while still saying that she preferred to work with a female friend. At the end of the year she made no distinctions between working with boys or girls but said that she spoke ‘normally’ and that if there were disagreements you went with the majority; and her female friend was in the group.

It was quite common for pupils to say that they wanted to work with their friends and those people who they got on well with. They often were not pleased about having to work with people who they did not know or get on with so well, while recognising why they were having to do it.

Learning to deal with each other

Information to ascertain to what extent pupils can be enabled to handle conflict within small group situations comes from materials used in the classroom. Pupils were given tasks to complete, and at the end of the activity to fill in an **Opinions** sheet on what conflict arose, and how they dealt with it.

Initially the pupils said that they got on well in the groups and that there was no conflict, although some groups did not work well. This seemed to be due to both under-reporting, but also that most group members simply accepted what ever went on. However, in some groups, as they were made more aware of their interactions through the sheets and questions, so they became **more** socially aware and so stood up for themselves. Hence the conflict increased in some groups. However, the pupils generally learn to handle the conflict. The ways ranged from learning the skills, through to “I just ignore them”.

Toward the end of the year the evidence from classroom-based materials **Opinions** sheets indicated that although arguments were occurring in up to a third of the groups the majority of pupils felt that they could talk when they wanted (77%). Only 14% felt that they were stopped from talking, while 14% said they were not stopped much. Hence 72% stated that the other group members did not stop them from talking. Another indication that they were learning to deal with the conflict came from their statements on whether or not they changed their opinions during the group work. Only 14% said that they did not change their views. 49% said they definitely did, and the remaining 28% made comments like: “I don’t know”, “No, as I knew it all before” or “I didn’t have any”. This is a large percentage and was probably due to the use of the phrase ‘change your views’ in the questionnaire. Pupils were, say, doing an experiment on electric circuits; hence they could change their understanding without changing their views. I think that this resulted in confusion about how to reply. 81% of pupils felt that arguments, when they took place, were resolved to a reasonable degree.

However, the pupils said very clearly that while they appreciated having to work with people they did not get on with, they would rather work with friends. There was a constant problem for teachers in trying to decide how to form the groups. Some pupils had poor social skills and nobody wanted to work with them. To what extent should others be made to work with them rather than these pupils be put into a group together? There was not common agreed solution to this one and decisions had to be made on a day to day basis.

Communication skills

One teacher said:

The more predominant one at the moment for Year 7s is the social side of it I think... Where they are actually learning to talk to the people that they don't normally talk to and think about what, what they've got to offer. They tend to be getting on better I think. They find it easier to work with anybody I put them with, doing this sort of research. They don't moan about it too much. And I think that to actually force them into that situation is sort of very good socially. (sp1)

In the interviews the pupils were overwhelmingly of the view that the group work had helped them get on better; indicating increased communication: "It's helps us get to know people and learn how to get along with other people (girl)", "when you're their partner then you get to know them more and so you become better friends" (boy).

There were a variety of questions answered by the pupils during lessons. Their answers in an objective survey indicated that their preferences for working in groups – rather than individually – increased over the year.

Their listening skills developed. An independent evaluator interviewed the pupils at the end of the project and judged their skills highly; she wishes to use transcripts for work with the Teacher Training Agency to show how pupils, especially boys, can develop their listening skills.

The contributions of the groups from the **Opinions** sheets were analysed for statements from those that spoke the least, and these were compared with those who spoke the most. At the end of the year only 13% of groups had a pupil who indicated that they felt noticeably more negative than the rest of group members about discussion in the groups. This indicates that a substantial majority of pupils did not speak less because they were 'shut out' or dominated, but felt they could speak when they wanted to.

An idea of the overall feelings of pupils towards working together can be gained from a sheet they did towards the end of the year where they were asked what they liked and disliked about working with the same and opposite sex. Here are some of the answers that will give a flavour of their feelings:

Boys comments:

Why I like working with Girls (other sex)	dislike about working with girls	Like working with boys (same sex)	Dislike about working with boys
nice/smart/can say things to them/ you learn to get on with girls/ fun/they express their feelings/don't mess around/make work easier/sometimes they talk to you/learn more/ you learn what girls talk about/ can concentrate/ don't interrupt the teacher/ more knowledge, know the answer/ they are sexy and kind/they don't whine/	giggle/muck about and do dumb things/moan/ annoying/leave you out/keep saying you fancy someone/ they are so bossy/I hate girls when they take charge of the group/girls get uptight and its hard to learn how to get on with them/talk too much	fun/talk about football/easy to talk/help you talk about girls/have fun/cheer you up/want to learn/work with friends/understand them more as same sex/like working with you/they like what I like/ talk about boys stuff/get to know them better/helps me understand girls	take the mickey/get into trouble/don't work as hard/ you may get in trouble/ muck about/drone out the teacher/can't keep still/ will switch over and work with someone else/ silly/some really get on my nerves/ should get on with the work.

