VOLUME II: APPENDICES

TABLE OF CONTENTS

APPENDIX 4 QUANTITATIVE DATA FROM YEARS 6 AND 7: CHILDREN, TEACHERS AND SCHOOLS.

APPENDIX 5 STATISTICAL ANALYSES OF QUANTITATIVE DATA.

APPENDIX 6 QUALITATIVE DATA FROM YEARS 6 AND 7: CHILDREN, TEACHERS AND SCHOOLS.

INDEX OF TABLES

INDEX OF FIGURES

VOLUME I: THESIS

APPENDIX 1 PILOT STUDIES

1.1 THE FIRST PILOT STUDY OF THE CHILDREN'S QUESTIONNAIRE

The first stage in the development of the questionnaire centred on producing an instrument that would use indirect but valid methods of assessing attitudes, and that young children would find easy to use. To that end, it was decided to make a trial using pictures and smiley scales as well as the more usual written form of items. The objective in this first trial was to check on the validity of using pictures to represent science activities such as writing, calculating and investigating, with smiley scales (Davies & Brember, 1994) to rate the activities. The questionnaire included two sections: a section of written statements, from TOSRA (Fraser, 1980) and SIMSS (Keys, 1987) and a section of pictures (see Appendix 3 for a copy of this instrument).

The sample used was one class of children in year 6 of one primary school in South East Cambridgeshire, and one class of children in year 7 in one secondary school in North West Essex. After the questionnaire had been administered the class teachers were asked to comment on any aspects of the questionnaire that they felt were problematic. For example: the format, the level of difficulty of the questionnaire for the children, or in its administration. The teachers' reports indicated few problems; the children had enjoyed doing the questionnaire and only two written statements had caused difficulty in terms of reading and comprehension. The length of time taken to complete the questionnaire was judged to be about right by the class teachers concerned.

However, analysis of the results revealed some serious inconsistencies between the responses to the written statements and to the pictures. Interviews were conducted with 9 children: (5 boys and 4 girls) in an attempt to understand these inconsistencies.

The interviews revealed that, despite efforts to keep the pictures very simple, without any unnecessary context, even this limited context was affecting responses. There were two particular problems: the interpretation of the pictures and the effect of gender. An example of the first problem involves the three pictures representing different aspects of measuring (Appendix 3). Picture 1 is meant to represent weighing. The responses to this picture were different from the responses to the other two measurement pictures. In the interviews, it became clear that the reason for the different responses to this picture was that it was not perceived as a science activity because the measuring instrument looked like a set of kitchen scales. One girl said 'It looks like weighing in H.E.' (Home Economics) and a boy said ' It looks like weighing food or something to do with H.E. I wouldn't like that.'

The second problem related to the gender of the respondents. Great pains had been taken to ensure that the figure used in all the drawings was 'unisex'; indeed, exactly the same figure was used in every picture. However, boys regarded the figure in the weighing scale picture as female but the girls saw it as male. The boys also regarded the figure in the thermometer picture as male. The effect of these contextual clues was that the children answered the written questions in a different way from the picture questions. This led to the decision that, although the children enjoyed them, pictures would not be used to represent statements, since their validity was in serious doubt.

Interviews with the children were also used to check the validity of the written statements. All of the children interviewed said that writing in science was an area of difficulty and that practical work was a source of enjoyment. This led to the development of additional statements about written work and practical work for inclusion in the second pilot.

1.2 THE SECOND PILOT OF THE CHILDREN'S QUESTIONNAIRE

The objectives in this second trial were to check on the validity and reliability of the newly developed statements, and the readability and optimum length of the questionnaire. Validity and reliability were checked by a combination of visual checks and statistical methods. The children were asked to write on the questionnaire if they had any comments about particular items, and the teachers were asked to give their criticisms of the questionnaire.

The sample on this occasion comprised 341 children in year 6 in three primary schools, and 250 children in year 7 in three secondary schools, in Essex. A standard Likert-type questionnaire was used with a four-item format with no 'undecided' category since this category was thought to be potentially confusing for young children (Foddy, 1995). The questionnaire had three sections of written statements: attitudes to school, attitudes to science and activities in science lessons. The attitudes to school section contained items about general enjoyment of school and about motivation and attitude to work. These items had been previously tested for reliability and validity, since they were taken directly from SIMSS (Keys, 1987). The attitudes to science section contained groups of sentences about enjoyment of science lessons, understanding ideas, scientific attitudes, the importance of science to society, the facility of science, problem

solving, writing difficulty, practical work, calculations, the use of computers in science, and continuity in science. Most of these were taken from SIMSS and TOSRA but some were developed for the present study, as a result of the first pilot study. A section of items about the nature of science, which reflected those developed in the pilot studies of the teachers' questionnaires (see below), was also included. The final section about activities in science lessons included statements about teaching methods and the amount of teacher control or autonomy in classroom activities. These statements were taken from SIMSS but in some cases the original wording was altered (see Appendix 3 for a copy of this questionnaire.). One hundred items were used in this pilot, in order to test as large a number of statements as possible and also to establish the best number for the target age group.

The teachers' reports were mixed; some said the children had enjoyed the questionnaire while others criticised it for being too long; one commented that there were too many negative statements. Teachers said that the children had enjoyed the front page in particular because they liked choosing their favourite subjects. Their evaluations of reading and comprehension difficulty varied with the age of the children and the socio-economic background of the school. Secondary school teachers felt that there were no problems with the reading and comprehension levels. Teachers from primary schools with an intake of children from relatively affluent backgrounds reported no difficulty with reading and comprehension. Teachers in schools in working-class urban areas reported some reading difficulties, which they had overcome by reading the sentences aloud with the children.

Visual checks revealed that many children had disliked the four-item forced format; some had taken the trouble to write in a 'middle' score, (between "agree" and "disagree"), and some had added 'don't know' at the end. Some teachers also

commented on this, saying that the children wanted an 'undecided' category. Visual checks also allowed the format to be adjusted to improve readability. For example, errors such as ticking two responses for one item and then no responses for the next or previous item, suggested that the spacing and the font size should be larger.

There were three stages in the statistical analysis: first the proportion of missing responses for each item was checked in order to remove items which were clearly not being answered by the majority of children. These items were omitted before the second stage, factor analysis. Factor analysis was used to establish groups of items that related to single constructs. Finally, Cronbach's α was calculated for each factor to test its reliability.

Some items had a very high proportion of missing answers, these were generally the ones mentioned in the teachers' reports as being difficult to understand or read. These items were eliminated before further analysis was undertaken because of their unreliability and lack of validity. The items removed were those concerned with understanding ideas, scientific attitudes, problem solving, and the nature of science.

Table 1-1 Numbers of boys and girls in the second pilot study

	Boys	**Girls**
	N	N
Year 6	165	193
Year 7	145	105

Figure 1-1 Number of valid responses by Year 6 children in the second pilot

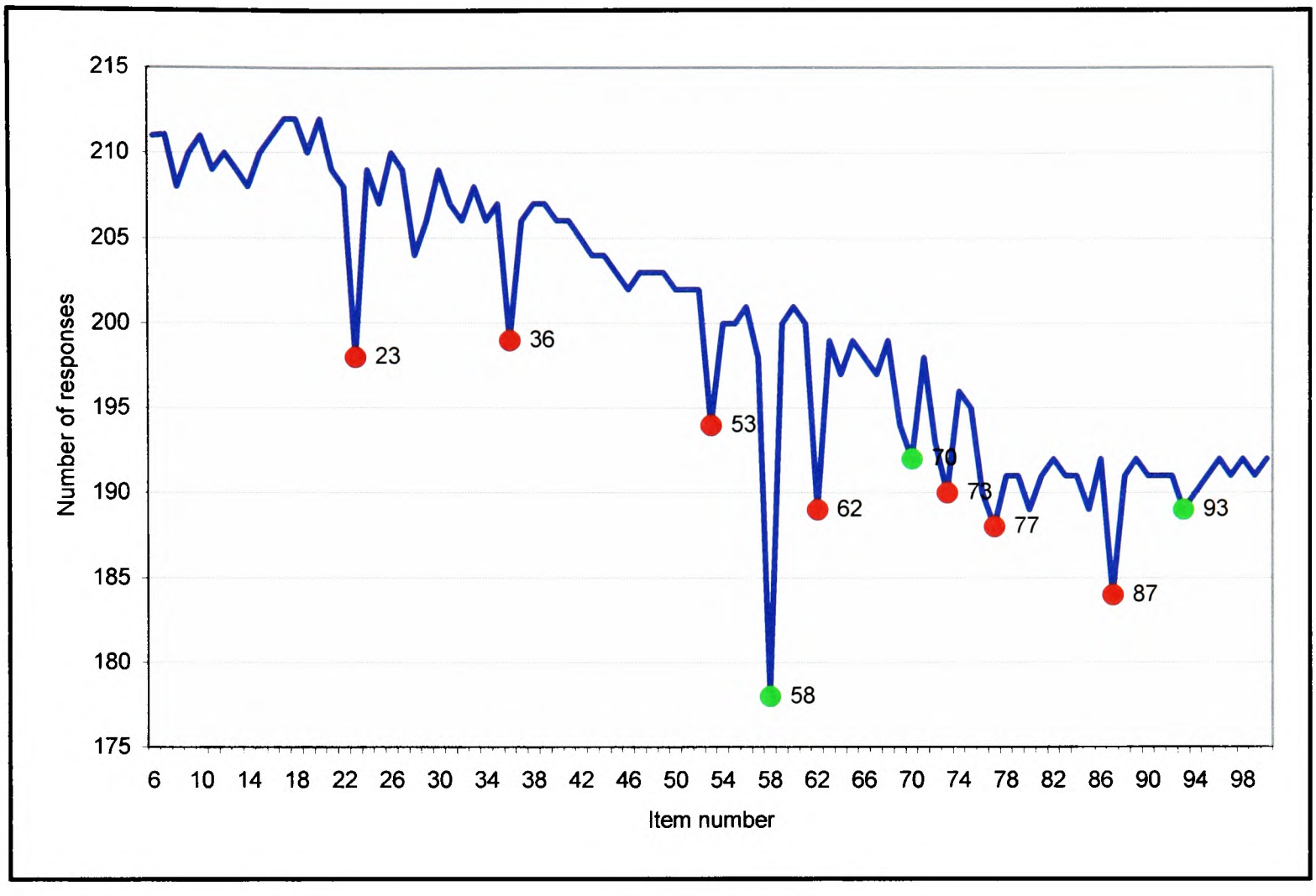


Table 1-2 Items omitted from analysis

Item number	Statement
a23	There is no such thing as a *true* scientific theory
a27	A scientist's job is to discover the true nature of the world
a36	Emotions have nothing to do with finding out new scientific knowledge
a40	Scientists don't know what will happen in an experiment before they do it
a49	You don't need to do experiments to learn about science
a53	The way a scientist works has nothing to do with morals or religion
a62	Scientists decide carefully between two theories just by looking at the results of experiments
a66	The most important part of science lessons is learning how to do investigations not remembering the facts
a73	Scientists need to have a good imagination to help them work out new theories
a77	Scientific theories are only worthwhile if they can be useful to people
a84	There are some things in the universe that science will never be able to explain
a85	Science is different from other subjects because it uses special methods of working
a87	New scientific theories are just the result of lots of experiments and observations

N.B. Although many children did not respond to item 58, it was not omitted from analysis because it had been validated in other research studies (Keys, 1987).

Table 1-3 Responses from second pilot to items about school

			Boys %					Girls %				
No.	Item	Year	Valid N	SA	A	D	SD	Valid N	SA	A	D	SD
6	School is not very enjoyable	Primary	162	5.1	20.1	14.1	6.5	192	5.6	29.9	14.4	4.2
		Secondary	145	4.8	29.2	16.0	8.0	105	3.2	23.2	13.6	2.0
7	I enjoy everything about school	Primary	162	2.3	9.3	24.6	9.6	192	2.8	13.0	27.7	10.7
		Secondary	145	.4	12.0	39.6	6.0	105	2.0	9.6	26.8	3.6
8	I am bored most of the time at school	Primary	159	11.7	16.2	10.8	6.6	192	10.8	29.3	10.5	4.0
		Secondary	144	7.6	31.7	12.4	6.0	105	7.6	29.3	4.4	.8
9	There are lots of school subjects I don't like	Primary	161	5.1	18.8	17.3	4.5	191	9.7	22.4	16.8	5.4
		Secondary	145	7.2	22.8	22.0	6.0	105	6.0	19.6	15.2	1.2
10	The most enjoyable part of my life is the time I spend at school	Primary	161	2.0	4.5	17.0	22.2	191	2.0	6.0	25.6	20.7
		Secondary	145	2.4	8.4	24.8	22.4	105	.8	6.8	22.8	11.6
11	I generally don't like my schoolwork	Primary	161	4.8	22.7	13.6	4.5	191	6.0	29.0	14.5	4.8
		Secondary	145	5.2	30.4	20.0	2.4	105	3.2	28.8	9.2	.8
12	I get good marks for my work	Primary	162	2.3	22.4	15.6	5.7	190	5.1	26.7	18.5	3.7
		Secondary	145	9.2	37.6	10.4	.8	105	5.6	28.4	7.2	.8
13	I always work as hard as I can at school	Primary	162	9.7	17.9	14.0	4.6	189	12.8	26.8	11.1	3.1
		Secondary	145	15.2	26.4	13.2	3.2	105	10.0	23.6	8.4	
14	I always behave badly at school	Primary	161	15.7	20.9	6.6	2.9	189	28.6	21.7	2.3	1.4
		Secondary	145	22.9	28.1	4.8	2.4	104	22.1	18.9	.8	
15	I am keen to answer questions in class	Primary	162	10.2	18.7	12.2	4.8	191	7.1	24.4	16.1	6.5
		Secondary	145	10.4	30.0	14.0	3.6	105	4.0	24.0	12.4	1.6

Table 1-4 Responses from second pilot to items about science

			Boys %						Girls %					
No.	Item	Year	N	M	SA	A	D	SD	N	M	SA	A	D	SD
16	I look forward to science lessons	Primary	162		20.2	46.0	22.1	11.0	192		17.2	32.8	38.0	12.0
		Secondary	145		14.5	56.6	22.8	6.2	105		13.3	65.7	16.2	4.8
17	It is easy to understand the new ideas I learn about in science	Primary	163		8.6	43.6	40.5	7.4	192		3.1	40.6	49.0	7.3
		Secondary	144		8.3	55.9	26.9	8.3	105		6.7	62.9	29.5	1.0
18	I would rather find out why something happens by doing an experiment than by being told	Primary	162	.6	56.4	30.7	10.4	1.8	192		44.8	47.4	6.8	1.0
		Secondary	145		57.9	32.4	9.0	.7	105		44.8	46.7	5.7	2.9
19	Scientific inventions improve our standard of living	Primary	161	1.2	39.3	41.1	14.1	4.3	190	1.0	22.9	53.6	19.8	2.6
		Secondary	143	1.4	37.2	51.7	8.3	1.4	103	1.9	22.9	64.8	10.5	
20	Science is a difficult subject	Primary	162		9.9	40.7	41.4	8.0	191		11.5	41.9	31.4	15.2
		Secondary	144		9.7	46.5	34.0	9.7	104		9.6	51.0	37.5	1.9
21	Science is more interesting when we use computers	Primary	162	.6	39.3	29.4	20.9	9.8	187	2.6	27.1	30.7	30.2	9.4
		Secondary	132	9.0	20.0	23.4	38.6	9.0	100	4.8	7.6	20.0	60.0	7.6
22	Science uses too many special words	Primary	157		6.9	20.0	34.4	38.8	189		10.3	22.3	37.5	29.9
		Secondary	143		6.3	28.2	50.0	15.5	105		3.8	28.6	42.9	24.8
24	There is too much writing to do in science	Primary	160		12.5	41.3	26.3	20.0	190		9.5	42.6	27.4	20.5
		Secondary	143		7.7	40.6	32.9	18.9	103		9.7	48.5	30.1	11.7
25	I like to hear scientific explanations of the world we live in	Primary	158	2.5	17.9	47.5	23.5	8.6	188	2.1	12.0	49.0	27.1	9.9
		Secondary	144	.7	13.1	50.3	24.8	11.0	103	1.9	6.7	58.1	30.5	2.9
26	I like doing experiments	Primary	162		65.4	31.5	1.2	1.9	191	.5	54.2	39.1	5.7	.5
		Secondary	144	.7	69.7	26.2	2.8	.7	105		61.9	31.4	3.8	2.9
28	Science is difficult when it involves calculations	Primary	161		10.6	31.1	41.6	16.8	183		11.5	29.0	44.3	15.3
		Secondary	143		7.0	37.1	44.1	11.9	102		5.9	39.2	45.1	9.8
29	I dislike science lessons	Primary	160		38.1	38.8	13.8	9.4	187		27.8	40.1	18.7	13.4
		Secondary	145		38.6	43.4	8.3	9.7	105		38.1	51.4	7.6	2.9
30	There are too many new ideas to learn in science	Primary	157		12.1	37.6	36.3	14.0	189		7.9	34.9	43.9	13.2
		Secondary	143		9.1	50.3	29.4	11.2	103		11.7	55.3	28.2	4.9
31	Doing experiments is not as good as finding out information from teachers	Primary	160		57.5	28.1	8.1	6.3	186		46.5	33.7	12.3	7.0
		Secondary	145		58.6	26.9	8.3	6.2	105		57.1	32.4	6.7	3.8
32	Science has ruined the environment	Primary	158		21.5	41.8	24.1	12.7	188		26.1	42.6	26.6	4.8
		Secondary	142		21.1	44.4	31.7	2.8	104		12.5	58.7	15.4	13.5
33	There are too many facts to learn in science	Primary	160		6.3	41.3	45.0	7.5	190		11.6	35.3	43.2	10.0
		Secondary	140		8.6	39.3	42.9	9.3	105		1.9	56.2	32.4	9.5

Table 1-4 continued

			Boys %						Girls %					
No.	Item	Year	N	M	SA	A	D	SD	N	M	SA	A	D	SD
34	Using a computer makes science so interesting I don't want to stop	Primary	159	1.2	23.5	34.6	25.9	14.2	187	2.1	19.9	16.8	45.0	16.2
		Secondary	130	9.1	10.5	20.3	46.9	13.3	100	4.8	3.8	13.3	62.9	15.2
35	It is difficult to write down what an experiment was about	Primary	159		2.5	24.5	53.5	19.5	189		3.7	21.7	52.9	21.7
		Secondary	141		5.0	36.9	46.1	12.1	105		4.8	41.0	48.6	5.7
37	There are too many new words to learn in science	Primary	161		8.3	21.7	41.4	28.7	186		6.3	19.6	51.9	22.2
		Secondary	139		6.3	25.9	42.7	25.2	105		4.8	31.4	52.4	11.4
38	Finding out about new things in science is not important to me	Primary	161		29.8	42.2	19.9	8.1	188		21.8	58.0	12.2	8.0
		Secondary	142		23.9	50.7	16.2	9.2	105		22.9	55.2	19.0	2.9
39	Doing experiments in science is a waste of time	Primary	159		60.4	28.9	5.0	5.7	187		50.3	36.9	7.5	5.3
		Secondary	140		65.0	28.6	3.6	2.9	105		59.0	36.2	2.9	1.9
41	The calculations we do in science are difficult	Primary	158		6.3	36.1	41.8	15.8	186		6.5	33.3	45.7	14.5
		Secondary	141		5.7	41.1	42.6	10.6	101		4.0	51.5	35.6	8.9
42	Science lessons bore me	Primary	159		40.9	37.1	13.8	8.2	185		23.8	44.9	18.9	12.4
		Secondary	142		31.0	47.9	10.6	10.6	105		40.0	44.8	8.6	6.7
43	Listening to ideas about science is boring	Primary	157		31.2	35.0	21.0	12.7	187		15.0	47.6	23.5	13.9
		Secondary	141		19.9	46.1	21.3	12.8	105		21.9	49.5	21.9	6.7
44	I would rather agree with other people than do an experiment to find out for myself	Primary	159	1.2	41.4	36.4	14.8	6.2	185	6.3	30.4	38.2	19.4	5.8
		Secondary	142		35.9	35.2	25.5	3.4	105		31.4	43.8	18.1	6.7
45	Science will help to make the world a better place in the future	Primary	160		26.9	49.4	17.5	6.3	182		19.8	47.3	26.9	6.0
		Secondary	139		27.3	51.8	17.3	3.6	104		24.0	51.9	20.2	3.8
46	Science is difficult when it involves calculations	Primary	160		6.9	33.8	45.6	13.8	182		7.1	36.8	40.7	15.4
		Secondary	141		8.5	36.2	46.8	8.5	103		3.9	46.6	36.9	12.6
47	When I use a computer in science I understand things better	Primary	159		23.3	44.0	24.5	8.2	180		22.8	32.2	38.3	6.7
		Secondary	130		8.5	33.1	48.5	10.0	94		7.4	24.5	58.5	9.6
48	Spelling scientific words is really difficult	Primary	160	1.9	3.7	19.8	49.4	25.3	184	6.3	4.2	13.6	55.5	20.4
		Secondary	142		4.1	30.3	53.8	11.7	105	1.0	1.9	21.0	58.1	18.1
50	I already know about the science my teacher is teaching us	Primary	159		13.8	55.3	24.5	6.3	183		10.4	63.9	20.8	4.9
		Secondary	145		11.0	56.6	30.3	2.1	105		10.5	74.3	14.3	1.0
51	I like to listen to people whose opinions are different from mine	Primary	160		23.8	58.8	11.9	5.6	183		23.0	67.2	7.1	2.7
		Secondary	144		16.0	66.0	13.9	4.2	105		21.9	71.4	6.7	
52	I enjoy planning my own investigations	Primary	160		29.4	48.8	18.8	3.1	182		22.5	41.8	30.8	4.9
		Secondary	145		16.6	57.2	20.7	5.5	105		19.0	44.8	26.7	9.5