Girls comments:

Like about working with boys (other sex)	Dislike about Boys	like about working with girls (same sex)	Dislike about wk with girls
different opinions from other sex/ sometimes smart and useful/ understand you/co-operate/ they aren't the same and have different opinions/ give you ideas/learn about boys/sometimes not selfish/funny/help, understand things more/ they understand you and get on with the work/ know what they like and dislike/ know how to speak to them/ sometimes boys can take more notice of what you say/ boys have different feelings about science /	go over the top/ too immature/jokes that aren't funny/not sensible/annoying and stupid/ mess about/call you names/talk to each other and mess about/ make something you don't agree with into an issue/ rough/ silly/ ignore you/ make sure answers are right before going on/ can be personal/when they are with their friends they muck about.	Understand you/co-operate well/share ideas/fun/know them/get on with our work/ talk better/ learn better/ communicate better/ friends so fun/don't embarrass you/ have same opinions/ understand them better than boys/ sensible and responsible/	Can be bitchy/ think they're the boss/ sometimes play with their nails/ chat to boys and start to mess about / be annoying/ get bossy and then you don't get to say anything/ not work and chat all the way through/ moan at you/ talk about boys/ make you feel low/

We can notice that the girls in particular seem to have learnt to value the difference (e.g., they aren't the same and have different opinions/ boys have different feelings about science). Learning to get on is not to think the same. Also the last boy who says that he likes working with boys because you learn to understand girls has either just filled it in in the wrong column, or intuitively realises that to understand the 'other' helps you to understand the 'self'.

Overall in the research groups the boys and girls made a similar ratio of comments for liking and disliking each sex; e.g., for each comment the boys made about **disliking** girls they made 2.4 comments on why they liked them, and for each comment they made about **disliking** working with boys, they made 2.1 positive comments.

However, the control groups made a proportionally greater number of negative comments about disliking the other sex. The same-sex ratios were similar to the research groups.

Additionally, it was noticeable that the girls in the control groups comments about other girls were generally stronger, for example, they made over three times as many comments about other girls being bitchy than in the research groups. These results imply that in the research groups the girls got on better with each other, and so provide possible evidence that the girl-girl relationships were stronger. This evidence, along with that from the **Survey**, see back, are mutually supportive on this point. And, of course, one thing that could increase inter-sex solidarity is having the other sex around!

Overall the evidence from the different sources indicates that the pupils are, to varying degrees, learning to get along with some degree of understanding.

One part of conflict is both being able to stand up for oneself, as well as to make compromises. However, compromise is not always a suitable outcome as one can have strong feelings. This relates to a feeling of self-confidence.

Self-confidence

To find out if pupil's self-esteem had been raised during the year, three ways of assessing changes were used. The first way was through teacher observation, the second through an objective questionnaire and the third through interviews.

Here is a quote from a teacher talking about the changes in her class:

.... if they are more confident they think better about themselves, they are not scared to go and do things, they don't think 'Oh, I can't do that because I am not as good as them'. They are willing to have a try because they've got the confidence that nobody in the class will laugh at them and make fun of them if they get it wrong. They won't get into trouble, and that sort of thing, so their whole self esteem improves, like Bob, Bob the blond boy who sits next to Jake usually – very low self-esteem, just huddle... and Alan, as well. And suddenly, you know, well, not suddenly, they've gradually got more confident ... From what I heard from around school they say a lot more in Science than they say in other lessons so they obviously feel more confident in here. and everything, but it has definitely built their self-esteem as well.

The two other teachers thought that their pupils were increasing their self-esteem, although one pointed out the difficulty of trying to assess it.

More evidence comes from the pupil interviews, where about 40% were asked their views on the research. In these interviews nearly all pupils agreed it had helped them gain confidence:

“Yeah, it makes you feel more confident (boy)”, “When I first came here I was really shy, but when you’re working in groups in science it helps you to talk to other people and builds up your confidence” (girl). Some pupils also saw that it helped them with work, although not explicitly making a link to self-confidence: “Group work is like a shot at saying that, ‘could you do this by yourself without a teacher showing you and that you are experimenting, like, I can actually do something [by ourselves]”.

Again, this supports and confirms the evidence from the **Survey** that their confidence increased (see back: asked “How confident would you be that you could say what you wanted to a pupil of the other sex”, the pupils’ scores went up significantly from a score of 5.2 to 6.2 out of a possible score of 8). Similarly, when asked if they could work with 3 pupils of the other sex, how confident would they be in being able to say what they wanted, the scores increased from 4.7 to 5.1. When asked if a pupil of the opposite sex would like them, the scores increased from 4.7 to 5.0.

Clearly, this confidence is mainly about talking and working in groups, and no general statements can be made about the pupil’s overall self-confidence.

One feature that has come out clearly has been that pupils much prefer to work with friends. They feel that this increases their ability to communicate. Yet they, to varying degrees, also see that they need to learn the social skills to get on with other, whether they liked them or not. They have put forward many reasons for this in the **Opinions** sheet “Because you get know what other people are like and what their opinions are”, “You make more friends”, “So that you don’t become a loner”, “Because you work with different people you can learn more, also important because you can get a better job”, “Very important because other people’s views matter just as much as yours” and “[You can learn to] listen to older people who have more experience”.

However, the conflict between wanting to work with only friends, and, despite the difficulties, with others remains. This presents a real difficulty for teachers on how to achieve this balance.

It is also of interest to note that the independent evaluator noted the great extent to which the pupils, unprompted during the interviews, said that the class members would help each other. This strengthens the point made that they felt the other sex would help them.

The findings, then, indicate that the pupils have increased in their personal skills. Similarly, the quotes from pupils on group work and science (see below p18) also indicate positive attitudes to intergender social situations.

Attitudes to science education

In brief, the pupils in the research groups were happier about their science lessons than those in the control groups. To find out how they felt about science lessons they filled in questions in an objective questionnaire, answered questions in class, and were interviewed.

It was decided to ask questions about how the pupils felt about their science lessons in a variety of ways. The questions in the **Survey**, and the results, are given below (Table 7):

Table 7. Questions on science lessons	At start of year. Research groups	At end of year. Research groups	Change over the year	At start of year. Control groups	At end of year. Control groups	Change over the year	boy single sex	girl single sex
How happy are you when you see science on the timetable?	5.7	6.1	0.4 * boys: 0.2 girls: 0.6 *	5.9	5.4	-0.5 * boys: -0.6 * girls: -0.4 #	-1.1*	-0.9*
Are science lessons interesting or boring?	5.9	6.3	0.4 # boys: 0.1 girls: 0.7 *	6.3	5.8	-0.5 * boys: -0.6 * girls: -0.3	-0.6*	-1.3*
Do you enjoy or hate science lessons?	6.2	6.8	0.6 * boys: 0.4 # girls: 0.9 *	6.2	6.0	-0.2 boys: -0.3 girls: -0.2	-0.1	-1.1*

Overall, this is a very positive set of results. In many other studies it has been shown that pupil's interest in science lesson has decreased significantly. This indicates that the research methods may not only be halting that decline, but also reversing it. These results are very pleasing, however, in these three questions, unlike the responses to most of the others, the pilot results varied considerably from the above. For this reason it is worthwhile incorporating the pilot study. When the results of the pilot and this study are combined the results are:

Table 8. PILOT + RESEARCH	research groups + pilot	research groups + pilot	Change over the year	Control groups + pilot	Control groups + pilot	Change over the year	boy single sex + pilot	girl single sex + pilot
How happy are you when you see science on the timetable?	6.1	6.1	0.0 boys: -0.1 girls: 0.1	5.8	5.4	-0.6 * boys: -0.6 * girls: -0.4 #	-1.0*	-0.7*
Are science lessons interesting or boring?	6.0	5.9	-0.1 boys: -0.1 girls: 0.0	6.3	5.7	-0.6 * boys: -0.6 * girls: -0.6 *	-0.7*	-1.0*
Do you enjoy or hate science lessons?	6.2	6.2	0.0 boys: 0.0 girls: 0.0	6.2	5.7	-0.5 * boys: -0.3 girls: -0.2	-0.5*	-1.2*

These still give a positive sets of results for the research. Now, although in both cases the pupils were told that the project was aiming to improve their learning and social skills, it must be acknowledged that the Hawthorne effect (that people respond to what researchers tell them) was present. It is not possible to say to what degree. As a gut feeling, if we take the combined pilot and research results, it would probably more than compensate for the Hawthorne effect.