Table 1-4 continued

			Boys %						Girls %					
No.	Item	Year	N	M	SA	A	D	SD	N	M	SA	A	D	SD
54	Doing calculations in science is boring	Primary	159		10.1	40.9	35.2	13.8	179		6.1	41.9	34.1	17.9
		Secondary	145		6.2	40.0	37.2	16.6	100		7.0	41.0	37.0	15.0
55	Science lessons are a waste of time	Primary	161		50.3	36.0	6.8	6.8	181		40.3	45.9	9.9	3.9
		Secondary	145		52.4	35.2	9.0	3.4	105		50.5	37.1	9.5	2.9
56	My ideas don't always agree with my teacher's ideas	Primary	160	.6	4.3	8.0	58.6	27.8	183	4.2	2.6	12.0	60.2	20.9
		Secondary	143	1.4	2.1	12.4	66.9	17.2	105		1.9	16.2	64.8	17.1
57	I would rather do my own experiment than find out information from the teacher	Primary	160		39.0	32.7	19.5	8.8	179		33.3	42.5	18.3	5.4
		Secondary	145		42.3	40.1	12.0	5.6	105		36.2	43.8	14.3	5.7
58	Scientific discoveries do more harm than good	Primary	150	7.4	13.0	44.4	27.8	7.4	165	13.6	15.7	38.7	25.1	6.8
		Secondary	144	.7	15.9	54.5	20.7	8.3	103	1.9	13.3	51.4	26.7	6.7
59	Science is difficult when it involves doing experiments	Primary	159	1.9	30.9	43.8	14.2	9.3	182	4.7	26.7	46.1	16.8	5.8
		Secondary	144	.7	30.3	52.4	11.7	4.8	105		21.9	65.7	10.5	1.9
60	I would rather someone told me the answer to a difficult problem than work it out for myself	Primary	160	1.2	23.5	34.0	25.3	16.0	180	5.8	20.4	44.0	16.2	13.6
		Secondary	145		20.7	41.4	28.3	9.7	104	1.0	23.8	41.9	28.6	4.8
61	I am often unsure of the way I should write about experiments	Primary	159		4.3	31.7	50.3	13.7	179		7.5	34.4	42.5	15.6
		Secondary	145		7.2	36.0	43.2	13.7	104		4.8	38.1	47.6	9.5
63	The ideas we learn in science are too easy	Primary	158	2.5	21.6	59.3	12.3	4.3	178	6.8	23.6	58.1	9.9	1.6
		Secondary	145		9.7	78.6	10.3	1.4	105		13.3	77.1	6.7	2.9
64	I find it boring to hear about new science ideas	Primary	158	2.5	25.9	45.1	16.0	10.5	179	6.3	25.1	45.5	15.7	7.3
		Secondary	145		25.5	54.5	14.5	5.5	105		21.9	59.0	15.2	3.8
65	Planning my own investigation is difficult	Primary	165	3.6	7.9	31.5	45.5	11.5	193	6.7	5.7	31.6	43.5	12.4
		Secondary	145	2.8	7.6	40.0	41.4	8.3	105		7.6	39.0	41.9	11.4
67	I don't like doing calculations in science	Primary	165	4.2	6.7	38.2	32.1	18.8	193	8.3	7.8	26.9	36.3	20.7
		Secondary	145	2.8	5.5	40.7	40.0	11.0	105	2.9	7.6	34.3	41.9	13.3
68	I really enjoy going to science lessons	Primary	156		28.2	34.0	24.4	13.5	181		19.3	27.1	37.6	16.0
		Secondary	141		17.7	44.0	26.2	12.1	105		21.0	46.7	25.7	6.7
69	I don't understand most of the theories we learn about in science	Primary	165	6.7	11.5	42.4	30.9	8.5	193	8.3	6.7	41.5	33.7	9.8
		Secondary	145	4.1	9.0	46.9	33.8	6.2	105		5.7	51.4	30.5	12.4
70	Science is very important for a country's development	Primary	165	6.7	23.6	51.5	13.9	4.2	193	10.4	19.2	49.2	19.2	2.1
		Secondary	145	3.4	29.7	53.8	10.3	2.8	105	1.0	18.1	59.0	17.1	4.8
71	There are too many new ideas to learn about in science	Primary	165	4.8	10.3	35.8	39.4	9.7	193	6.7	8.8	42.5	31.6	10.4
		Secondary	145	3.4	6.2	46.2	40.0	4.1	105		7.6	53.3	26.7	12.4

Table 1-4 continued

			Boys						Girls					
No.	Item	Year	N	M	SA	A	D	SD	N	M	SA	A	D	SD
72	I like writing about science experiments	Primary	165	6.1	10.3	19.4	44.2	20.0	193	9.3	6.2	26.9	40.4	17.1
		Secondary	145	2.8	6.9	31.7	41.4	17.2	105		7.6	36.2	43.8	12.4
74	I already know most of the science we have done this year	Primary	165	5.5	12.7	44.8	32.7	4.2	193	7.3	10.9	46.6	31.1	4.1
		Secondary	145	2.8	11.0	53.1	27.6	5.5	105	1.0	8.6	60.0	27.6	2.9
75	I don't want to listen to other people's opinions about science	Primary	165	6.7	22.4	47.3	17.6	6.1	193	8.3	28.0	50.3	8.8	4.7
		Secondary	145	4.1	25.5	53.1	10.3	6.9	105	1.0	31.4	59.0	7.6	1.0
76	I really enjoy doing investigations in science	Primary	165	7.9	30.3	38.2	15.2	8.5	193	9.3	20.2	39.4	20.7	10.4
		Secondary	145	3.4	26.9	46.2	17.2	6.2	105	1.0	32.4	50.5	15.2	1.0
78	I can't understand the calculations we do in science	Primary	165	5.5	11.5	38.8	35.2	9.1	193	12.4	5.2	37.3	35.2	9.8
		Secondary	145	4.1	6.9	46.2	35.2	7.6	105	5.7	10.5	54.3	26.7	2.9
79	I would enjoy school more if we did not have to do science	Primary	157		39.5	36.9	13.4	10.2	172		23.3	36.6	27.3	12.8
		Secondary	139		41.7	41.0	10.1	7.2	105		42.9	42.9	10.5	3.8
80	My ideas about science are the same as my teacher's ideas	Primary	165	5.5	1.2	12.7	57.0	23.6	193	11.9	2.1	8.3	54.9	22.8
		Secondary	145	4.8	4.1	15.2	59.3	16.6	105		3.8	13.3	73.3	9.5
81	Science is our worst enemy	Primary	156	3.7	45.1	31.5	10.5	9.3	173	9.4	25.1	39.3	12.6	13.6
		Secondary	141	2.8	51.7	35.2	4.8	5.5	105		47.6	44.8	3.8	3.8
82	Science is difficult when it involves writing	Primary	156	3.7	6.8	30.9	38.9	19.8	175	8.4	9.9	42.4	28.3	11.0
		Secondary	143	1.4	6.9	49.7	31.7	10.3	105		8.6	60.0	24.8	6.7
83	Writing about why I did an experiment is difficult	Primary	156	3.7	6.8	21.0	51.2	17.3	174	8.9	6.3	22.5	47.1	15.2
		Secondary	142	2.1	2.8	44.8	39.3	11.0	105		7.6	41.9	40.0	10.5
86	Writing a plan of an experiment is easy	Primary	155	4.3	4.9	16.0	62.3	12.3	174	8.9	5.8	15.2	59.2	11.0
		Secondary	142	2.1	4.8	29.0	54.5	9.7	105		5.7	33.3	56.2	4.8
88	I think the calculations we do in science are easy	Primary	156	3.7	1.9	21.6	49.4	23.5	172	9.9	3.7	16.2	56.5	13.6
		Secondary	143	1.4	4.1	22.8	57.9	13.8	102	2.9	4.8	16.2	69.5	6.7
89	I would rather keep my own opinion about science ideas even when the teacher explains a different view to me	Primary	156	3.7	8.6	35.8	35.2	16.7	174	8.9	6.8	39.3	34.0	11.0
		Secondary	143	1.4	20.0	42.8	31.0	4.8	104	1.0	8.6	53.3	32.4	4.8

Table 1-5 Responses from second pilot to items about classroom activities

No.	Item	Year	Valid N	Often	Some-times	Hardly ever
90	We use a textbook for our science lessons	Primary	328	10.7	19.8	69.2
		Secondary	248	46.4	39.5	14.1
91	We choose the topics we want to study	Primary	327	2.8	16.8	80.1
		Secondary	248	1.6	9.7	88.7
92	We copy the teacher's notes from the board or worksheet into our own books	Primary	327	25.1	61.2	13.8
		Secondary	245	31.0	41.2	27.8
93	We do experiments on our own as part of our science lessons	Primary	325	37.8	42.8	19.4
		Secondary	248	32.7	55.6	11.7
94	We use library books for learning science	Primary	326	15.3	41.4	43.3
		Secondary	247	6.1	34.8	59.1
95	We make up our own problems and then the teacher helps us to plan experiments to solve them	Primary	323	14.9	42.4	42.7
		Secondary	248	12.1	37.1	50.8
96	We have tests on what we have learned in science	Primary	323	19.2	43.3	37.5
		Secondary	247	78.1	21.1	.8
97	We work in small groups to do experiments	Primary	319	64.3	31.0	4.7
		Secondary	247	63.2	32.8	4.0
98	The teacher uses our ideas and suggestions in lessons	Primary	320	18.4	61.3	20.3
		Secondary	247	23.9	58.3	17.8
99	We watch the teacher do experiments	Primary	321	22.4	43.0	34.6
		Secondary	247	17.8	51.0	31.2
100	We use computers to help us with our science	Primary	320	7.8	19.7	72.5
		Secondary	245	.4	8.2	91.4

The remaining data were then subjected to factor analysis. This enabled a check of the internal validity of the sub-scales originally developed with the existing measures (SIMMS), and the development of uni-dimensional factors. Items were eliminated if they had loadings of less than 0.3 on any of the factors. The results of this factor analysis are given in Table 1-6. Seven factors remained after this analysis: enjoyment of science, the facility of science[1], the difficulty of written work, the use of computers in science, continuity and progression in science, enjoyment of school and attitudes to school work.

Table 1-6 Rotated Component Matrix for factor analysis of science items

	Component						
	1	2	3	4	5	6	7
I dislike science lessons	.821						
I really enjoy going to science lessons	.807						
I look forward to science lessons	.807						
Science is our worst enemy	.612						
I like doing experiments	.600						
Doing experiments in science is a waste of time	.471				.356		
Using a computer makes science so interesting I don't want to stop		.831					
Science is more interesting when we use computers		.793					
When I use a computer in science I understand things better		.780					
I can't understand the calculations we do in science			.691				
I don't like doing calculations in science			.678				
The calculations we do in science are difficult			.671				
I am often unsure of the way I should write about experiments				.771			
Writing about why I did an experiment is difficult			.370	.722			
Science is difficult when it involves writing			.396	.634			
Science has ruined the environment					.785		
Scientific discoveries do more harm than good					.648		
There are too many new words to learn in science			.335			.641	
There are too many new ideas to learn about in science	.405					.586	
There are too many facts to learn in science	.356				.375	.467	
The ideas we learn in science are too easy							.774
I already know most of the science we have done this year							.686
I already know about the science my teacher is teaching us						-.436	.487

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 10 iterations. Loadings of less than 0.3 omitted.

[1] The scale for the items in this factor reflected children's views about how easy they found science, so reflecting the easiness of science. Following the naming of this construct in the SIMMS analyses, the term 'facility' was used to represent 'easiness'

Table 1-7 Rotated Component Matrix for school items

	Component	
	1	2
School is not very enjoyable	.764	
I am bored most of the time at school	.745	
There are lots of school subjects I don't like	.693	
I enjoy everything about school	.551	
I always work as hard as I can at school		.738
I always behave badly at school		.712
I get good marks for my work		.688

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalized Rotation converged in 3 iterations. Loadings of less than 0.3 omitted.

Table 1-8: Cronbach's alpha for internal consistency for attitudes to science factors in the second pilot study

Attitude sub-scale	Number of items	Cronbach's α value
School work motivation	3	0.5212
School enjoyment	4	0.6869
The difficulty of written work	3	0.6467
Importance of science to society	3	0.6380
Difficulty of science	3	0.7033
Enjoyment of practical work	2	0.6532
Enjoyment of science lessons	3	0.8081
Use of computers in science	3	0.7659
Continuity and progression in science	3	0.4410
Calculations in science	3	0.7199

The attitude to schoolwork and continuity and progression factors had low α values. A low value for the internal consistence may reflect the lack of a theoretical construct underlying the scale (Gardner, 1995). However, they represented the best combinations available from the items tested and lack of time prevented a further pilot study. It was therefore decided that these factors should be used in the final questionnaire, but that the results of further analyses involving these items should be treated with caution.

The final design of the questionnaire, based on the analysis of this pilot study, included the following modifications:

- A six-point scale with an 'undecided' category and a 'don't know' category replaced the 'forcing' four-point format.

- The font was made larger and the spacing wider to facilitate reading and responding.
- The seven factors described above were used in the first two sections of the questionnaire, giving 35 items in total.
- A large space was provided for children to write further comments.
- The teachers of primary school children were asked to read the questionnaire aloud with the children.

1.3 THE FIRST AND SECOND PILOTS OF THE TEACHERS' QUESTIONNAIRE

The first pilot was designed to test the constructs and the formats of the three sections; biography, approaches to science teaching and views about science. It focused on producing an instrument that would offer a group of items that were accepted as reasonable by teachers, and a format that was easy to use.

Two small groups were involved in this pilot: 16 first-year undergraduate primary teaching students at a university in London, with science as their major subject, and 15 primary teachers attending a primary science INSET course, at a university in the Midlands. They were asked to complete the questionnaire and comment on any issues.

Layout and sentence construction were changed considerably in all three sections as a result of this first pilot.

The constructs used in section two appeared to be accepted and understood by this group, there were no comments by the teachers or the students. However, the items chosen were the one's involving general skills rather than aspects of science teaching. The second pilot omitted these general skills items and focused on more specific science teaching aspects.

The third section, concerning beliefs about science, seemed acceptable to the practising teachers but there were some surprisingly strong reactions from the group of students; some made comments about the incomprehensibility of many of the sentences. Consequently, the third section of the next pilot used fewer items, with a simplified form of words.

The second pilot was carried out with a group of second and third-year undergraduate primary teaching students, with science as their major subject. On this occasion, although all three sections were accepted and understood by the respondents, the information gained from the items in the third section was very limited. The reduction of the original items and format had been taken too far.

1.4 THE THIRD PILOT OF THE TEACHERS' QUESTIONNAIRE

A third version was piloted with minor changes to wording and format in sections one and two, but major changes to section three. This pilot tested both a simplified version, with 10 items (Q.1.2-10.2, on the back of the questionnaire), and a fuller version with 21 of Wellington and Nott's original sentences with some simplification of the wording (Q.v1-v21 on the questionnaire insert). This version was piloted with two groups of PGCE students (Primary PGCE, N=35; Secondary PGCE N=32). Most students completed the whole questionnaire and there were very few criticisms. At this stage, some simple analysis was undertaken.

1.5 ANALYSIS OF THE THIRD PILOT OF THE TEACHERS' QUESTIONNAIRE

Table 1-9 Primary and secondary PGCE students' responses to items in section 2

				Missing	Irrelevant	Not important	Important	Very important
No.	Item	Year	N	%	%	%	%	%
1	Stressing connections between science, technology and society	Primary	34	2.9		5.7	34.3	57.1
		Secondary	31	3.1	3.1	6.3	43.8	43.8
2	Using curriculum content to illustrate the tentative and changing nature of scientific knowledge	Primary	30	14.3		5.7	54.3	25.7
		Secondary	30	6.3	3.1	18.8	56.3	15.6
3	Providing opportunities for children to discuss and consider their own scientific ideas	Primary	35			2.9	2.9	94.3
		Secondary	31	3.1			25.0	71.9
4	Passing on scientific knowledge	Primary	35			5.7	77.1	17.1
		Secondary	31	3.1			25.0	71.9
5	Selecting topics and activities which the children will enjoy	Primary	35				22.9	77.1
		Secondary	31	3.1		3.1	34.4	59.4
6	Using time to study applications of scientific concepts	Primary	35		2.9	11.4	62.9	22.9
		Secondary	31	3.1		6.3	65.6	25.0
7	Supplementing the curriculum with challenging problems	Primary	35		2.9	14.3	48.6	34.3
		Secondary	31	3.1	3.1	3.1	71.9	18.8
8	Using the curriculum content to illustrate the processes of science	Primary	33	5.7	2.9	2.9	62.9	25.7
		Secondary	31	3.1		12.5	59.4	25.0
9	Ensuring a sound knowledge of the theoretical concepts and principles of science	Primary	33	5.7	2.9	20.0	40.0	31.4
		Secondary	31	3.1		9.4	59.4	28.1
10	Helping children to construct their own explanatory models	Primary	34	2.9		2.9	40.0	54.3
		Secondary	31	3.1		12.5	56.3	28.1
11	Giving children plenty of experimental results and information which explain the natural world	Primary	33	5.7	5.7	14.3	42.9	31.4
		Secondary	31	3.1		21.9	37.5	37.5
12	Illustrating the unique nature of science as objective, true and unchanging	Primary	29	17.1	42.9	17.1	17.1	5.7
		Secondary	31	3.1	31.3	25.0	21.9	18.8
13	Matching materials to students level of ability	Primary	34	2.9			20.0	77.1
		Secondary	31	3.1	3.1	6.3	25.0	62.5
14	Supplementing the curriculum with more detailed information	Primary	33	5.7	5.7	34.3	42.9	11.4
		Secondary	31	3.1		31.3	40.6	25.0

Table 1-10 Rotated Component Matrix of items in section 2

		Component (factor)				
		1	2	3	4	5
Q9	Ensuring a sound knowledge of the theoretical concepts and principles of science	.760				
Q7	Supplementing the curriculum with challenging problems	.737	.378			
Q6	Using time to study applications of scientific concepts	.680				
Q8	Using the curriculum content to illustrate the processes of science	.602				
Q3	Providing opportunities for children to discuss and consider their own scientific ideas	.503			.498	
Q2	Using curriculum content to illustrate the tentative and changing nature of scientific knowledge		.846			
Q1	Stressing connections between science, technology and society		.717			
Q11	Giving children plenty of experimental results and information which explain the natural world			.839		
Q14	Supplementing the curriculum with more detailed information			.693		
Q5	Selecting topics and activities which the children will enjoy				.838	
Q12	Illustrating the unique nature of science as objective, true and unchanging			.411	-.606	
Q13	Matching materials to students level of ability			.373		.734
Q4	Passing on scientific knowledge	.302				-.593
Q10	Helping children to construct their own explanatory models	.381	.386			.459

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 15 iterations.

Table 1-11 PGCE students' responses to simplified items about views of science

				Missing	SD	D	B	A	SA
No.	Item		N	%	%	%	%	%	%
Q1.2	The object of science is to reveal reality	Primary	34	2.9	17.1	37.1	11.4	31.4	0.0
		Secondary	32	0.0	6.3	9.4	37.5	28.1	18.8
Q2.2	Scientists have no idea of the outcome of an experiment before they do it	Primary	32	8.6	37.1	40.0	14.3	0.0	0.0
		Secondary	32	0.0	21.9	40.6	31.3	3.1	3.1
Q3.2	The way scientists work is independent of morals and ethics	Primary	33	5.7	22.9	34.3	20.0	17.1	0.0
		Secondary	32	0.0	21.9	34.4	34.4	3.1	6.3
Q4.2	The most valuable part of a scientific education is what remains after the facts have been forgotten	Primary	31	11.4	5.7	22.9	25.7	25.7	8.6
		Secondary	32	0.0	6.3	15.6	37.5	34.4	6.3
Q5.2	Human emotion plays no part in the creation of scientific knowledge	Primary	31	11.4	14.3	48.6	8.6	17.1	0.0
		Secondary	32	0.0	18.8	43.8	18.8	12.5	6.3
Q6.2	'Scientific method' is transferable from one scientific investigation to another	Primary	31	11.4	2.9	0.0	11.4	60.0	14.3
		Secondary	32	0.0		6.3	34.4	37.5	21.9
Q7.2	Scientists decide between theories purely by comparing the results of experiments	Primary	33	5.7	17.1	37.1	17.1	20.0	2.9
		Secondary	32	0.0	12.5	25.0	37.5	18.8	6.3
Q8.2	Scientific theories are as much a result of imagination and intuition as inference from experimental results	Primary	33	5.7	14.3	20.0	40.0	11.4	8.6
		Secondary	32	0.0	6.3	6.3	43.8	25.0	18.8
Q9.2	Scientific knowledge is different from other kinds of knowledge in that it is more objective	Primary	31	11.4	17.1	28.6	28.6	14.3	0.0
		Secondary	32	0.0	3.1	15.6	34.4	25.0	21.9
Q10.2	There are certain physical events in the universe which science can never explain	Primary	32	8.6	2.9	20.0	11.4	28.6	28.6
		Secondary	32	0.0	12.5	9.4	25.0	18.8	34.4

Table 1-12 PGCE students' responses to fuller items about views of science

No.	Item	Year	N	Missing	SD	D	B	A	SA
V1	The object of scientific activity is to find out the truth	Primary	27	22.9	17.1	25.7	17.1	11.4	5.7
		Secondary	32	3.0	3.0	9.1	51.5	12.1	21.2
V2	Scientists have no idea of the outcome of an experiment before they do it	Primary	26	25.7	25.7	31.4	11.4	5.7	0.0
		Secondary	32	3.0	21.2	39.4	36.4	0.0	0.0
V3	Scientific research is economically and politically determined	Primary	27	22.9	8.6	5.7	11.4	34.3	17.1
		Secondary	32	3.0	6.1	15.2	21.2	30.3	24.2
V4	Science education should be more about the learning of scientific processes than the learning of scientific facts	Primary	27	22.9	2.9	8.6	17.1	31.4	17.1
		Secondary	32	3.0	3.0	6.1	48.5	24.2	15.2
V5	The way scientists work does not depend on morals and ethics	Primary	27	22.9	17.1	31.4	11.4	8.6	8.6
		Secondary	32	3.0	27.3	27.3	27.3	9.1	6.1
V6	The most valuable part of a scientific education is what remains after the facts have been forgotten	Primary	24	31.4	2.9	22.9	20.0	17.1	5.7
		Secondary	32	3.0	0.0	12.1	39.4	36.4	9.1
V7	Scientific theories are valid if they work	Primary	26	25.7	22.9	14.3	20.0	11.4	5.7
		Secondary	32	3.0	12.1	27.3	42.4	9.1	6.1
V8	New scientific knowledge is entirely the result of many new experiments and observations	Primary	26	25.7	8.6	25.7	28.6	8.6	2.9
		Secondary	32	3.0	6.1	33.3	36.4	15.2	6.1
V9	There is no such thing as a true scientific theory	Primary	24	31.4	5.7	14.3	22.9	14.3	11.4
		Secondary	32	3.0	6.1	21.2	36.4	24.2	9.1
V10	Human emotion plays no part in the creation of scientific knowledge	Primary	25	28.6	22.9	37.1	11.4		
		Secondary	32	3.0	24.2	39.4	21.2	3.0	9.1
V11	Scientific theories describe a real external world which is independent of human perception	Primary	23	34.3	11.4	25.7	11.4	14.3	2.9
		Secondary	32	3.0	18.2	18.2	48.5	9.1	3.0
V12	Practical experience is not necessary for the acquisition of scientific knowledge	Primary	25	28.6	37.1	20.0	8.6	2.9	2.9
		Secondary	32	36.4	27.3	27.3	3.0	3.0	0.0
V13	Scientific theories have changed over time simply because experimental techniques have improved	Primary	25	28.6	8.6	17.1	22.9	20.0	2.9
		Secondary	32	3.0	12.1	30.3	39.4	12.1	3.0
V14	'Scientific method' is transferable from one scientific investigation to another	Primary	25	28.6	2.9	0.0	22.9	37.1	8.6
		Secondary	32	3.0	3.0	0.0	42.4	27.3	24.2
V15	Scientists decide between theories purely by looking carefully at the results of experiments	Primary	24	31.4	14.3	14.3	25.7	11.4	2.9
		Secondary	32	3.0	3.0	24.2	57.6	9.1	3.0
V16	Scientific theories are as much a result of imagination and intuition as inference from experimental results	Primary	26	25.7	8.6	11.4	17.1	31.4	5.7
		Secondary	32	3.0	9.1	15.2	33.3	24.2	15.2
V17	Scientific knowledge is different from other kinds of knowledge in that it is more objective	Primary	25	28.6	11.4	22.9	22.9	14.3	0.0
		Secondary	32	3.0	0.0	9.1	36.4	36.4	15.2
V18	There are certain physical events in the universe which science can never explain	Primary	26	25.7	5.7	8.6	5.7	22.9	31.4
		Secondary	32	3.0	9.1	0.0	33.3	21.2	33.3
V19	Scientific knowledge is morally neutral – only the application of the knowledge is ethically determined	Primary	26	25.7	20.0	8.6	25.7	14.3	5.7
		Secondary	32	3.0	9.1	12.1	30.3	24.2	21.2
V20	All scientific experiments and observations are determined by existing theories	Primary	25	28.6	5.7	20.0	25.7	8.6	11.4
		Secondary	32	3.0	12.1	21.2	54.5	9.1	0.0
V21	Science is special because of the methods and processes it uses	Primary	26	25.7	8.6	14.3	34.3	14.3	2.9
		Secondary	32	3.0	12.1	3.0	42.4	21.2	18.2

1.6 NOTT AND WELLINGTON'S DEFINITIONS OF THE TERMS USED FOR THE CONSTRUCTS IN THE NATURE OF SCIENCE PROFILE

(Taken from: Your nature of science profile: an activity for science teachers, Nott, M., & Wellington, J., School Science Review, 75 (270) 109-112, 1993)

RELATIVISM/POSITIVISM (RP)

Relativist

You deny that things are true or false solely based on an independent reality. The 'truth' of a theory will depend onthe norms and rationality of the social group considering it as well as the experimental techniques used to test it. Judgements as to the truth of scientific theories will vary from individual to individual and from one culture to another ie truth is relative not absolute.

Positivist

You believe strongly that scientific knowledge is more 'valid' than other forms of knowledge. The laws and theoriesgenerated by experiments are our descriptions of patterns we see in a real, external objective world. To the positivist, science is the primary source of truth. Positivism recognizes empirical facts and observable phenomena as the raw material of science. The scientist's job is to establish the objective relationships between thelaws governing the facts and observables. Positivism rejects inquiry into underlying causes and ultimate origins.

INDUCTIVISM/DEDUCTIVISM (ID)

Inductivism

You believe that the scientist's job is the interrogation of Nature. By observing many particular instances, one is able to infer from the particular to the general and then determine the underlying laws and theories. According to inductivism, scientists generalize from a set of observations to a universal law 'inductively'. Scientificknowledge is built by induction from a secure set of observations.

Deductivism

In our definition this means that you believe that scientists proceed by testing ideas produced by the logical consequences of current theories or of their bold imaginative ideas. According to deductivism (or hypotheticodeductivism) scientific reasoning consists of the forming of hypotheses which are not established by the empirical data but may be suggested

by them. Science thenproceeds by testing the observable consequences of these hypotheses, i.e., observations are directed or led byhypotheses -they are theory laden.

CONTEXTUALISM/DECONTEXTUALISM (CD)

Contextualism

You hold the view that the truth of scientific knowledge and processes is interdependent with the culture in whichthe scientists live and in which it takes place.

Decontextualism

You hold the view that scientific knowledge is independent of its cultural location and sociological structure.

PROCESS/CONTENT (PC)

Process

You see science as a characteristic set of identifiable methods/processes. The learning of these is the essential part ofscience education.

Content

You think that science is characterized by the facts and ideas it has and that the essential part of science education isthe acquisition and mastery of this 'body of knowledge'.

INSTRUMENTALISM/REALISM (IR)

Instrumentalism

You believe that scientific theories and ideas are fine if they work, that is they allow correct predictions to be made. They are instruments which we can use but they say nothing about an independent reality or their own truth.

Realism

You believe that scientific theories are statements about a world that exists in space and time independent of thescientists' perceptions. Correct theories describe things which are really there, independent of the scientists, eg atoms.

Table 1-13 Items used in 'views of science' section with construct abbreviations

Group	Item
CD	Human emotion plays no part in the creation of scientific knowledge
CD	Scientific knowledge is morally neutral – only the application of the knowledge is ethically determined
CD	Scientific research is economically and politically determined
CD	The way scientists work does not depend on morals and ethics
CD/RP	Scientific theories have changed over time simply because experimental techniques have improved
CD/RP	Scientists decide between theories purely by looking carefully at the results of experiments
ID	Scientific theories are as much a result of imagination and intuition as inference from experimental results
ID	All scientific experiments and observations are determined by existing theories
ID	Scientists have no idea of the outcome of an experiment before they do it
ID	New scientific knowledge is entirely the result of many new experiments and observations
IR	The object of scientific activity is to find out the truth
IR	Scientific theories are valid if they work
IR/RP	Scientific theories describe a real external world which is independent of human perception
IR/RP	There are certain physical events in the universe which science can never explain
IR/RP	There is no such thing as a true scientific theory
RP	Scientific knowledge is different from other kinds of knowledge in that it is more objective
PC	Practical experience is not necessary for the acquisition of scientific knowledge
PC	Science education should be more about the learning of scientific processes than the learning of scientific facts
PC	'Scientific method' is transferable from one scientific investigation to another
PC	Science is special because of the methods and processes it uses
PC	The most valuable part of a scientific education is what remains after the facts have been forgotten

Table 1-14 Rotated Component Matrix using all cases responding to fuller items

	Component (factor)								
	1	2	3	4	5	6	7	8	9
Q.15CD/RP	.911								
Q.13CD	.622		.366				.389		
Q.2ID	.443								
Q.9IR/RP		.880							
Q.16ID		-.549	.327					.471	
Q.13RP		-.507							.434
Q.18IR/RP			.899						
Q.11IR/RP				.942					
Q.19CD					.728				
Q.21PC		-.356			.698				
Q.1IR					.569		.446		
Q.7IR	.470		-.327		.565				
Q.20ID						.786			
Q.14PC						.671		-.316	
Q.17RP					.483	-.639			
Q.6PC				-.334		.542		.458	
Q.5CD			.312				.811		
Q.12PC							.696		
Q.8ID								.740	
Q.4PC			.367					.603	
Q.3CD									-.824
Q.10CD	.336	.303							.592

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 10 iterations.

Table 1-15 Rotated Component Matrix sorted by theoretical constructs

	Component								
	1	2	3	4	5	6	7	8	9
Q.1IR					.569		.446		
Q.7IR	.470		-.327		.565				
Q.11IR				.942					
Q.9IR		.880							
Q.18IR			.899						
Q.2ID	.443								
Q.8ID								.740	
Q.16ID		-.549	.327					.471	
Q.20ID						.786			
Q.3CD									-.824
Q.5CD			.312				.811		
Q.10CD	.336	.303							.592
Q.13CD	.622		.366				.389		
Q.15CD	.911								
Q.19CD					.728				
Q.4PC			.367					.603	
Q.6PC				-.334		.542		.458	
Q.12PC							.696		
Q.14PC						.671		-.316	
Q.21PC		-.356			.698				
Q.9RP		.880							
Q.11RP				.942					
Q.13RP		-.507							.434
Q.15RP	.911								
Q.17RP					.483	-.639			
Q.18RP			.899						

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 10 iterations.

Table 1-16 Rotated Component Matrix sorted by theoretical constructs (secondary PGCE cases only).

	Component								
	1	2	3	4	5	6	7	8	9
Q.1IR		.344	.328		.457				
Q.7IR	.410		.434		.461				
Q.11IR		.905							
Q.9IR	.894								
Q.18IR				.881					
Q.2ID						.909			
Q.8ID				.678					
Q.16ID	-.681	-.414							
Q.20ID	-.385						.629		
Q.3CD	-.315								.712
Q.5CD				.493		.576		.354	
Q.10CD	.452					.628			
Q.13CD			.693	.349					
Q.15CD			.912						
Q.19CD	.344				.378		.445	-.305	
Q.4PC			.387	.397	.415			-.379	
Q.6PC		-.688			.497				
Q.12PC								.904	
Q.14PC							.871		
Q.21PC					.869				
Q.9RP	.894								
Q.11RP		.905							
Q.13RP	-.345								-.773
Q.15RP			.912						
Q.17RP	.407	.467			.338				
Q.18RP				.881					

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 13 iterations.

APPENDIX 2 SAMPLING AND ANALYSIS

2.1 SAMPLING

2.1.1 A COMPARISON OF ESSEX EDUCATION AUTHORITY STATISTICS WITH THOSE OF OTHER SIMILAR LOCAL EDUCATION AUTHORITIES

Table 2-1 The three largest local education authorities in 1995

	Area in square miles (Ordnance Survey)	Pupils on roll in all schools (DfEE 1995)	Number of teaching staff (DfEE 1995)
Essex	1417.64	225174	14737
Hampshire	1459.55	220116	16288
Kent	1440.41	235538	16367

Table 2-2 Primary school performances at Key Stage 2 in the three largest English local education authorities in 1995

	English (average)	Maths (average)	Science (average)	Total (average)
England	56.3	53.2	61.2	56.9
Essex	56.1	53.1	60.1	56.4
Kent	59.5	55.6	60.6	58.6
Hampshire	58.5	55.6	66.7	60.3

Table 2-3 Secondary school performances at GCSE and A-level in the three largest English local education authorities in 1995

	% of pupils aged 15 obtaining:			Average points at A level
	5+ A-C	5+ A - G	1+ A - C	
England	44.5	86.0	92.1	18.3
Essex	43.1	88.9	93.6	17.5
Kent	43.7	88.0	93.6	16.8
Hampshire	46.5	90.4	95.0	16.3

Table 2-4 Demographic information from the 1991 National Census: Essex and England

	Ethnic minority groups	Unemployment	Free school meals	Lone parents
	%	%	%	%
England	6.6	4.36	18.68	3.70
Essex	2.0	4.07	15.00	2.96

2.1.2 DETAILS OF THE SAMPLE OF ESSEX SCHOOLS SELECTED

Table 2-5 The survey primary schools

School type	**LEA**	**GM**	**Church**	**Primary**	**Junior**
Number of schools in Essex	390	64	137	336	118
Number of schools contacted	177	34	42	139	72
Number of schools agreeing to survey	65	15	15	50	30
Surveyed schools % of all Essex schools	16.7	23.4	11.0	14.9	25.4
Surveyed schools % of schools contacted	36.7	44.1	35.7	36.0	41.7

Table 2-6 The survey secondary schools

School type	LEA	GM	Comp	RC or segregated (comp)	Modern	Grammar
Number of schools in Essex	34	69	83	8	4	8
Number of schools contacted	19	50	61	2	3	5
Number of schools agreeing to survey	11	24	31	1	1	2
Surveyed schools % of all Essex schools	32.4	34.8	37.3	12.5	25.0	25.0
Surveyed schools % of schools contacted	57.9	48.0	50.8	50.0	33.3	40.0

Table 2-7 Primary schools: survey numbers by area of Essex

Essex area	**Schools in area**	**Schools contacted**	**Schools agreeing to participate**	
	N	N	N	%
North west	88	36	17	19.32
North east	104	26	14	13.46
Mid	103	33	16	15.53
West	75	27	5	6.67
South west	112	46	16	14.3
South east	96	43	12	12.5
All areas	578	211	80	13.8

Table 2-8 Secondary schools: survey numbers by area of Essex

Essex area	**Schools in area**	**Schools contacted**	**Schools agreeing to participate**	
	N	N	N	%
North west	12	10	5	41.67
North east	17	8	6	35.29
Mid	19	9	8	42.11
West	11	7	3	27.27
South west	21	18	6	28.6
South east	23	17	7	30.43
All areas	103	69	35	34.0

2.2 ANALYSIS

2.2.1 FACTOR ANALYSIS

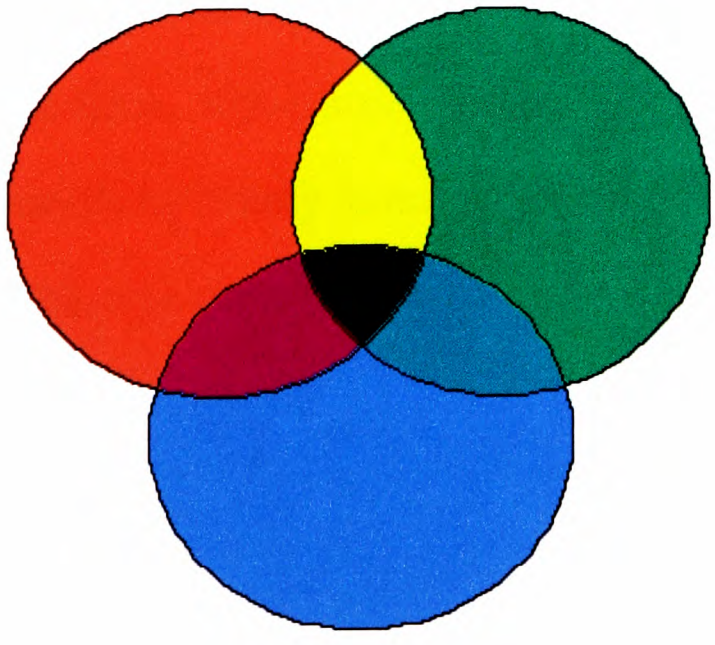
Factor analysis is carried out in order to reduce a large set of variables to a smaller set of variables, which appear to be related, in that they represent the same underlying psychological dimension. In factor analysis the major assumption is that thee mathematical factors represent latent variables (i.e. psychological dimensions).

Three steps are involved:

- A correlation matrix is computed for all variable combinations
- Extraction of factors from this matrix
- Rotation of factors (axes) to maximise the relationships between the variables and some of the factors.

Extraction of factors is done by examining the common variance between variables, as described in the Venn diagram in Figure 2-1 below for variables red, green and blue.

Figure 2-1: An illustration of common variance.



The overlap between any two variables, and between all three represents the common variance or factor. The first factor extracted accounts for the largest amount of common variance, and the second consists of the next largest amount of variance that is not related to or explained by the first one, and so on.

These overlap or factors could be considered geometrically, as points in space about an axis. When factors are rotated about this fixed axis some will overlap more strongly and others less so. Rotation is performed in order to achieve a configuration with the maximum number of variables loading on the minimum number of factors. The most commonly used method of rotation is known as 'varimax'.

In this study, exploratory factor analysis was carried out as described by Kinnear and Gray (1997, Chapter 15).

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett test of sphericity were checked for each analysis and are included in the statistics given; for a satisfactory analysis the KMO should be greater than 0.5 and The Bartlett test must be significant. Varimax rotation was used, and factor loadings below 0.3 were suppressed in tables of results.

Since deletion of variables from a factor model can affect the identification of that model (Lewis-Beck, 1994), such deletion was avoided, as far as possible, during factor analysis by initially removing invalid variables via external validation of items and unreliable items via examination of the proportion of missing responses per item.