It is useful to convert these figures to percentages as it gives an easier way to understand the differences involved. Since the questions were asked as a eight point Lickert scale, they can be interpreted into percentages, with the first four of the eight points indicating that the pupils are unhappy, to some degree, when they see science on the timetable, and the next four of the eight point scale indicating that they are happy to some degree. Here are the percentages at the

end of the year based on these, admittedly rough assumptions, and using the figures from table 8 (Table 9):

Table 9	Percentage that are happy to see science on the timetable		Percentage saying science lessons are interesting		Percentage enjoying science lessons	
	boys	girls	boys	girls	boys	girls
Research + pilot	83%	85%	85%	88%	90%	88%
Control + pilot	73%	74%	77%	83%	76%	82%

These indicate that research group have more positive attitudes to science lessons. These figures can be compared with another study, done three years ago, where 482 secondary pupils were asked to draw pictures of two scientists and ask a series of questions, one of which was how much did they enjoy science lessons. There were a wide range of co-educational schools involved, 40% doing better in the 'league tables' than the research schools. The 120 year 7 pupils gave responses that indicated responses that were below the research groups, and similar or slightly above the control groups.

Some indications for why the research groups could have more positive attitudes to science come from the **Survey**. The extent to which the research and control groups feel they understand science are similar, to within 5% of each other. However, the research groups feel that science is more relevant to them, the boys 6% higher and the girls 11% higher.

All groups say that they like practical work, as is in line with other studies. However, although the control and research groups were paralleled, and so did similar amounts of practical work there is a slight variation in the results: the boys in both groups and the girls in the control group all estimate that the percentage of theory to practical is 60%. Only the research girls are higher at 73%. It may be that the girls see the group work/discussions as having a practical element to a greater degree than the boys have. Since practical work is universally liked, that the girls see it as higher may be a contributory factor.

When asked if they would consider continuing with science if they had a choice, then the research groups are clearly higher, although of course, there is a long way to go before choices are actually made, table 10.

Table 10. Question on continuing with science from The Survey	Research groups. Mean score out of 8 at start of year	Research groups. Mean score out of 8 at end of year.	Change over the year	Control groups Mean score out of 8 at start of year.	Control groups Mean score out of 8 at end of year.	Change over the year
I would be very likely to continue with science.	5.4 n=74 S D = 1.8	6.1 n=74 S D = 1.8	0.7 * boys: 0.7 * girls: 0.8 *	5.8 n=75 S D = 2.8	5.7 n=75 S D = 1.9	-0.1 boys: -0.2 girls: -0.1

Matched t-test: $p < 0.05$ is indicated by *; $0.1 > p > 0.05$ by # and $p > 0.1$ is left blank.

It is illustrative to find out the percentages, as explained above, to see how many pupils are thinking about taking up science at the end of the year (table 11):

Table 11	Percentage that indicate that they are likely to continue with science.	
	boys	girls
Research	85%	85%
Control	71%	76%
Significance of the difference using a chi squared test.	#	

The results in the study on drawing scientists explained above gave the results: boys 76% and the girls 67%. There is a clear difference with the girls being less likely to take up science than the boys, unlike the research group.

Further evidence on why the research groups may be more interested in science lessons comes from the classroom-based **Opinion** sheets. Three questions were directly relevant; these were (Table 12):

Table 12	Negative replies	Neutral replies/%	Positive replies/%
Does group work affect how you feel about science?	18% b=13; g=23	14% b= 5%; g=23%	68% b=83%; g=54%
Would doing regular group work make pupils more interested in science?	11%	20%	69% b=71%, g=67%
Is group work a good way to learn science?	0%	11%	89% b=89%; g=89%

With the exception of the first question the boy's and girl's replies were similar in percentage terms. Here are some of their answers from the first two questions:

'Because you can compare answers and if you are right it will make you feel good' (girl).

'Because you can work with feelings' (boy).

Group work is good, because if you don't understand the others will explain it and make it easier. Sometimes there are disagreements, but most of the time it is interesting (girl).

'It makes it more interesting because you are with your friends' (boy).

'More interesting because you talk to other people' (boy).

'It makes it easier because you get ideas from other people. There is more disagreements because we all got different ideas' (boy).

'It is interesting, easier and more social' (girl).

'Depends on the group' (girl).

'There are more arguments because of the [boy's] lack of work' (girl).

'If I work by myself I get more time to think' (boy).

In some cases there have been a disagreement between pupils outside of the classroom and it affects their attitude, resulting in negative comments about group work. The subjective impression of the teachers is that this affects girls more than boys.