2.2.2 REGRESSION ANALYSIS

Essentially, this involves a procedure similar to that involved in producing the equation $y = ax + c$ by calculating the values of a and c to give the best straight line fit from the measured values of x and y. When more variables are involved the equation becomes more complex but the concept remains the same. Regression equations are generally represented as:

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \ldots + e$$

where y is the dependent variable and x_1, x_2, x_3 etc are the independent variables. The intercept is α, the slope is β and e is described as the error term, which shows the proportion of the variance in y that is not explained by the variables measured. The fit procedure attempts to reduce the value of the error term to a minimum.

For example, if children's enjoyment of science (enj) were related to the percentage of free school meals (meals) and teacher qualifications (qual) by the following equation:

$$enj = 2.3 - 0.0721meals + 0.2132qual$$

this would indicate that an increase of 1% in free school meals decreases (due to negative sign) the enjoyment of science by 0.0721, and every increase in level of qualifications increases enjoyment of science by 0.2132.

This technique allows the establishment of the relative importance of the different independent variables. For example, in the above equation 'meals', having a very low value of β is a much less important variable than 'qual'. However, unless all the variables are measured on the same scale the relative importance cannot be established and so standardized regression coefficients, standardized β values,

are often used in preference to these simple β values (Bryman & Cramer, 1992, p 237-239).

The coefficient of multiple determination between a dependent variable and two or more independent variables, R-squared, is obtained from regression analysis in the same way as r-squared is obtained from simple correlation coefficients and represents a measure of how well the equation of best fit represents the relationship between the variables (Garrett, 1958, p 413-414). For example, if R^2 between children's enjoyment of science (the dependent variable) and school size, free school meals and teacher qualifications were 0.32, that would mean that the effects of school size, free school meals and teacher qualifications explained 32% of the variation in children's enjoyment of science. R-squared is usually corrected to take into account the chance errors arising from the number of measurements taken and so the adjusted R-squared value gives a better measure of the amount of variation accounted for by all the variables (Garrett, 1958, p. 416).

In multiple regression the variables may all be entered together assuming no theoretical model or they may be entered in blocks based on a theoretical model. In the present analysis the data were entered in blocks according to the models presented in Chapter 3; the models for primary and secondary data analysis are reproduced overleaf (Figures 2-2 and 2-3).

Figure 2-2 The primary school model

REGRESSION BLOCKS					
BLOCK 1	**BLOCK 2**	**BLOCK 3**	**BLOCK 4**	**BLOCK 5**	**Dependent variable**
CHILD	**SCHOOL**	**TEACHER**	**CLASSROOM**	**SCHOOL ATTITUDE**	**ATTITUDE TO SCIENCE Y6**

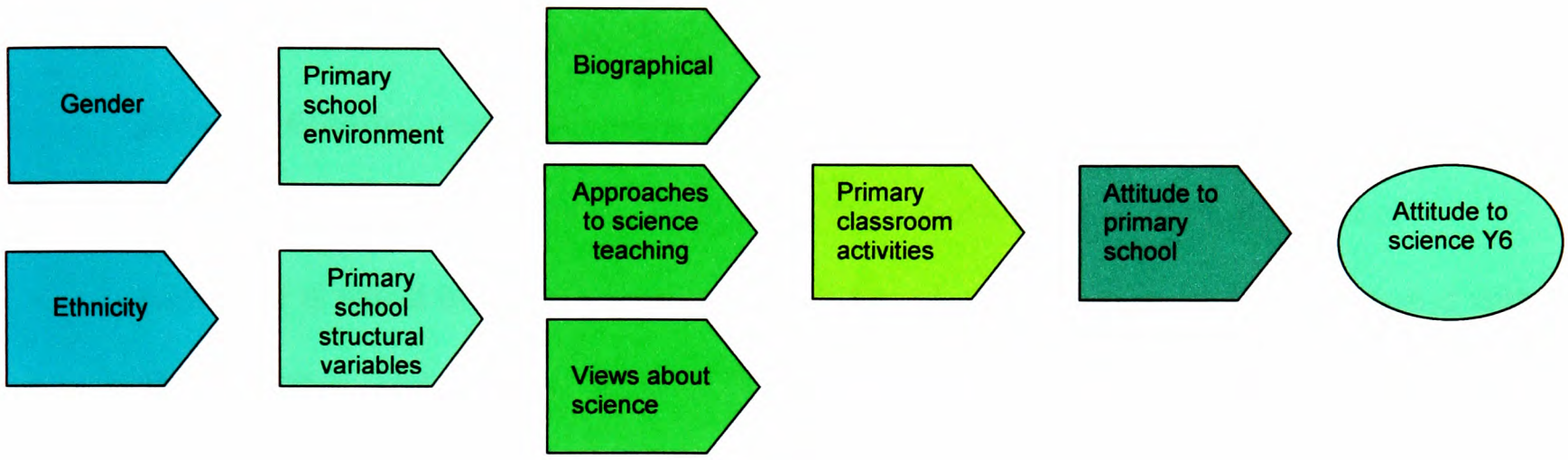
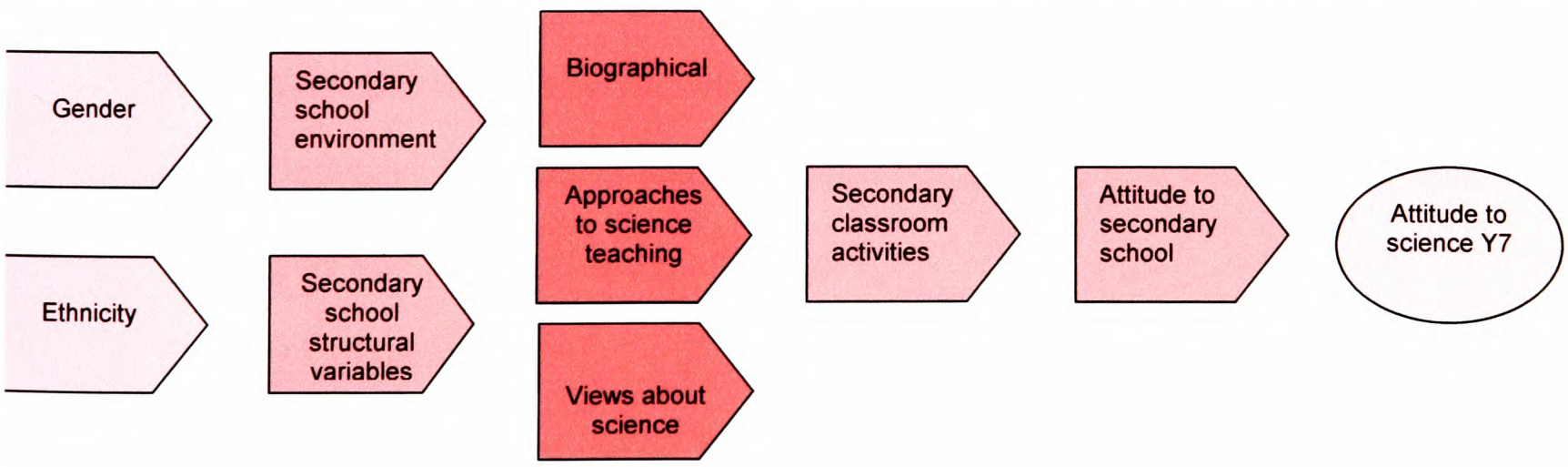


Figure 2-3 The secondary school model

REGRESSION BLOCKS					
BLOCK 1	**BLOCK 2**	**BLOCK 3**	**BLOCK 4**	**BLOCK 5**	**Dependent variable**
CHILD	**SCHOOL**	**TEACHER**	**CLASSROOM**	**SCHOOL ATTITUDE**	**ATTITUDE TO SCIENCE Y7**



The variables in each block are analysed together, but separately from the variables in any other block. The blocks are analysed in the order specified by the model.

The SPSS software package allows four different methods of analysis of the data within a single block ('enter', 'forward', 'backwards' and 'stepwise'). In the current analysis the 'stepwise' method was used. In stepwise analysis independent variables are entered in steps with the variable having the highest correlation with the dependent variable being entered first. The variable with the highest partial correlation, with the first variable partialled out, is entered next, and so on. Each variable entered must also meet the significance criteria of the program or it may be rejected again at a later step. Each variable included in the final regression equation is listed in the SPSS output with the change in R-squared associated with that variable. This R-squared change value indicates the amount of variation explained by each variable. The stepwise method has been criticized because it uses statistical criteria rather than theoretical ones (Bryman & Cramer, 1994, p245). The 'enter' method could be used instead, this enters every variable regardless of statistical criteria, however this could lead to over-estimates of the importance of variables and is not used in the current analysis.

Dealing with residual outliers

A more reliable regression analysis is usually obtained by removing outliers. In the current analysis the outliers were removed but this had little effect on the values of R-squared and standardised β values.

Dummy variables

Regression analysis cannot be used for categorical variables but is able to work with dichotomous variables; in order to overcome the problem of categorical variables, dummy variables are created which are dichotomous. The dummy variables created and used in the present analyses are shown in Table2-9 overleaf.

Table 2-9 Dummy variables used in the regression analyses

Variable	Dummy variable	Dummy variable = 0	Dummy variable = 1
Ethnicity	ESWI	Not ESWI	ESWI
	ASIAN	Not Asian	Asian
Highest qualification	QUALIFICATIONS GROUP	Not university level	University level
Highest science qualification	SCIENCE QUALIFICATIONS GROUP	Not university level	University level
In-service training	INSET	No science inset	Science inset
Secondary teaching approach	INTEGRATED	Not integrated science	Integrated science
	BPC	Not separate sciences	Separate sciences
Primary teaching approach	CURRICULUM FOCUS	Not curriculum focus	Curriculum focus
	SUBJECT	Not subject based	Subject based
	TOPIC	Not topic based	Topic based
Scheme of work/textbook used in secondary science	OWN	Not own scheme of work	Own scheme of work
	SPOTLITE	Spotlite not used	Spotlite used
	SALTERS	Salters not used	Salters used
	STARTSCIENCE	Starting science not used	Starting science used
Use of transfer information	TRANSFERN	Transfer information not useful	Transfer information useful

Table 2-10 Variables used in regression analysis of year 6 data

Variable	Block	Type
ASIAN	Child	Dummy
ESWI		Dummy
Gender		Dichotomous
% free school meals	Primary school	Continuous
Number on roll		Continuous
Number in year 6		Continuous
% level 4 or above in 1996 end of key stage 2 tests		Continuous
% children with special needs		Continuous
CURRICULUM FOCUS		Dummy
SUBJECT		Dummy
TOPIC		Dummy
INSET	Primary teacher	Dummy
QUALIFICATIONS GROUP		Dummy
SCIENCE QUALIFICATIONS GROUP		Dummy
Score on knowledge factor (f1)		Continuous
Score on science and society factor (f2)		Continuous
Score on child-centred factor (f3)		Continuous
Score on motivation factor (f4)		Continuous
Length of non-teaching employment		Continuous
Length teaching employment		Continuous
Contextualist-decontextualist score (CD)		Continuous
Inductive-deductive score (ID)		Continuous
Process-content score (PC)		Continuous
Collaborative learning in year 6	Classroom activities	Continuous
Standardised learning in year 6		Continuous
Teacher-directed learning in year 6		Continuous
Student directed learning in year 6		Continuous
Enjoyment of school in year 6	School attitudes	Continuous
Enjoyment of schoolwork in year 6		Continuous

Table 2-11 Variables used in regression analysis of year 7data

Variable	Block	Type
ASIAN	Child	Dummy
ESWI		Dummy
Gender		Dichotomous
% with five or more A-C grades	Secondary school	Continuous
% with one or more A-G grades		Continuous
Five or more A-G grades % in school		Continuous
Authorised absences % half days missed		Continuous
Number of half day sessions used for induction		Continuous
% free school meals		Continuous
% children with special needs		Continuous
% children with statements		Continuous
Number on roll		Continuous
BPC		Dummy
INTEGRATED		Dummy
OWN		Dummy
SALTERS		Dummy
SPOTLITE		Dummy
STARTSCIENCE		Dummy
CASE		Dichotomous
USE OF TRANSFER INFORMATION		Dummy
Mixed or single-sex teaching		Dichotomous
Results of Key stage 2 tests available		Dichotomous
Results of Key stage 2 tests used		Dichotomous
Selective school		Dichotomous
Sixth form		Dichotomous
Primary teacher assessments available		Dichotomous
Primary teacher assessments used		Dichotomous
Timetabled time available for liaison		Dichotomous
Type of school		Dichotomous
Unauthorised absences % half days missed		Continuous
Number on roll in year 7		Continuous
INSET	Secondary teacher	Dummy
QUALIFICATIONS GROUP		Dummy
SCIENCE QUALIFICATIONS GROUP		Dummy
Score on knowledge factor (f1)		Continuous
Score on science and society factor (f2)		Continuous
Score on child-centred factor (f3)		Continuous
Score on motivation factor (f4)		Continuous
Length of non-teaching employment		Continuous
length teaching employment		Continuous
Contextualist-decontextualist score (CD)		Continuous
Inductive-deductive score (ID)		Continuous
Process-content score (PC)		Continuous
Collaborative learning in year 7	Classroom activities	Continuous
Standardised learning in year 7		Continuous
Teacher-directed learning in year 7		Continuous
Student directed learning in year 7		Continuous
Enjoyment of school in year 7	School attitudes	Continuous
Enjoyment of schoolwork in year 7		Continuous

2.2.3 TREATMENT OF MISSING DATA

Re-coding missing values

The number of children varies from sub-scale to sub-scale because not all children responded to all items. When SPSS is used, a sub-scale total is not calculated for a case if a missing value occurs; thus any child with only one missing value would be excluded from part of the analysis.

Some children didn't answer items because they did not fully understand the sentences or did not know how to respond, but there were also children who occasionally missed an item accidentally or who responded 'don't know' when in fact they meant 'not sure'[1]. Where children had clearly missed items accidentally or had used 'don't know' instead of 'not sure' they were included in the analysis by replacing their missing answers with a 'not sure' score (a score of 3 on the Likert scale). Cases were selected for re-coding as follows: if a child had ticked less than three 'don't know' boxes and had omitted only one item then the 'missing' item and the 'don't know' items were re-coded as 'not sure' (a value of 3, the mid-point of the scale). These criteria allowed a much larger proportion of children to be included in those with calculated sub-scores. While it is acknowledged that some children with reliable and valid responses would be have to be eliminated from an analysis, it is unlikely that any genuinely unreliable responses would have been included. A relatively small number of cases were changed in this way; the remainder were left with their missing values. Tables 2-12 and 2-13 show the relative number and proportion of values replaced for each item.

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[1] This was clearly revealed in interviews when children were asked how they would respond to items in the questionnaire. Children who had said they were not sure whether they would agree or disagree with a particular statement said they would tick the 'don't know' box in the questionnaire

Table 2-12: Percentage of missing values for year 6 children (n= 3373)

	Don't know N		Don't know %		Missing N		Missing %	
Item No.	Initially	Recoded	Initially	Recoded	Initially	Recoded	Initially	Recoded
13	204	177	5.8	0.1	5	5	0.1	0.1
14	514	427	14.6	12.7	23	23	0.7	0.7
15	708	597	20.1	17.7	25	25	0.7	0.7
16	120	104	3.4	3.1	32	29	0.9	0.9
17	807	588	22.9	17.4	55	54	1.6	1.6
18	297	258	8.4	7.6	27	27	0.8	0.8
19	578	489	16.4	14.5	23	22	0.7	0.7
20	324	286	9.2	8.5	27	27	0.8	0.8
21	55	48	1.6	1.4	28	28	0.8	0.8
22	736	622	20.9	18.4	11	11	0.3	0.3
23	468	380	13.3	11.3	7	7	0.2	0.2
24	1041	743	29.6	22.0	23	22	0.7	0.7
25	151	125	4.3	3.7	29	29	0.9	0.9
26	207	182	5.9	5.4	35	34	1.0	1.0
27	109	99	3.1	2.9	20	0.6	19	0.6
28	642	577	18.3	17.1	31	29	0.9	0.9
29	191	164	5.4	4.9	28	26	0.8	0.8
30	253	207	7.2	6.1	31	30	0.9	0.9
31	362	310	10.3	9.2	39	36	1.1	1.1
32	717	626	20.4	18.6	37	36	1.1	1.1
33	239	192	6.8	5.7	26	23	0.7	0.7
34	444	380	12.6	11.3	22	21	0.6	0.6
35	321	269	9.1	8.0	12	12	0.3	0.3

Table 2-13: Percentage of missing values for year 7 children (n= 3199)

	Don't know N		Don't know %		Missing N		Missing %	
Item No.	Initially	Recoded	Initially	Recoded	Initially	Recoded	Initially	Recoded
13	112	101	3.5	3.2	290	290	9.1	9.1
14	764	684	23.9	21.4	293	293	9.2	9.2
15	311	248	9.7	7.8	294	294	9.2	9.2
16	65	50	2.0	1.6	290	290	9.1	9.1
17	458	316	14.3	9.9	303	303	9.5	9.5
18	152	122	4.8	3.8	289	289	9.0	9.0
19	796	726	24.9	22.7	298	298	9.3	9.3
20	89	71	2.8	2.2	298	298	9.3	9.3
21	13	11	.4	.3	291	291	9.1	9.1
22	960	829	30.0	25.9	309	309	9.7	9.7
23	201	151	6.3	4.7	292	292	9.1	9.1
24	641	426	20.0	13.3	295	295	9.2	9.2
25	81	63	2.5	2.0	294	294	9.2	9.2
26	108	86	3.4	2.7	300	300	9.4	9.4
27	46	38	1.4	1.2	298	298	9.3	9.3
28	349	293	10.9	9.2	301	301	9.4	9.4
29	84	74	2.6	2.3	301	301	9.4	9.4
30	86	74	2.7	2.3	297	297	9.3	9.3
31	155	123	4.8	3.8	313	313	9.8	9.8
32	352	311	11.0	9.7	305	305	9.5	9.5
33	124	107	3.9	3.3	308	308	9.6	9.6
34	140	113	4.4	3.5	301	301	9.4	9.4
35	173	139	5.4	4.3	290	290	9.1	9.1

If *all* cases with any missing values are excluded from analysis the number of cases is very severely reduced and it is likely that the small sample remaining will suffer from bias; hence listwise deletion of cases is not a satisfactory way forward. However, if pairwise deletion is used the matrix may be inconsistent unless it can be assumed that all missing values are missing in an entirely random way. A combination of listwise and pairwise deletion was chosen as the best compromise: cases were only included if they met the following conditions:

- School attitude scales: included if more than 6 out of 12 responses
- Science attitude scales: included if more than 14 out of 20 responses
- Teacher approaches & views scales: included if more than 10 out of 18 responses

Missing values, reliability and validity.

It is clear from an examination of the relative proportions of 'missing' and 'don't know' values for each item that children found some items particularly difficult to answer. The later interviews with children and teachers illuminated possible reasons for the difficulties with some items: these were items relating to calculations, computers and the values of science to society.

Items referring to calculations (15, 28 & 32) were included in the final questionnaire after interviews with teachers at the pilot stage indicated that the responses would be valid. Teachers were asked whether they thought that the children understood the items on calculations; all the primary school teachers involved at the pilot stage were quite positive that their children understood these items. However it is clear from the number of 'don't knows' and 'missing' answers that this was not the case. When children were interviewed, in the main study, they

were asked about this issue. A large proportion of children said that they didn't have any idea what calculations were. However, there was a similarly large proportion that said they did know what calculations were but when asked to explain there ideas they gave various interesting but incorrect explanations of calculations. It is probable that many children ticked the 'don't know' box or omitted these items because they did not have a clear understanding of the concept of 'calculations'. Responses to these items were unreliable and also not valid since children did not understand them in the way they were intended to be understood. The 'calculations' sub-scale was therefore not used in the analysis.

Items referring to use of computers (14, 19 & 22) were missing for, apparently, a quite different reason; a large number of children had annotated their questionnaires, writing sentences such as "I have ticked 'don't know' because we don't use computers" next to items 14, 19 & 22, concerning computers. When this information is combined with the fact that in Section Three of the questionnaire (classroom activities) children indicated that they rarely used computers it appears that lack of use was often the motivation for children to tick 'don't know' rather than express a view. Those who expressed a view about use of computers were found to be quite reliable and since there did not appear to be any misunderstanding of these items they are not invalidated, and this sub-scale was therefore included in analysis.

Items referring to the value of science to society (17, 24 & 33) are a less homogeneous group than either of the preceding ones. Interviews with the children demonstrated that there were significant misunderstandings concerning these items but that the causes of the misunderstandings were different for each item.

Item 17 was answered 'don't know' by a large proportion of children because it was an issue about which they appeared to have little or no knowledge; also, some teachers in interview said that this was not an issue they would deal with. Item 24 was probably not understood because of the use of the phrase 'scientific discoveries'; children interviewed remarked that they didn't know what this phrase meant. Finally, although only a small proportion of children failed to respond to item 33, it was thought to be invalid because children could understand it in two conflicting ways: in the context of this item 'science' was regarded by some of those interviewed as meaning 'science lessons at school' and by others as meaning 'science in society'. A further concern about these items is that as the children grow older and are exposed to the secondary school science they are likely to understand them differently. All in all this group of items produced an unreliable and invalid sub-scale that cannot be used in the analysis.

APPENDIX 3 QUESTIONNAIRES AND INTERVIEW SCHEDULES

3.1 FIRST PILOT OF CHILDREN'S QUESTIONNAIRE

YOU AND YOUR SCHOOLWORK
A questionnaire for year 7 students

A study being carried out by the School of Education

the University *of* Greenwich

Dear student

I am trying to find out how you feel about things you do at school, and how you feel about science. Your answers to this questionnaire will help me. Although I need your name so that I can follow your progress next year, your answers will be kept private and no-one will be identified individually. Thank you for your time and help in answering my questions.

Pat Bricheno (the University of Greenwich)

All your answers will be treated as CONFIDENTIAL

Name.....

Male ☐ Female ☐

List your three favourite school subjects in order

a).....

b).....

c).....

SECTION 1: HOW DO YOU FEEL ABOUT SCHOOL?

In this section I am trying to find out how you feel about school and school work. Read through each sentence and then see if you agree or not with what has been said. When you have decided, circle the number in the column closest to what you feel.

Example for practice

Look at the sentences below.
Read each one and then see if you agree or not with what has been said. When you have decided, circle the number in the column closest to what you feel.

	Strongly agree	*Agree*	*Disagree*	*Disagree strongly*
I like ice cream	*1*	*2*	*3*	*4*
I like cleaning shoes	*1*	*2*	*3*	*4*

Please work through quickly, circling one number on each line. Don't worry about the fact that some of the sentences are similar.

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
find school challenging	*1*	*2*	*3*	*4*
chool is not very enjoyable	*1*	*2*	*3*	*4*
enjoy everything about school	*1*	*2*	*3*	*4*
essons are boring most of the time	*1*	*2*	*3*	*4*
here are lots of school subjects do not enjoy	*1*	*2*	*3*	*4*
am very happy when I am school	*1*	*2*	*3*	*4*
generally don't like schoolwork	*1*	*2*	*3*	*4*
hool is interesting and fun	*1*	*2*	*3*	*4*
hool is completely boring	*1*	*2*	*3*	*4*
lways work as hard as I can at school	*1*	*2*	*3*	*4*
lways behave badly at school	*1*	*2*	*3*	*4*

SECTION 2: YOU AND YOUR SCIENCE LESSONS

In this section I am trying to find out how you feel about science and science lessons. Work through quickly, circling one number on each line. Don't worry that many of the sentences are similar.

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
Money spent on science is worthwhile	*1*	*2*	*3*	*4*
I like science	*1*	*2*	*3*	*4*
Science lessons are a waste of time	*1*	*2*	*3*	*4*
Science is an enjoyable school subject	*1*	*2*	*3*	*4*
Science is fun when we use computers	*1*	*2*	*3*	*4*
The science taught at school is interesting	*1*	*2*	*3*	*4*
I get so interested in science lessons that I don't want to stop	*1*	*2*	*3*	*4*
Science is our worst enemy	*1*	*2*	*3*	*4*
Doing experiments is not as good as finding out information from teachers	*1*	*2*	*3*	*4*
Science is a difficult subject	*1*	*2*	*3*	*4*
I dislike science lessons	*1*	*2*	*3*	*4*
I get bored watching science programmes on TV at home	*1*	*2*	*3*	*4*
The government should spend more money on scientific research	*1*	*2*	*3*	*4*
Science is fun when we use computers	*1*	*2*	*3*	*4*
Science is difficult when it involves using apparatus	*1*	*2*	*3*	*4*
Science has ruined our environment	*1*	*2*	*3*	*4*
I would rather do experiments than read about them	*1*	*2*	*3*	*4*
Science is difficult when it involves writing about experiments	*1*	*2*	*3*	*4*
Science is one of the most interesting school subjects	*1*	*2*	*3*	*4*

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
There are too many facts to learn in science	*1*	*2*	*3*	*4*
Using a computer makes science so interesting I don't want to stop	*1*	*2*	*3*	*4*
Science inventions improve our standard of living	*1*	*2*	*3*	*4*
Science is difficult when it involves calculations	*1*	*2*	*3*	*4*
Science will help make the world a better place in the future	*1*	*2*	*3*	*4*
When I use a computer in science I understand things better	*1*	*2*	*3*	*4*
Scientific discoveries do more harm than good	*1*	*2*	*3*	*4*

SECTION 3: WHAT HAPPENS IN YOUR SCIENCE LESSONS

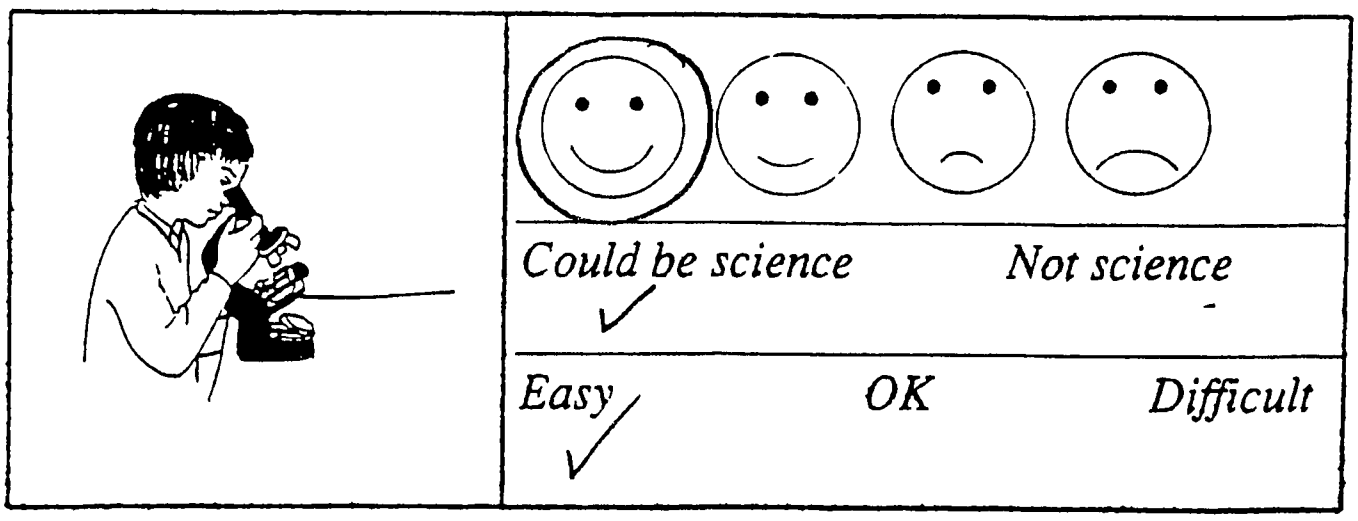
As before, work though quickly, circling one number on each line.

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
We use library books for learning science	*1*	*2*	*3*	*4*
We choose the topics we want to study in science	*1*	*2*	*3*	*4*
We often use computers in science	*1*	*2*	*3*	*4*
The teacher uses our ideas and suggestions when planning science lessons	*1*	*2*	*3*	*4*
We use a text book for our science lesson	*1*	*2*	*3*	*4*
We watch the teacher do experiment during our science lessons	*1*	*2*	*3*	*4*
During the science lessons we copy he teacher's notes from the board nto our own books	*1*	*2*	*3*	*4*

SECTION 4: SCIENCE ACTIVITIES

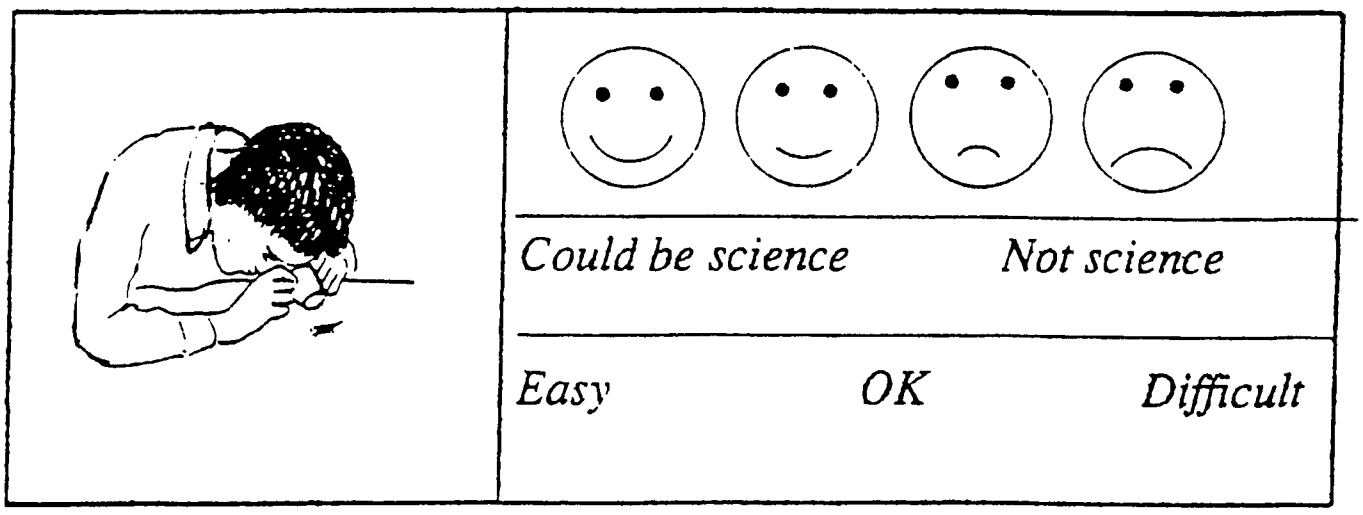
The pictures below, and on the following pages, show activities that *could* happen in lessons. Look at the pictures carefully. Decide if you think these activities could be part of a *science* lesson and decide how you feel about each activity. When you have decided, circle the face and the words that are closest to what you think and feel about the activities.

(a)

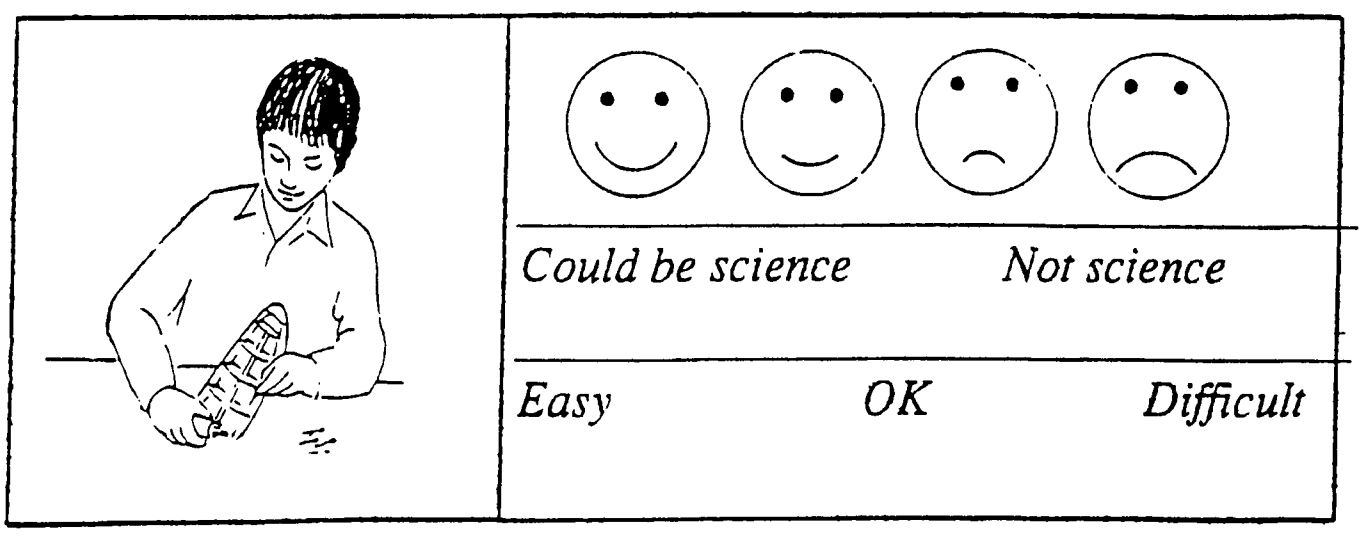


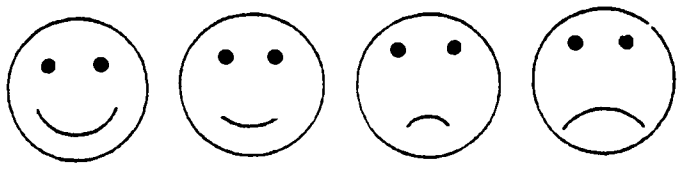
In (a) I have put a ring round the smiley face because I like using a microscope. I have ticked the *science* box because I think I might use a microscope in a science lesson and I have ticked the *easy* box because I think it is easy to use a microscope. Now you practice by doing (b) and (c)

(b)



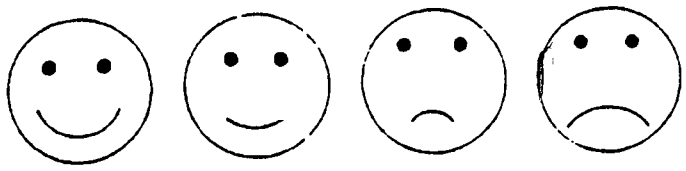
(c)





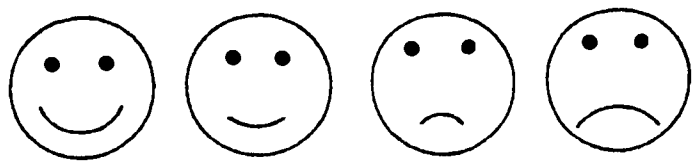
Could be science *Not science*

Easy *OK* *Difficult*



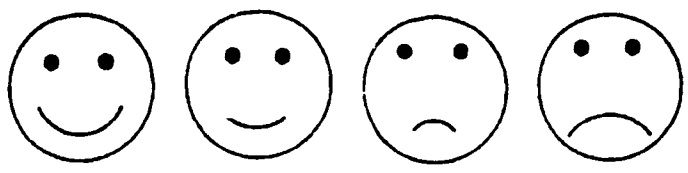
Could be science *Not science*

Easy *OK* *Difficult*



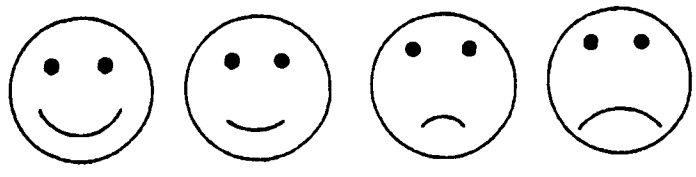
Could be science *Not science*

Easy *OK* *Difficult*



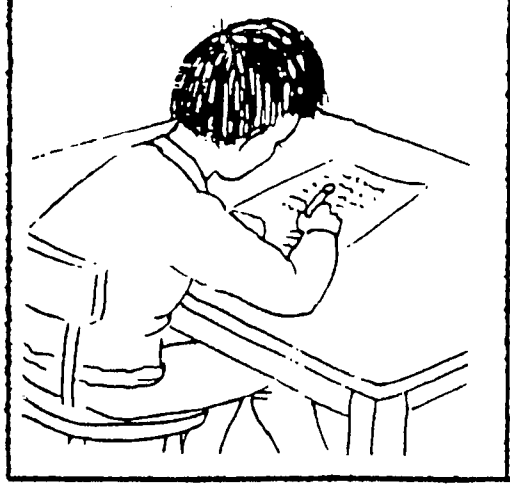
Could be science *Not science*

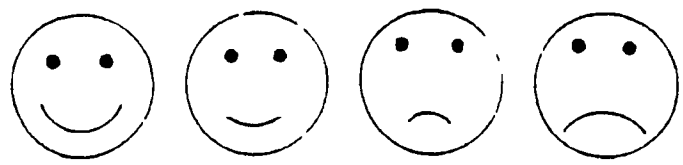
Easy *OK* *Difficult*



Could be science *Not science*

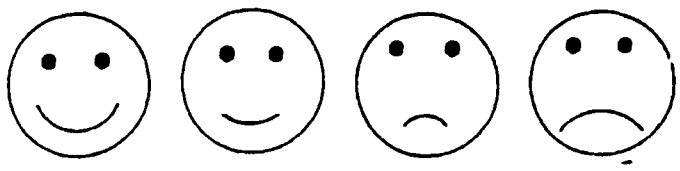
Easy *OK* *Difficult*





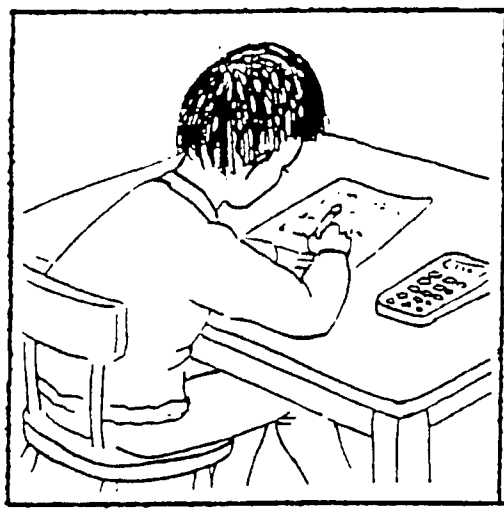
Could be science *Not science*

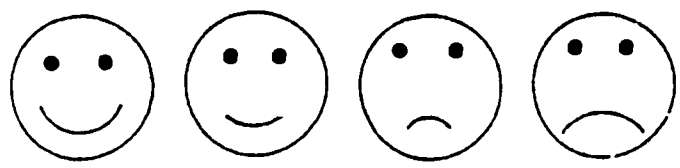
Easy *OK* *Difficult*



Could be science *Not science*

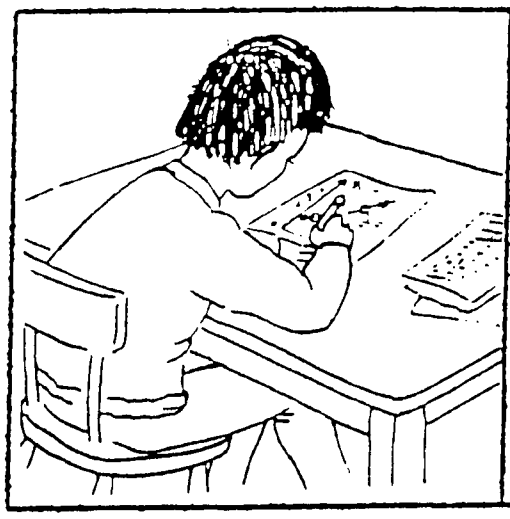
Easy *OK* *Difficult*

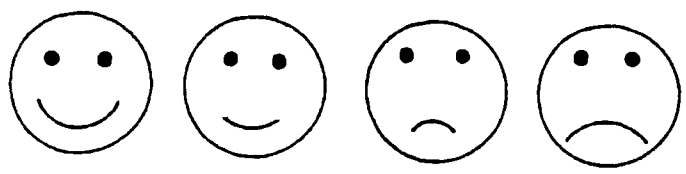




Could be science *Not science*

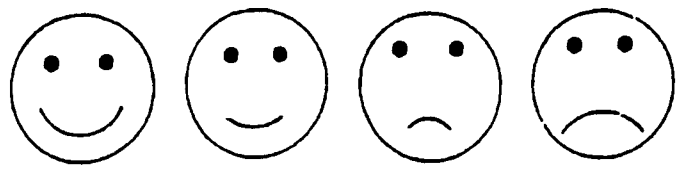
Easy *OK* *Difficult*





Could be science *Not science*

Easy *OK* *Difficult*



Could be science *Not science*

Easy *OK* *Difficult*

3.2 SECOND PILOT OF CHILDREN'S QUESTIONNAIRE

YOU AND YOUR SCHOOLWORK
A questionnaire for year 6 students

A study being carried out by the School of Education

the University *of* Greenwich

Dear student
I am trying to find out how you feel about things you do at school, and how you feel about science. Your answers to this questionnaire will help me. Although I need your name so that I can follow your progress next year, your answers will be kept private and no-one will be identified individually. Thank you for you time and help in answering my questions.