And these are pupil-answers for the last question:

- 'Yes, because when I was telling the girls it got stuck in my head' (boy)
- 'Yes, because you get to hear what other people wanted to say. And you learn more' (boy).
- 'Yes, you can say what you want to in the groups' (girl)
- 'Yes, because ideally people will discuss it and the ones who understand one thing will explain it to the others and visa versa' (girl).
- 'Yes, it is because you expand your memory and learn more and find out stuff what you did not know'
- 'Yes, because you can learn without knowing' (boy)
- 'Yes, science in groups is helping me to work, but I would prefer to work with my friends' (boy).

These quotes give a clear indication that they feel more positively towards the science lessons because of the group work. Since they had indicated that learning social skills was so important these results could contribute to them saying they had more positive feelings towards science as a subject in schools. These results are important as they indicate that there is a chance that with this sort of work continuing in schools through years 8-11 that all pupils, and especially girls, would be more likely to continue with science as a subject.

Conclusion

The results of the project give a strong indication that the sort of work pioneered in this study could enable boys and girls to develop their social and emotional skills, while enhancing their interest in science as a subject. However, it must be acknowledged that teachers have to learn the skills to help pupils, and that the pressures of the National Curriculum affect the degree of time that can be spent on developing pupil-skills.

The findings give support for co-educational schools, and for providing opportunities for pupils to grow social and emotionally. Hence it is justified within its own right. Additionally though, this approach to teaching and learning could contribute to citizenship and PHSE in the following areas: to learn to resolve conflict fairly; justify their personal opinions orally; contribute to group and exploratory class discussions; use their imagination to consider other people's views; to negotiate, decide and take part in school-based activities; and to reflect on the process of participating (NC1999; p184 1g, 2b, c, 3a, b & c).

As I wrote this paper and filled in the details, so I became aware that the boys and girls answers in the research group were more similar than I would have suspected. In general they are closer than those for the control and certainly than the single sex-schools. In nearly all cases the boys and girls results have a high degree of overlap. This gives support for co-education as it focuses on both sexes at the same time.

Since one of the schools was put on special measures during the research, the results in the study can be seen to be positive. Unfortunately, the project was only one year in length, and as a result the findings can only be taken as an indication of possibilities. However, this does show that it is a rich field for further study.

Points for further research:

1. Could the results obtained here be sustained, or improved on, over a longer period of, say, three years?
2. How would the results be affected if done in a wider range of schools and subjects?

3. Can the strategies developed in this research help pupils develop same-gender relationships at the same time as intergender ones?
4. The patterns of talking and supporting each other were reported as being similar. To what extent was this because the pupils are associating these factors with the person who talked the most?
5. Pupils found it very difficult to say how well each other had done in lessons. Why was this and could techniques be found to help them?
6. The techniques developed were used to foster intergender understanding. Could the same techniques be used to with pupils of different ethnic groups and finding ways of promoting understanding between them? See a previous paper based on the pilot project (Matthews and Sweeney; 1997) and Matthews (2001). Similarly, it is possible that the techniques could apply to helping people to understand each other across cultural and religious divides as well.
7. To what extent would a whole school approach enhance the pupils' social and emotional development?

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DISCUSSION ASSESSMENT

APPENDIX 1.

DA1

Observer: _____ Class: _____ Date: _____

Name _____ Each time a person talks, put in a ✓.

Main comments When you fill in the chart below, do **not** use ticks or numbers. Make a comment like: The most; a lot; the least; frequently; well; not at all.

Name	talking	listening	interrupted others	helped others	how much did they learn?

Other comments

APPENDIX 2

GUESSES

Class: _____ Date: _____

Fill in the chart below, **without looking at anyone else's**. Do **not** use ticks or numbers but make a comment like: The most; a lot; the least; frequently; well; not at all.

Name	talking	listening	interrupted others	helped others	how much did they learn?
Yours:					

Other comments (Use the back of the paper as well)

APPENDIX 3

Name:	Class:	Date:	6
Members of group:			

In each of the questions below write the person's names in order in the boxes.

1. Who do you think spoke:

the most next most the least

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2. Who do you think listened:

the most next most the least

--	--	--	--

3. Who do you think suggested useful things to do:

the most next most the least

--	--	--	--

4. Who do you think disrupted the group:

the least next least the most

--	--	--	--

5. When I was working in my group I felt

because

6. Working in a group was useful because.....

7. How does group work help you, or stop you, from learning?

APPENDIX 4

Name:	Class:	Date:	7
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1. How well did you get on with the rest of your group? Were there any differences with sex or 'race'?

2. Do you get on better as you do more group work?

3. The other people in the group could help me learn more by

4. Besides giving you the answers, how could the teacher help you learn more when you work in groups?

5. Order of speaking	6. Order of listening
Spoke the most	Listened the most
Spoke the least	Listened the least