Pat Bricheno (the University of Greenwich)

All your answers will be treated as CONFIDENTIAL

Name.....

School.....

Teacher.....

Male ☐ Female ☐

List your three favourite school subjects in order

a).....

b).....

c).....

YOU AND YOUR SCHOOLWORK
A questionnaire for year 7 students

A study being carried out by the School of Education

the **University** ***of*** **Greenwich**

Dear student

I am trying to find out how you feel about things you do at school, and how you feel about science. Your answers to this questionnaire will help me. Although I need your name so that I can follow your progress next year, your answers will be kept private and no-one will be identified individually. Thank you for you time and help in answering my questions.

Pat Bricheno (the University of Greenwich)

All your answers will be treated as CONFIDENTIAL

Name.....

School.....

Teacher.....

Male ☐ Female ☐

List your three favourite school subjects in order

a).....

b).....

c).....

In each of the following sections read through each sentence, then see if you agree or not with what has been said. When you have decided, circle the number in the column closest to what you feel.

Example for practice

Look at the sentences below.
Read each one and then see if you agree or not with what has been said. When you have decided, circle the number in the column closest to what you feel.

	Strongly agree	*Agree*	*Disagree*	*Disagree strongly*
I like ice cream	*1*	*2*	*3*	*4*
I like cleaning shoes	*1*	*2*	*3*	*4*

SECTION 1: HOW DO YOU FEEL ABOUT SCHOOL?

In this section I am trying to find out how you feel about school and school work.Read through each sentence and then see if you agree or not with what has been said. When you have decided, circle the number in the column closest to what you feel. Please work through quickly, circling one number on each line. Don't worry about the fact that some of the sentences are similar

	Strongly agree	Agree	Disagree	Strongly disagree	
School is not very enjoyable	1	2	3	4	6
I enjoy everything about school	1	2	3	4	7
I am bored most of the time at school	1	2	3	4	8
There are lots of school subjects I don't like	1	2	3	4	9
The most enjoyable part of my life is the time I spend at school	1	2	3	4	10
I generally don't like my schoolwork	1	2	3	4	11
I get good marks for my work	1	2	3	4	12
I always work as hard as I can at school	1	2	3	4	13
I always behave badly at school	1	2	3	4	14
I am keen to answer questions in class	1	2	3	4	15

SECTION 2: SCIENCE AND SCIENCE LESSONS

In this section I am trying to find out how you feel about science and science lessons. Work through quickly, circling one number on each line. Don't worry that many of the sentences are similar.

	Strongly agree	Agree	Disagree	Strongly disagree	
I look forward to science lessons	1	2	3	4	16
It is easy to understand the new ideas I learn about in science	1	2	3	4	17
I would rather find out why something happens by doing an experiment than by being told	1	2	3	4	18
Scientific inventions improve our standard of living	1	2	3	4	19
Science is a difficult subject	1	2	3	4	20
Science is more interesting when we use computers	1	2	3	4	21
Science uses too many special words	1	2	3	4	22
There is no such thing as a ***true*** scientific theory	1	2	3	4	23
There is too much writing to do in science	1	2	3	4	24
I like to hear scientific explanations of the world we live in	1	2	3	4	25
I like doing experiments	1	2	3	4	26
A scientist's job is to discover the true nature of the world	1	2	3	4	27
Science is difficult when it involves calculations	1	2	3	4	28
I dislike science lessons	1	2	3	4	29
There are too many new ideas to learn in science	1	2	3	4	30
Doing experiments is not as good as finding out information from teachers	1	2	3	4	31

continued on next page

	Strongly agree	Agree	Disagree	Strongly disagree	
Science has ruined the environment	1	2	3	4	32
There are too many facts to learn in science	1	2	3	4	33
Using a computer makes science so interesting I don't want to stop	1	2	3	4	34
It is difficult to write down what an experiment was about	1	2	3	4	35
Emotions have nothing to do with finding out new scientific knowledge	1	2	3	4	36
There are too many new words to learn in science	1	2	3	4	37
Finding out about new things in science is not important to me	1	2	3	4	38
Doing experiments in science is a waste of time	1	2	3	4	39
Scientists don't know what will happen in an experiment before they do it	1	2	3	4	40
The calculations we do in science are difficult	1	2	3	4	41
Science lessons bore me	1	2	3	4	42
Listening to ideas about science is boring	1	2	3	4	43
I would rather agree with other people than do an experiment to find out for myself	1	2	3	4	44
Science will help to make the world a better place in the future	1	2	3	4	45
Science is difficult when it involves calculations	1	2	3	4	46
When I use a computer in science I understand things better	1	2	3	4	47
Spelling scientific words is really difficult	1	2	3	4	48

continued on next page

	Strongly agree	Agree	Disagree	Strongly disagree	
You don't need to do experiments to learn about science	1	2	3	4	49
I already know about the science my teacher is teaching us	1	2	3	4	50
I like to listen to people whose opinions are different from mine	1	2	3	4	51
I enjoy planning my own investigations	1	2	3	4	52
The way a scientist works has nothing to do with morals or religion	1	2	3	4	53
Doing calculations in science is boring	1	2	3	4	54
Science lessons are a waste of time	1	2	3	4	55
My ideas don't always agree with my teacher's ideas	1	2	3	4	56
I would rather do my own experiment than find out information from the teacher	1	2	3	4	57
Scientific discoveries do more harm than good	1	2	3	4	58
Science is difficult when it involves doing experiments	1	2	3	4	59
I would rather someone told me the answer to a difficult problem than work it out for myself	1	2	3	4	60
I am often unsure of the way I should write about experiments	1	2	3	4	61
Scientists decide between two theories just by looking carefully at the results of experiments	1	2	3	4	62
The ideas we learn about in science are too easy	1	2	3	4	63
I find it boring to hear about new science ideas	1	2	3	4	64

continued on next page

	Strongly agree	Agree	Disagree	Strongly disagree	
Planning my own investigation is difficult	1	2	3	4	65
The most important part of science lessons is learning how to do investigations not remembering the facts	1	2	3	4	66
I don't like doing calculations in science	1	2	3	4	67
I really enjoy going to science lessons	1	2	3	4	68
I don't understand most of the theories we learn about in science	1	2	3	4	69
Science is very important for a country's development	1	2	3	4	70
There are too many new ideas to learn about in science	1	2	3	4	71
I like writing about science experiments	1	2	3	4	72
Scientists need to have a good imagination to help them work out new theories	1	2	3	4	73
I already know most of the science we have done this year	1	2	3	4	74
I don't want to listen to other people's opinions about science	1	2	3	4	75
I really enjoy doing investigations in science	1	2	3	4	76
Scientific theories are only worthwhile if they can be useful to people	1	2	3	4	77
I can't understand the calculations we do in science	1	2	3	4	78
I would enjoy school more if we did not have to do science	1	2	3	4	79
My ideas about science are the same as the teacher's ideas	1	2	3	4	80
Science is our worst enemy	1	2	3	4	81

continued on next page

	Strongly agree	Agree	Disagree	Strongly disagree	
Science is difficult when it involves writing	1	2	3	4	82
Writing about why I did an experiment is difficult	1	2	3	4	83
There are some things in the universe that science will never be able to explain	1	2	3	4	84
Science is different from other subjects because it uses special methods of working	1	2	3	4	85
Writing a plan for an experiment is easy	1	2	3	4	86
New scientific theories are just the result of lots of experiments and observations	1	2	3	4	87
I think the calculations we do in science are easy	1	2	3	4	88
I would rather keep my own opinion about science ideas even when the teacher explains a different view to me	1	2	3	4	89

SECTION 3: WHAT HAPPENS IN YOUR SCIENCE LESSONS

Read through each sentence and then think about how often you work in that way in your science class. When you have decided, circle the number in the column closest to what you think.

	Often	Sometimes	Hardly ever	
We use a textbook for our science lessons	1	2	3	90
We choose the topics we want to study in science	1	2	3	91
We copy the teacher's notes from the board or worksheet into our own books	1	2	3	92
We do experiments on our own as part of our science lessons	1	2	3	93
We use library books for learning science	1	2	3	94
We make up our own problems and then the teacher helps us to plan experiments to solve them	1	2	3	95

continued on next page

	Often	Sometimes	Hardly ever	
We have tests on what we have learned in science	1	2	3	96
We work in small groups to do experiments	1	2	3	97
The teacher uses our ideas and suggestions in lessons	1	2	3	98
We watch the teacher do experiments	1	2	3	99
We use computers to help us with our science	1	2	3	100

SECTION 4: WHAT WILL NEXT YEAR BE LIKE?

Think about what it will be like to do science next year in Year7. Make a list of any things you think will be different about science next year. 101

.

.

.

.

110

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Please put the completed questionnaire in the envelope provided, seal the envelope and return it to your teacher.

3.3 FIRST PILOT OF TEACHERS' QUESTIONNAIRE

SCIENCE TEACHING

A questionnaire for teachers of Year 6 and 7 pupils

A study being carried out by the School of Education, Greenwich University

All your answers will be treated as CONFIDENTIAL

BIOGRAPHICAL DETAILS

Title Initials Surname

Age

For how many years have been a teacher?

- Up to 5 years ☐
- 6-10 ☐
- 11-20 ☐
- 21-30 ☐
- 31 or more ☐

Approximately how much of the school day do you spend teaching science? ☐ hrs

What were the main subject(s) of your initial training?

Science subjects only ☐ Please indicate which science(s)

_____

_____

_____

Science and non-science subjects ☐ Please indicate which science(s)

_____

_____

_____

Non-science subjects only ☐

Have you any non-teaching employment experience? Yes ☐

No ☐

If "Yes" please indicate briefly the nature and length of the employment

AIMS OF SCIENCE TEACHING

Below is a list of possible aims for science teaching in year 6 and year 7
Will you please give each statement an importance ranking for teaching in year 6 ***and*** in year 7 by marking out of 3
1 = not very important, 2 = fairly important, 3 = very important.

	YR6	YR7
Laying the foundations for secondary school science	☐	■
Building on concepts introduced in primary school science	■	☐
Developing children's practical skills	☐	☐
Giving children opportunities to improve observational skills	☐	☐
Improving children's communication skills	☐	☐
Allowing plenty of opportunities to practice investigative skills such as: predicting, fair testing and concluding.	☐	☐
Providing an environment which focuses children's experience and discussions	☐	☐
Helping the children to see the importance of applications of science	☐	☐
Helping children to appreciate the nature of science	☐	☐
Ensuring a sound knowledge of the theoretical concepts and principles of science	☐	☐
Motivating the children by selecting topics and activities which they will enjoy	☐	☐
Helping children to recognise the needs of society by stressing connections between science, technology and society	☐	☐
Ensuring that children are stretched by providing additional information and activities to supplement the National Curriculum.	☐	☐

YOUR PHILOSOPHY OF SCIENCE

	Agree	*Partially agree*	*Disagree*	*Cannot answer*
The object of scientific activity is to discover the true nature of the world we live in	*1*	*2*	*3*	*4*
Scientific theories are valid if they work	*1*	*2*	*3*	*4*
The most valuable part of a scientific education is what remains after the facts have been forgotten	*1*	*2*	*3*	*4*
Scientists have no idea of the outcome of an experiment before they do it	*1*	*2*	*3*	*4*
Scientific theories are as much a result of imagination and intuition as inference from experimental results	*1*	*2*	*3*	*4*
The processes of science are divorced from moral and ethical considerations	*1*	*2*	*3*	*4*
Scientific theories describe the real world which is independent of human perception	*1*	*2*	*3*	*4*
New scientific knowledge arises entirely through the accumulation of new experiments and observations	*1*	*2*	*3*	*4*
Practical experience is not essential for the acquisition of scientific knowledge	*1*	*2*	*3*	*4*
Scientific research is economically and politically determined	*1*	*2*	*3*	*4*
Scientific knowledge has a different status from other knowledge in that it is an objective account of nature	*1*	*2*	*3*	*4*
Science is essentially characterised by the methods and processes it uses	*1*	*2*	*3*	*4*

3.4 SECOND PILOT OF TEACHERS' QUESTIONNAIRE

SCIENCE TEACHING

A questionnaire for teachers of Year 6 and 7 pupils

A study being carried out by the School of Education
The University of Greenwich

All your answers will be treated as CONFIDENTIAL

BIOGRAPHICAL DETAILS

Please tick, underline or delete where appropriate

School

Name Title Initials Surname

Male/Female

Length of teaching employment

Up to 5 years 6-10 11-20 21-30 31 or more

Do you hold a post of responsibility?

Yes No

If "yes" please indicate the nature of your responsibilities.

What is your main area of teaching?

Year 6 class teacher
primary/junior science teacher
secondary science teacher

Which group(s)/classes do you teach?

What type of subjects did you study during your initial training?

Science subjects only
Science and non-science subjects
Non-science subjects only

If science studied which was the main science subject studied?

Biology Chemistry Physics Science

Have you any non-teaching employment experience?

Yes No

If "Yes" please indicate briefly the nature of the employment:

Length of non-teaching employment

0-1 yr 1-5 yr 6-10 yr 11 + yr

AIMS OF SCIENCE TEACHING

Below is a list of possible aims for science teaching. Please read the list carefully and place a tick beside the six aims which you consider to be be the most important. You do not need to put them in any ranking order.

1. Rearranging topics for more effective learning

2. Using curriculum content to illustrate the tentative and changing nature of scientific knowledge

3. Providing opportunities for emphasising children's experiences and discussions

4. Passing on scientific knowledge

5. Selecting topics and activities which the children will enjoy

6. Using time to study applications of scientific concepts

7. Ensuring plenty of direct experiences with aspects of the curriculum which assist learning

8. Using the curriculum content to illustrate the philosophy and processes of science

. Ensuring a sound knowledge of the theoretical concepts and principles of science

10. Helping children to construct their own explanatory models

11. Providing experimental results and information which explain the natural world

12. Illustrating the unique nature of science as objective, true and unchanging

13. Matching materials to students level of ability

14. Stressing the connections between science, technology and society

15. Supplementing the curriculum with detailed information and challenging problems

YOUR PHILOSOPHY OF SCIENCE

Please read each of the statements carefully. Give each one a number ranging from strongly agree (5) to strongly disagree (1) and place it next to the statement. A score of 3 will indicate a balanced view.

1 The object of scientific activity is to reveal reality.

2 Scientists have no idea of the outcome of an experiment before they do it.

3 Scientific research is economically and politically determined

4 Science education should be more about the learning of scientific processes than the learning of scientific facts

5 The processes of science are divorced from moral and ethical considerations.

6 The most valuable part of a scientific education is what remains after the facts have been forgotten

7 Scientific theories are valid if they work.

8 New scientific knowledge arises entirely through the accumulation of new experiments and observations

9 There is such a thing as a true scientific theory.

10 Human emotion plays no part in the creation of scientific knowledge.

11 Scientific theories describe a real external world which is independent of human perception.

12 Practical experience is not essential for the acquisition of scientific knowledge

13 Scientific theories have changed over time simply because experimental techniques have improved.

14 "Scientific method" is transferable from one scientific investigation to another.

15 In practise choices between competing theories are made purely on the basis of experimental results.

16 Scientific theories are as much a result of imagination and intuition as inference from experimental results.

17 Scientific knowledge is different from other kinds of knowledge in that it has higher status.

18 There are certain physical events in the universe which science can never explain.

19 Scientific knowledge is morally neutral - only the application of the knowledge is ethically determined.

20 All scientific experiments and observations are determined by existing theories.

21 Science is essentially characterised by the methods and processes it uses.

3.5 THIRD PILOT OF TEACHERS' QUESTIONNAIRE

SCIENCE TEACHING
A questionnaire for teachers

A study being carried out by the School
of Education
the
University
of
Greenwich

Dear Colleague

I am trying to find out what aspects of science you value most in your teaching and I am also interested in your views on the nature of science. Although I need your name, in case I need to do some follow-up work, your answers will be kept private and no-one will be identified individually. Thank you for your time and help in completing my questionnaire.

Pat Bricheno (the University of Greenwich)

All your answers will be treated as CONFIDENTIAL

Please write the name of your school below

----------**School**

BIOGRAPHICAL DETAILS

Please tick, underline or delete where appropriate

Name

Male/Female

Length of teaching employment

Up to 5 years ☐ 6-10 ☐ 11-20 ☐ 21-30 ☐ 31 or more ☐

Do you hold a post of responsibility? Yes/No

If "yes" please outline briefly your main responsibilities

What is your main area of teaching?

Year 6 class ☐ primary/junior science ☐ secondary science ☐

Which of these qualifications do you hold? Please tick any that you have.

One or more Science GCSE/GCE ☐

A level Biology ☐ A level Chemistry ☐ A level Physics ☐

Degree- BA/BEd/BSc ☐

If you studied a science at degree level what was your main subject?

Have you any non-teaching employment experience? Yes/No

If "Yes" please indicate briefly the nature of the employment:

Length of non-teaching employment

)-1 yr ☐ 1-5 yr ☐ 6-10 yr ☐ 11 + yr ☐

AIMS OF SCIENCE TEACHING

Below is a list of possible aims for science teaching. Please read the list carefully and decide how important each aim is in your teaching of science. When you have decided write the number which matches most closely with your view in the space next to the statement.

4=Very important, 3=Important, 2=Not important, 1=Irrelevant

1. Stressing the connections between science, technology and society
2. Using curriculum content to illustrate the tentative and changing nature of scientific knowledge
3. Providing opportunities for children to discuss and consider their own scientific ideas
4. Passing on scientific knowledge
5. Selecting topics and activities which the children will enjoy
6. Using time to study applications of scientific concepts
7. Supplementing the curriculum with challenging problems
8. Using the curriculum content to illustrate the processes of science
9. Ensuring a sound knowledge of the theoretical concepts and principles of science
0. Helping children to construct their own explanatory models
1. Giving children plenty of experimental results and information which explain the natural world
2. Illustrating the unique nature of science as objective, true and unchanging
3. Matching materials to students level of ability
4. Supplementing the curriculum with more detailed information

lease complete the following sentences to reflect your views on science teaching:

Science teaching involves...

Teaching children about science is.....

YOUR VIEWS ABOUT SCIENCE

In the following section read through each sentence carefully, then see if you agree or not with what has been said. When you have decided, write the number which matches most closely with your view in the box opposite the statement.

5=Strongly agree, 4=Agree, 3=Balanced view, 2=Disagree, 1=Strongly disagree

1	The object of science is to reveal reality	☐
2	Scientists have no idea of the outcome of an experiment before they do it	☐
3	The way scientists work is independent of morals or ethics	☐
4	The most valuable part of a scientific education is what remains after the facts have been forgotten	☐
5	Human emotion plays no part in the creation of scientific knowledge	☐
6	"Scientific method" is transferable from one scientific investigation to another	☐
7	Scientists decide between theories purely by comparing the results of experiments	☐
8	Scientific theories are as much a result of imagination and intuition as inference from experimental results	☐
9	Scientific knowledge is different from other kinds of knowledge in that it is more objective	☐
10	There are certain physical events in the universe which science can never explain	☐

Please complete the following sentence to reflect your view of science:
"Science is .....

YOUR VIEWS ABOUT SCIENCE

Please read each of the statements carefully. Give each one a number ranging from strongly agree (5) to strongly **disagree (1) and place it next to the statement.** A score of 3 will indicate a balanced view.

1	The object of scientific activity is to find out the truth	
2	Scientists have no idea of the outcome of an experiment before they do it	
3	Scientific research is economically and politically determined	
4	Science education should be more about the learning of scientific processes than the learning of scientific facts	
5	The way scientists work does not depend on morals or ethics	
6	The most valuable part of a scientific education is what remains after the facts have been forgotten	
7	Scientific theories are valid if they work	
8	New scientific knowledge are entirely the result of many new experiments and observations	
9	There is no such thing as a true scientific theory	
10	Human emotion plays no part in the creation of scientific knowledge	
11	Scientific theories describe a real external world which is independent of human perception	
12	Practical experience is not essential for the acquisition of scientific knowledge	
13	Scientific theories have changed over time simply because experimental techniques have improved	
14	"Scientific method" is transferable from one scientific investigation to another	
15	Scientists decide between theories purely by looking carefully at the results of experiments	
16	Scientific theories are as much a result of imagination and intuition as inference from experimental results	
17	Scientific knowledge is different from other kinds of knowledge in that it is more objective	
18	There are certain physical events in the universe which science can never explain	
19	Scientific knowledge is morally neutral - only the application of the knowledge is ethically determined	
20	All scientific experiments and observations are determined by existing theories	
21	Science is special because of the methods and processes it uses	

3.6 PRIMARY SCHOOL INTERVIEW SCHEDULE

THE
UNIVERSITY OF GREENWICH

School of Primary and Secondary Education

LONGITUDINAL STUDY OF ATTITUDES TO SCIENCE

CONFIDENTIAL

Interview schedule
Primary schools

LONGITUDINAL STUDY OF ATTITUDES TO SCIENCE

Date of interview: .....

Name of school: .....

Name of respondent: .....

Position held by respondent: .....

.....

.....

AREA: .....

Any other relevant information:

SECTION A: FEEDBACK ON THE SURVEY

1. Were there any problems with the time or organisation of the survey week?

.....

.....

.....

.....

.....

.....

.....

2. Were there any problems with the questionnaires – children/teachers?

.....

3. Any other comments

.....

.....

.....

.....

.....

.....

.....

SECTION B ARRANGEMENTS FOR SCIENCE IN YEAR 6

1. How is science teaching organised in your school?

.....

.....

.....

2. What science topics did the children study just prior to the survey?

.....

.....

.....

.....

.....

.....

.....

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..

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.....

PART C: LIAISON ARRANGEMENTS

1. What links do you have with local secondary schools?

.....

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.....

.....

.....

2. Are there any particular links with any secondary school science departments?

.....

.....

.....

.....

.....

3. How do you feel about liaison arrangements with the secondary schools?

.....

.....

.....

.....

.....

.....

4. Any other comments:

SECTION D: OTHER INFORMATION

1. Would it be possible to have a copy of the school prospectus and the most recent report to parents by the governors?

.....

.....

2. Could you let me have a list of the ethnic origins of pupils?

.....

.....

3. Any other comments:

3.7 SECONDARY SCHOOL INTERVIEW SCHEDULE

THE
UNIVERSITY OF GREENWICH

School of Primary and Secondary Education

LONGITUDINAL STUDY OF ATTITUDES TO SCIENCE

Interview schedule
Secondary schools

CONFIDENTIAL

LONGITUDINAL STUDY OF ATTITUDES TO SCIENCE

Date of interview: .....

Name of school: .....

Name of respondent: .....

Position held by respondent: .....

.....

.....

AREA: .....

Any other relevant information:

SECTION A : ARRANGEMENTS FOR NEXT YEAR

The pupil's survey may be carried out at any convenient time during the week beginning Monday 3rd February 1997. It is not necessary to complete the questionnaire in a science lesson, but, please, not during the lunch-hour or on Friday afternoon since at these times pupils are likely to feel less positive about completing the questionnaire. It should take approximately 15 minutes to complete.

The teacher's questionnaire may be completed at any time during the survey week and should take no more than 15 minutes.

Here are samples of this year's version for you to look at.

The pupils who completed the questionnaire last year came from the following schools:

.....

.....

.....

.....

There is no need for any other pupils to do the questionnaire but I will need a list of pupils in year 7 (preferably by primary school) so that I can allocate a number to each child and so that I know how many questionnaires will be needed.

All the materials needed will be delivered at least one week before the survey week.

1. Are there any problems with the time of the survey week?

.....

2. Do you have any questions about the arrangements?

.....

.....

.....

3. Some of the children coming to you were interviewed by me last year, as part of the survey, would it be possible to interview them again next year? The interviews take about 40 minutes and pupils are interviewed in pairs.

.....

.....

4. Last year I interviewed the children's teachers as well, would you ask your staff if any of them would consider being interviewed about their personal approach to science teaching and their views about science? The interviews, which are confidential, would take not more than 30 minutes.

.....

.....

.....

.....

Any other comments:

SECTION B: ARRANGEMENTS FOR SCIENCE IN YEAR 7

1. In what way are pupils grouped for science in year 7?
.....

.....

.....

.....

2. Do you work from a published scheme of work? .....

.....

.....

.....

.....

IF YES

1. What sections do year 7 usually cover in their first term and the first weeks of their second term?.....

.....

.....

.....

.....

..

.....

.....

.....

IF NO

1. How is your scheme of work arranged? .....

.....

.....

.....

.....

2. May I have a copy of your scheme of work (in outline) as it applies to year 7 in their first term and the first weeks of their second term?

.....

.....

.....

IF NO

1. Could you tell me briefly the areas of the curriculum year 7 will cover during their first term and the first half of their second term?

.....

.....

.....

.....

.....

.....

3. Do you have a particular departmental policy on the approach you take to the teaching of science?

.....

.....

.....

.....

.....

.....

IF YES

1. Could I have a copy of it? .....

.....

4. When are pupils first formally assessed by your department?
.....

5. What grading system do you use for pupils' levels of attainment? NC levels or some other system?

.....

.....

.....

6. Do you think it would be possible for the teachers concerned to give me an assessment of the pupils' approximate national curriculum level?

.....

.....

.....

.....

Any other comments:

PART C: LIAISON ARRANGEMENTS

1. What arrangements are there for pupils to get to know the staff and to experience the school in general before they join in year 7?

.....

.....

.....

.....

.....

2. Will pupils have had any experience of the science department before joining year 7?

.....

.....

.....

.....

.....

3. How do you feel about these liaison arrangements?

.....

.....

.....

.....

.....

.....

Any other comments:

SECTION D: OTHER INFORMATION

1. There are a few other bits of information which would help me very much. Would it be possible for me to have a copy of the school prospectus and the most recent annual report to parents by the governors?

.....

.....

2. Could you let me have a list of the ethnic origins of pupils? .....

Any other comments:

3.8 CHILDREN INTERVIEW SCHEDULE

Welcome and thank the respondents. Introduce yourself. Seat respondents, offer refreshments.

"Well as you may have been told already, today I am conducting some discussions about people's opinions on science. I am involved in a major survey on this topic, and I have asked you along today so that I can benefit from your views and experiences for my research. The interviews are entirely private and your names will not be linked to anything you say here. Most people find these interviews interesting."

Secure both respondents' permission to record the interview on tape.

Q1 Could we begin by looking at the questionnaire you did last term. Would you help me to check what other children of your age would have thought about some of the questions. Which ones might they have found difficult to answer and why.: which questions might they have misunderstood or thought that it meant more than one thing.

Go through questionnaire drawing attention in particular to Q13, 15, 22, 23, 24, 25, 28, 30, 33.

If it has not become clear by this stage how the respondent feels about science at school and at home go to Q2 and Q3

Q2 Could you tell me a bit about how you feel about science?

Clarification What you feel about science topics at school?

Q3 How do you think what you do when you do science at school compares with what scientists do?

Q4 What about at home and science? e.g. TV programmes/hobbies/family?

Q5 I'd like you to say a bit now about science next year at secondary school. How do you think it will compare with this year?

Clarification Do you think it will be about the same or do you think it will be different?

Probe In what ways will it be ...the same/different?

Probe answers which mention.....

fun/excitement	tell me a bit more about that. What will be different which will make it more fun or more exciting next year?
hard/ difficult/easy	tell me a bit more about that . In what ways will it be harder? How do you feel about it being harder?
danger/chemicals	How do you feel about it being more dangerous/using chemicals? What makes you think it will be dangerous?
animal experiments/dissection	Could you tell me why you think this? How do you feel about it?
chemicals/liquids/powders	What sort of thing do you mean? Can you give me an example?
proper /real/ science	How do you mean? Can you explain it to me a bit more? Can you give me an example of what you mean by proper?

Ending the interview:

"Well, I think we have covered everything I needed to ask you. Thank you very much, you have been most helpful. Is there anything you would like to ask me?" ("Do you have any questions?")

After answering these - switch off the tape recorder. Any last minute confidences after the recorder is switched off should be noted down as soon as possible.

Hello. Do you remember we talked last year? You might remember that I am interested in your opinions and ideas on science. I am doing a big survey about it, and I have asked you along today so that I can hear some more of your views and ideas for my research. these interviews are totally private and nothing you say here will get back to anyone in the school or home. Most people find these interviews interesting."

Secure both respondents' permission to record the interview.

How is everything going this year?

Are you enjoying being at secondary school?

What are you enjoying and what do you not enjoy?

Could you tell me a bit about how you feel about science

How does science now compares with science last year? Do you think it is about the same or do you think it is different? In what ways is it ...the same/different?

Experiments

Do you like doing experiments? Why do you like/dislike it?
Why do you do experiments?
Why do scientists do experiments?

Writing

How do you feel about the writing in science? Why do you think that?
Order/words/remembering/understanding

Do you work in groups? Who do you work with? All boys/girls?
Does it make a difference whether you work/sit with boys or girls
Are there any subjects where you would get on better if you sat by a girl/boy

What do you think calculations are

Do you use computers in science?

Going back to how you feel about science lessons, you say you feel you don't enjoy them that much and yet you say you like doing experiments and you don't have a problem with writing so what is it that you don't like about science.
Show list.

"Well, I think we have covered everything I needed to ask you. Thank you very much, you have been most helpful. Is there anything you would like to ask me?"

I don't like science because:

Science doesn't teach you about the real world

It's difficult to understand

Science does harm to the world

My family aren't interested in science

TV programmes have put me off science

Its a boy's/girl's subject

My family don't help me with my science homework

Science won't help me to get a job

It's hard to do the writing

I like science because:

It teaches you about the real world

Its easy to understand

Science is helpful to the world

My family areinterested in science

TV programmes make science more interesting

Its a boy's/girl's subject

My family help me with science homework

It will help me to get a job

It's easy to do the writing

3.9 TEACHERS' INTERVIEW SCHEDULE

Welcome and thank the respondent. Introduce yourself. Seat respondent, offer refreshments.

"Well, as you may have been told already, today I am conducting some discussions about people's opinions on science. I am involved in a major survey on this topic, and I have asked you along today so that I can benefit from your views and experiences in my research. The interviews are entirely private and confidential, your name will not be linked to anything you say here. Most people find these interviews very interesting."

Secure respondent's permission to record the interview on tape.

Introductory question: Would you begin by telling me something about how you came to be teaching in this school?

Q2 Could you give me your impressions of how teaching science in schools is going now, compared to the past, before the introduction of the National Curriculum?

Q3 In what ways would you say you are most affected by National Curriculum Science?

Q4 Could we turn now to the questionnaire which you completed for me last term. I realise that it may be quite difficult to express your views fully when given a few set choices / tick boxes. Would you like to take this opportunity to talk more about your approach to teaching science and your view of science. If you would like to have a copy of the original questionnaire I have one here.

Prompt: Some people say that it's important that children learn the facts of science but others say that the processes, skills, methods of science are most important. What do you think?

Prompt: Do you think that science should be taught in a social, moral or ethical context?

Prompt: Some people say that science should be represented as tentative and changing but others say it should be shown as objective and true. How do you think it should be represented to children.

Prompt: How do you think investigations contribute to children's understanding of science and how scientists work?

Q5 Finally could we review the children whom I will be interviewing today. Could you give me your impressions of them. Their ability and their attitude to school and science.

Go through the list of children

_____

_____

_____

_____

_____

_____

Ending the interview:

"Well, I think we have covered everything I needed to ask you. Thank you very much, you have been most helpful. Is there anything you would like to ask me?"

After answering these - switch off the tape recorder. Any last minute confidences after the recorder is switched off should be noted down as soon as possible.

3.10 CHILDREN'S QUESTIONNAIRE

HOW TO COMPLETE THIS QUESTIONNAIRE

Read through each sentence, then see if you agree or not with what has been said. When you have decided, put a tick to show what you feel.

Examples: *Look at the sentences below.*

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like ice cream	✔					

(I like ice cream a lot so I have ticked "Strongly agree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like cleaning shoes				✔		

(I don't like cleaning shoes much but I don't strongly disagree, so I have ticked "Disagree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like rainy weather			✔			

(Sometimes I like rainy weather and sometimes I don't, so I have ticked "Undecided")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
Dogs like rainy weather						✔

(I don't know about this one so I have ticked "Don't know")

continued on next page

ABOUT SCHOOL

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I enjoy everything about school	☐	☐	☐	☐	☐	☐	(6)
I am bored most of the time at school	☐	☐	☐	☐	☐	☐	(7)
There are lots of school subjects I don't like	☐	☐	☐	☐	☐	☐	(8)
I get good marks for my work	☐	☐	☐	☐	☐	☐	(9)
I always work as hard as I can at school	☐	☐	☐	☐	☐	☐	(10)
I always behave badly at school	☐	☐	☐	☐	☐	☐	(11)
School is not very enjoyable	☐	☐	☐	☐	☐	☐	(12)

continued on next page

ABOUT SCIENCE

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I look forward to science lessons	☐	☐	☐	☐	☐	☐	(13)
Science is more interesting when we use computers	☐	☐	☐	☐	☐	☐	(14)
The calculations we do in science are difficult	☐	☐	☐	☐	☐	☐	(15)
I don't like science lessons	☐	☐	☐	☐	☐	☐	(16)
Science has ruined the environment	☐	☐	☐	☐	☐	☐	(17)
There are too many facts to learn in science	☐	☐	☐	☐	☐	☐	(18)
Using a computer makes science so interesting I don't want to stop	☐	☐	☐	☐	☐	☐	(19)
There are too many new words to learn in science	☐	☐	☐	☐	☐	☐	(20)
I like doing experiments	☐	☐	☐	☐	☐	☐	(21)
When I use a computer in science I understand things better	☐	☐	☐	☐	☐	☐	(22)
I already know the science my teacher teaches us	☐	☐	☐	☐	☐	☐	(23)

continued on next page

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
Scientific discoveries do more harm than good	☐	☐	☐	☐	☐	☐	(24)
I'm not always sure how to write about experiments I have done	☐	☐	☐	☐	☐	☐	(25)
The ideas we learn about in science are too easy	☐	☐	☐	☐	☐	☐	(26)
Doing experiments in science is a waste of time	☐	☐	☐	☐	☐	☐	(27)
I like doing calculations in science	☐	☐	☐	☐	☐	☐	(28)
Science is difficult when it involves writing	☐	☐	☐	☐	☐	☐	(29)
I enjoy going to science lessons	☐	☐	☐	☐	☐	☐	(30)
There are too many new ideas to learn about in science	☐	☐	☐	☐	☐	☐	(31)
I don't understand the calculations we do in science	☐	☐	☐	☐	☐	☐	(32)
Science is our worst enemy	☐	☐	☐	☐	☐	☐	(33)
I already know most of the science we have done this year	☐	☐	☐	☐	☐	☐	(34)
Writing about why I did an experiment is difficult	☐	☐	☐	☐	☐	☐	(35)

continued on next page

ABOUT SCIENCE LESSONS

	Every lessons	More than half our lessons	Half our lessons	Less than half our lessons	Never	Don't know	
We use textbooks	☐	☐	☐	☐	☐	☐	(36)
We use library books	☐	☐	☐	☐	☐	☐	(37)
We copy the teacher's notes from the board or worksheet	☐	☐	☐	☐	☐	☐	(38)
We make up our own experiments and the teacher helps us to make a plan to do them	☐	☐	☐	☐	☐	☐	(39)
We choose the topics we want to study	☐	☐	☐	☐	☐	☐	(40)
We talk in a group about our ideas	☐	☐	☐	☐	☐	☐	(41)
We talk to the teacher about our ideas	☐	☐	☐	☐	☐	☐	(42)
We have tests on what we have learned	☐	☐	☐	☐	☐	☐	(43)
We work in small groups to do experiments	☐	☐	☐	☐	☐	☐	(44)
We work on our own to do experiments	☐	☐	☐	☐	☐	☐	(45)
We watch the teacher do experiments	☐	☐	☐	☐	☐	☐	(46)
We use computers	☐	☐	☐	☐	☐	☐	(47)

continued on next page

ABOUT NEXT YEAR

Think about what it will be like to do science next year in Secondary school. Make a list of any things you think will be different about science next year.

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Please put the completed questionnaire in the envelope provided, seal the envelope and return it to your teacher.

the UNIVERSITY of GREENWICH

Dear Student

I am trying to find out how you feel about things you do at school, and how you feel about **science**. Your answers to this questionnaire will help me.

There are no right or wrong answers, so just put down what you feel is right for you.

Thank you very much for your help in answering my questions.

Yours sincerely

Pat Bricheno

All your answers will be kept PRIVATE

Name.....

Boy ☐ Girl ☐

School.....

Science teacher.....

List your three favourite school subjects in order:

1st favourite.....

2nd favourite.....

3rd favourite.....

HOW TO COMPLETE THIS QUESTIONNAIRE

Read through each sentence, then see if you agree or not with what has been said. When you have decided, put a tick to show what you feel.

Examples: *Look at the sentences below.*

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like ice cream	✔					

(I like ice cream a lot so I have ticked "Strongly agree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like cleaning shoes				✔		

(I don't like cleaning shoes much but I don't strongly disagree, so I have ticked "Disagree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like rainy weather			✔			

(Sometimes I like rainy weather and sometimes I don't, so I have ticked "Undecided")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
Dogs like rainy weather						✔

(I don't know about this one so I have ticked "Don't know")

continued on next page

ABOUT SCHOOL

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I enjoy everything about school	☐	☐	☐	☐	☐	☐	(6)
I am bored most of the time at school	☐	☐	☐	☐	☐	☐	(7)
There are lots of school subjects I don't like	☐	☐	☐	☐	☐	☐	(8)
I get good marks for my work	☐	☐	☐	☐	☐	☐	(9)
I always work as hard as I can at school	☐	☐	☐	☐	☐	☐	(10)
I always behave badly at school	☐	☐	☐	☐	☐	☐	(11)
School is not very enjoyable	☐	☐	☐	☐	☐	☐	(12)

continued on next page

ABOUT SCIENCE

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I look forward to science lessons	☐	☐	☐	☐	☐	☐	(13)
Science is more interesting when we use computers	☐	☐	☐	☐	☐	☐	(14)
The calculations we do in science are difficult	☐	☐	☐	☐	☐	☐	(15)
I don't like science lessons	☐	☐	☐	☐	☐	☐	(16)
Science has ruined the environment	☐	☐	☐	☐	☐	☐	(17)
There are too many facts to learn in science	☐	☐	☐	☐	☐	☐	(18)
Using a computer makes science so interesting I don't want to stop	☐	☐	☐	☐	☐	☐	(19)
There are too many new words to learn in science	☐	☐	☐	☐	☐	☐	(20)
I like doing experiments	☐	☐	☐	☐	☐	☐	(21)
When I use a computer in science I understand things better	☐	☐	☐	☐	☐	☐	(22)
I already know the science my teacher teaches us	☐	☐	☐	☐	☐	☐	(23)

continued on next page

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
Scientific discoveries do more harm than good	☐	☐	☐	☐	☐	☐	(24)
I'm not always sure how to write about experiments I have done	☐	☐	☐	☐	☐	☐	(25)
The ideas we learn about in science are too easy	☐	☐	☐	☐	☐	☐	(26)
Doing experiments in science is a waste of time	☐	☐	☐	☐	☐	☐	(27)
I like doing calculations in science	☐	☐	☐	☐	☐	☐	(28)
Science is difficult when it involves writing	☐	☐	☐	☐	☐	☐	(29)
I enjoy going to science lessons	☐	☐	☐	☐	☐	☐	(30)
There are too many new ideas to learn about in science	☐	☐	☐	☐	☐	☐	(31)
I don't understand the calculations we do in science	☐	☐	☐	☐	☐	☐	(32)
Science is our worst enemy	☐	☐	☐	☐	☐	☐	(33)
I already know most of the science we have done this year	☐	☐	☐	☐	☐	☐	(34)
Writing about why I did an experiment is difficult	☐	☐	☐	☐	☐	☐	(35)

continued on next page

ABOUT SCIENCE LESSONS

	Every lessons	More than half our lessons	Half our lessons	Less than half our lessons	Never	Don't know	
We use textbooks	☐	☐	☐	☐	☐	☐	(36)
We use library books	☐	☐	☐	☐	☐	☐	(37)
We copy the teacher's notes from the board or worksheet	☐	☐	☐	☐	☐	☐	(38)
We make up our own experiments and the teacher helps us to make a plan to do them	☐	☐	☐	☐	☐	☐	(39)
We choose the topics we want to study	☐	☐	☐	☐	☐	☐	(40)
We talk in a group about our ideas	☐	☐	☐	☐	☐	☐	(41)
We talk to the teacher about our ideas	☐	☐	☐	☐	☐	☐	(42)
We have tests on what we have learned	☐	☐	☐	☐	☐	☐	(43)
We work in small groups to do experiments	☐	☐	☐	☐	☐	☐	(44)
We work on our own to do experiments	☐	☐	☐	☐	☐	☐	(45)
We watch the teacher do experiments	☐	☐	☐	☐	☐	☐	(46)
We use computers	☐	☐	☐	☐	☐	☐	(47)

continued on next page

THIS YEAR AND LAST YEAR

Which school did you go to last year? .....

Who was your teacher last year? .....

How do you think science at secondary school compares with science last year at junior school. What things are the same and what things are different?

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Please put the completed questionnaire in the envelope provided, seal the envelope and return it to your teacher.

the UNIVERSITY of GREENWICH

Dear Student

I am trying to find out how you feel about things you do at school, and how you feel about **science**. Your answers to this questionnaire will help me.

There are no right or wrong answers, so just put down what you feel is right for you.

Thank you very much for your help in answering my questions.

Yours sincerely

Pat Bricheno

All your answers will be kept PRIVATE

Name.....

Boy ☐ Girl ☐

School.....

Science teacher.....

List your three favourite school subjects in order:

1st favourite.....

2nd favourite.....

3rd favourite.....

HOW TO COMPLETE THIS QUESTIONNAIRE

Read through each sentence, then see if you agree or not with what has been said. When you have decided, put a tick to show what you feel.

Examples: *Look at the sentences below.*

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like ice cream	✓					

(I like ice cream a lot so I have ticked "Strongly agree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like cleaning shoes				✓		

(I don't like cleaning shoes much but I don't strongly disagree, so I have ticked "Disagree")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
I like rainy weather			✓			

(Sometimes I like rainy weather and sometimes I don't, so I have ticked "Undecided")

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know
Dogs like rainy weather						✓

(I don't know about this one so I have ticked "Don't know")

continued on next page

ABOUT SCHOOL

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I enjoy everything about school	☐	☐	☐	☐	☐	☐	(6)
I am bored most of the time at school	☐	☐	☐	☐	☐	☐	(7)
There are lots of school subjects I don't like	☐	☐	☐	☐	☐	☐	(8)
I get good marks for my work	☐	☐	☐	☐	☐	☐	(9)
I always work as hard as I can at school	☐	☐	☐	☐	☐	☐	(10)
I always behave badly at school	☐	☐	☐	☐	☐	☐	(11)
School is not very enjoyable	☐	☐	☐	☐	☐	☐	(12)

continued on next page

ABOUT SCIENCE

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
I look forward to science lessons	☐	☐	☐	☐	☐	☐	(13)
Science is more interesting when we use computers	☐	☐	☐	☐	☐	☐	(14)
The calculations we do in science are difficult	☐	☐	☐	☐	☐	☐	(15)
I don't like science lessons	☐	☐	☐	☐	☐	☐	(16)
Science has ruined the environment	☐	☐	☐	☐	☐	☐	(17)
There are too many facts to learn in science	☐	☐	☐	☐	☐	☐	(18)
Using a computer makes science so interesting I don't want to stop	☐	☐	☐	☐	☐	☐	(19)
There are too many new words to learn in science	☐	☐	☐	☐	☐	☐	(20)
I like doing experiments	☐	☐	☐	☐	☐	☐	(21)
When I use a computer in science I understand things better	☐	☐	☐	☐	☐	☐	(22)
I already know the science my teacher teaches us	☐	☐	☐	☐	☐	☐	(23)

continued on next page

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Don't know	
Scientific discoveries do more harm than good	☐	☐	☐	☐	☐	☐	(24)
I'm not always sure how to write about experiments I have done	☐	☐	☐	☐	☐	☐	(25)
The ideas we learn about in science are too easy	☐	☐	☐	☐	☐	☐	(26)
Doing experiments in science is a waste of time	☐	☐	☐	☐	☐	☐	(27)
I like doing calculations in science	☐	☐	☐	☐	☐	☐	(28)
Science is difficult when it involves writing	☐	☐	☐	☐	☐	☐	(29)
I enjoy going to science lessons	☐	☐	☐	☐	☐	☐	(30)
There are too many new ideas to learn about in science	☐	☐	☐	☐	☐	☐	(31)
I don't understand the calculations we do in science	☐	☐	☐	☐	☐	☐	(32)
Science is our worst enemy	☐	☐	☐	☐	☐	☐	(33)
I already know most of the science we have done this year	☐	☐	☐	☐	☐	☐	(34)
Writing about why I did an experiment is difficult	☐	☐	☐	☐	☐	☐	(35)

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ABOUT SCIENCE LESSONS

	Every lessons	More than half our lessons	Half our lessons	Less than half our lessons	Never	Don't know	
We use textbooks	☐	☐	☐	☐	☐	☐	(36)
We use library books	☐	☐	☐	☐	☐	☐	(37)
We copy the teacher's notes from the board or worksheet	☐	☐	☐	☐	☐	☐	(38)
We make up our own experiments and the teacher helps us to make a plan to do them	☐	☐	☐	☐	☐	☐	(39)
We choose the topics we want to study	☐	☐	☐	☐	☐	☐	(40)
We talk in a group about our ideas	☐	☐	☐	☐	☐	☐	(41)
We talk to the teacher about our ideas	☐	☐	☐	☐	☐	☐	(42)
We have tests on what we have learned	☐	☐	☐	☐	☐	☐	(43)
We work in small groups to do experiments	☐	☐	☐	☐	☐	☐	(44)
We work on our own to do experiments	☐	☐	☐	☐	☐	☐	(45)
We watch the teacher do experiments	☐	☐	☐	☐	☐	☐	(46)
We use computers	☐	☐	☐	☐	☐	☐	(47)

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THIS YEAR AND LAST YEAR

Which school did you go to last year ?.....

Who was your science teacher last year ? .....

How do you feel about science this year compared to last year ?

What things are the same and what things are different ?

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Please put the completed questionnaire in the envelope provided, seal the envelope and return it to your teacher.

3.11 TEACHERS' QUESTIONNAIRE

APPROACHES TO SCIENCE TEACHING

A study being carried out by
the School of Education
the
University
of
Greenwich

Dear Colleague

I am trying to find out what you regard as important in your **science** teaching and I am also interested in your views about the nature of science. Although I need your name, in case I need to do some follow-up work, your answers will be kept private and no-one will be identified individually. Thank you very much for your time and help in completing my questionnaire.

Pat Bricheno (the University of Greenwich)

All your answers will be treated as CONFIDENTIAL

School.....

Name.....

BIOGRAPHICAL DETAILS

Please tick where appropriate

Male ☐ **Female** ☐ (3)

Length of teaching employment:

Up to 5 yrs ☐
6-10 yrs ☐
11-20 yrs ☐
21-30 yrs ☐
31 or more yrs ☐ (4)

Main area of teaching:

Year 6 class ☐
primary/junior science ☐
secondary science ☐ (5)

Post of responsibility (6)

If you hold a post of responsibility please state your main area of responsibility.....
.....
.....

In-service training: (7)

INSET in the last 2 years: please indicate the general area of training and the approcimate length

Area
Science ☐
Teaching approaches ☐

Other(pleasestate.....

Length (days)
.....
.....

.....

Qualifications: (8)

One or more Science GCSE/GCE ☐

A levels (in maths or science):

Biology ☐
Chemistry ☐
Physics ☐
Mathematics ☐
Other science (please state).....

Degree:

BA ☐
BEd ☐
BSc ☐
Other (please state).....

Main subject of degree..... (9)

Non-teaching employment: (10)

Nature of employment:

.....

.....

.....

(11)

Length of employment

0-1 yr ☐
1-5 yrs ☐
6-10 yr ☐
11+ yr ☐

YOUR APPROACH TO SCIENCE TEACHING

Below is a list of approaches to science teaching. Please read the list carefully and decide how important each one is to you in your teaching of science. When you have decided tick the box which matches most closely with your view.

	Very important	Quite important	Not important	Irrelevant	
• Making the connections between science, technology and society	☐	☐	☐	☐	(12)
• Showing that science knowledge is tentative and changing	☐	☐	☐	☐	(13)
• Providing opportunities for discussions of children's own scientific ideas	☐	☐	☐	☐	(15)
• Passing on scientific knowledge	☐	☐	☐	☐	(16)
• Selecting topics and activities which the children will enjoy	☐	☐	☐	☐	(17)
• Using time to study applications of scientific concepts	☐	☐	☐	☐	(18)
• Supplementing the curriculum with challenging problems	☐	☐	☐	☐	(19)
• Using the curriculum content to illustrate the processes of science	☐	☐	☐	☐	(20)
• Ensuring sound knowledge of theoretical concepts and principles	☐	☐	☐	☐	(21)
• Helping children to construct their own explanatory models	☐	☐	☐	☐	(22)
• Providing experimental results and information which explain the natural world	☐	☐	☐	☐	(23)
• Illustrating that scientific knowledge is objective and true	☐	☐	☐	☐	(24)
• Matching materials to students level of ability	☐	☐	☐	☐	(25)
• Supplementing the curriculum with more detailed information	☐	☐	☐	☐	(26)

Please complete the following sentence to reflect your views on science teaching:

"Teaching children about science .....

Continued on next page

YOUR VIEWS ABOUT SCIENCE

Read through each sentence, then see if you agree or not with what has been said. When you have decided put atick to show what you feel.

	Strongly agree	Agree	Balanced view	Disagree	Strongly disagree	No opinion	
• The object of scientific activity is to reveal realiity	☐	☐	☐	☐	☐	☐	(27)
• Scientists have no idea of the outcome of an experiment before they do it	☐	☐	☐	☐	☐	☐	(28)
• Scientific research is economically and politically determined	☐	☐	☐	☐	☐	☐	(29)
• Science education should be more about the learning of scientific processes than thelearning of scientific facts	☐	☐	☐	☐	☐	☐	(30)
• The way scientists work is independent of morals or ethics	☐	☐	☐	☐	☐	☐	(31)
• The most valuable part of a scientific education is what remain after the facts have been forgotten	☐	☐	☐	☐	☐	☐	(32)
• Scientific theories are valid if they work	☐	☐	☐	☐	☐	☐	(33)
• New scientific knowledge is entirely the result of many new experiments and observations	☐	☐	☐	☐	☐	☐	(34)
• There is no such thing as a true scientific theory	☐	☐	☐	☐	☐	☐	(35)
• Human emotion plays no part in the creation of scientific knowledge	☐	☐	☐	☐	☐	☐	(36)
• Scientific theories describe a real external world which is independent of human perception	☐	☐	☐	☐	☐	☐	(37)
• Practical experience is not essential for the acquisition of scientific knowledge	☐	☐	☐	☐	☐	☐	(38)
• Scientific theories have changed over time simply because experimental techniques have improved	☐	☐	☐	☐	☐	☐	(39)
• "Scientific method" is transferable from one scientific investigation to another	☐	☐	☐	☐	☐	☐	(40)
• Scientists decide between theories purely by looking carefully at the results of experiments	☐	☐	☐	☐	☐	☐	(41)
• Scientific theories are as much a product of imagination and intuition as inference from experimental results	☐	☐	☐	☐	☐	☐	(42)
• Scientific knowledge is different from other kinds of knowledge in that it is more objective	☐	☐	☐	☐	☐	☐	(43)
• There are certain physical events in the universe which science can never explain	☐	☐	☐	☐	☐	☐	(44)
• Scientific knowledge is morally neutral - only the application of the knowledge is ethically determined	☐	☐	☐	☐	☐	☐	(45)
• All scientific experiments and observations are determined by existing theories	☐	☐	☐	☐	☐	☐	(46)
• Science is special because of the methodsand processes it uses	☐	☐	☐	☐	☐	☐	(47)

Please complete the following sentence to reflect your view of science:
"Science is...

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

APPENDIX 4 QUANTITATIVE DATA FROM YEARS 6 AND 7:

CHILDREN, TEACHERS AND SCHOOLS.

4.1 THE CHILDREN

4.1.1 DESCRIPTIVE DATA

Table 4-1 Numbers and proportions of pupils involved in the survey

	Primary school pupils surveyed in year 6		Secondary school pupils surveyed in year 7	
	N	%	N	%
Boys	1677	49.8	1624	50.8
Girls	1693	50.2	1575	49.2
Total	3370	100	3199	100

Table 4-2 Ethnic origins of pupils in longitudinal survey

	Ethnic origins of pupils in longitudinal survey	
	n	%
ESWI	3296	97.8
Other	35	1.0
Asian	38	1.1

Table 4-3: Pupils lost and gained during the course of the survey

	Pupils lost from primary school on transfer		Pupils gained at secondary school on transfer	
	N	%	N	%
Boys	559	50.3%	505	53.7%
Girls	553	49.7%	436	46.3%
Total	1112	100	941	100

Some children took part in the second survey although they were not involved in the first survey. These children had come into the secondary schools from primary schools that were not part of the study. The numbers of boys and girls were similar, and the number of children added was quite similar to the number lost.

These losses and gains allowed checks to be made concerning two of the problems of longitudinal surveys: the effects of attrition and of repeated measurements. Independent sample t- tests were used to compare the year 6 responses of the lost group with those of the continuing group; there were no significant differences between these two groups. Thus, the 'lost' group was not

significantly different from the continuing group, and so bias was unlikely to have been introduced by this attrition. Similarly, the year 7 responses of the 'gained' group were compared with those of the continuing group to look for the effect of repeated use of the questionnaire; again independent t-tests showed no significant differences between the two groups, with the possible exception of attitudes to schoolwork (but this sub-scale had a low reliability). Thus, the repeated use of the questionnaire did not appear to introduce any significant bias.

Table 4-4 Group Statistics for cross-sectional & longitudinal samples in year 6

	Group	N	Mean	Std. Deviation	Std. Error Mean
Enjoyment of science in year 6	Cross-sectional	944	4.12	.72	.02
	Longitudinal	1883	4.07	.74	.02
Difficulty of science writing in year 6	Cross-sectional	962	3.01	.86	.03
	Longitudinal	1912	3.07	.88	.02
Difficulty of science in year 6	Cross-sectional	886	.10	2.72	.09
	Longitudinal	1807	-.10	2.69	.06
Attitude to computers in science in year 6	Cross-sectional	871	3.69	.94	.03
	Longitudinal	1650	3.68	.94	.02
View of progression in year 6	Cross-sectional	891	3.66	.78	.03
	Longitudinal	1764	3.68	.75	.02
Enjoyment of school in year 6	Cross-sectional	923	3.61	.77	.03
	Longitudinal	1851	3.57	.78	.02
Enjoyment of schoolwork in year 6	Cross-sectional	858	3.92	.67	.02
	Longitudinal	1710	3.88	.64	.02

Table 4-5 Group Statistics for cross-sectional & longitudinal samples in year 7

	Group	N	Mean	Std. Deviation	Std. Error Mean
Enjoyment of science in year 7	Cross-sectional	857	4.00	.7449	.03
	Longitudinal	1815	3.10	.7664	.02
Difficulty of science writing in year 7	Cross-sectional	855	2.92	.8966	.03
	Longitudinal	1810	2.95	.8901	.02
Difficulty of science in year 7	Cross-sectional	866	0.18	2.8124	.10
	Longitudinal	1755	0.07	2.8077	.07
Attitude to computers in science in year 7	Cross-sectional	558	3.01	.9353	.04
	Longitudinal	1403	3.11	.9273	.02
View of progression in year 7	Cross-sectional	836	3.61	.7862	.03
	Longitudinal	1777	3.64	.7269	.02
Enjoyment of school in year 7	Cross-sectional	839	3.27	.8549	.03
	Longitudinal	1733	3.27	.8327	.02
Enjoyment of schoolwork in year 7	Cross-sectional	792	3.91	.6371	.02
	Longitudinal	1692	3.99	.5804	.01

Table 4-6 Independent samples test for longitudinal and cross-sectional Y6 groups

	Equal variances	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Enjoyment of science in year 6	Assumed	.409	.522	1.814	2825	.070	.05	.03	.00	.11
	Not assumed			1.835	1945	.067	.05	.03	.00	.11
Difficulty of science writing in year 6	Assumed	1.222	.269	-1.747	2872	.081	-.06	.03	-.13	.01
	Not assumed			-1.757	1954	.079	-.06	.03	-.13	.01
Difficulty of science in year 6	Assumed	.174	.677	1.789	2691	.074	.20	.11	-.02	.41
	Not assumed			1.782	1742	.075	.20	.11	-.02	.42
Attitude to computers in science in year 6	Assumed	.066	.797	.177	2519	.859	.01	.04	-.07	.08
	Not assumed			.177	1762	.860	.01	.04	-.07	.08
View of progression in year 6	Assumed	1.449	.229	-.827	2653	.408	-.03	.03	-.09	.04
	Not assumed			-.814	1712	.416	-.03	.03	-.09	.04
Enjoyment of school in year 6	Assumed	.001	.976	1.202	2772	.229	.04	.03	-.02	.10
	Not assumed			1.205	1854	.228	.04	.03	-.02	.10
Enjoyment of schoolwork in year 6	Assumed	.757	.385	1.359	2566	.174	.04	.03	-.02	.09
	Not assumed			1.342	1659	180	.04	.03	-.02	.09

Table 4-7 Independent samples test for longitudinal and cross-sectional Y7 groups

	Equal variances	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Enjoyment of science in year 7	Assumed	1.089	.297	.105	2670	.916	.00	.03	-.06	.07
	Not assumed			.107	1723	.915	.00	.03	-.06	.06
Difficulty of science writing in year 7	Assumed	.040	.841	-.765	2663	.444	-.03	.04	-.10	.04
	Not assumed			-.763	1664	.446	-.03	.04	-.10	.04
Difficulty of science in year 7	Assumed	.010	.920	2.170	2619	.030	.25	.12	.02	.48
	Not assumed			2.168	1720	.030	.25	.12	.02	.48
Attitude to computers in science in year 7	Assumed	.058	.809	-2.057	1959	.040	-.10	.05	-.19	.00
	Not assumed			-2.049	1016	.041	-.10	.05	-.19	.00
View of progression in year 7	Assumed	8.143	.004	-1.186	2611	.236	-.04	.03	-.10	.02
	Not assumed			-1.153	1526	.249	-.04	.03	-.10	.03
Enjoyment of school in year 7	Assumed	1.598	.206	-.098	2570	.922	.00	.04	-.07	.07
	Not assumed			-.097	1619	.923	.00	.04	-.07	.07
Enjoyment of schoolwork in year 7	Assumed	11.596	.001	-3.057	2482	.002	-.08	.03	-.13	-.03
	Not assumed			-2.956	1424	.003	-.08	.03	-.13	-.03

4.1.1 QUESTIONNAIRE RESPONSES

Table 4-8: Year 6 & 7 responses to school attitude items

Item	Year	Boys						Girls					
			SA	A	U	D	SD		SA	A	U	D	SD
		N	%	%	%	%	%	N	%	%	%	%	%
I enjoy everything about school	Primary	1562	6.9	28.2	33.1	25.6	6.1	1597	9.6	35.2	35.0	17.7	2.4
	Secondary	938	2.2	18.7	28.5	38.1	12.6	950	2.8	23.7	30.3	37.2	6.0
I am bored most of the time at school	Primary	1592	6.5	13.8	15.5	44.2	20.0	1603	2.4	8.6	12.5	52.3	24.1
	Secondary	952	6.4	15.7	17.3	43.6	17.0	957	2.8	12.2	17.8	51.0	16.2
There are lots of school subjects I don't like	Primary	1575	6.1	19.2	16.6	40.8	17.3	1583	3.0	15.4	14.2	48.6	18.8
	Secondary	952	7.4	26.2	15.4	37.1	14.0	961	5.1	22.3	14.7	43.9	14.0
I get good marks for my work	Primary	1418	10.7	41.5	33.4	9.4	5.0	1397	7.7	44.5	37.9	8.1	1.9
	Secondary	884	9.8	50.3	30.4	6.7	2.7	898	7.7	57.0	28.5	5.6	1.2
I always work as hard as I can at school	Primary	1584	25.0	38.1	19.4	13.6	3.9	1626	31.0	47.7	13.5	6.8	1.0
	Secondary	943	23.5	43.2	19.9	11.3	2.0	965	28.9	49.6	14.0	6.8	.6
I always behave badly at school	Primary	1553	2.8	3.5	12.8	37.7	43.1	1603	.8	1.3	5.7	34.6	57.6
	Secondary	944	1.7	2.5	9.4	37.4	48.9	963	.3	.6	3.8	35.5	59.7
School is not very enjoyable	Primary	1583	9.2	11.9	17.1	33.3	28.6	1618	4.4	8.6	13.3	42.3	31.5
	Secondary	947	11.6	17.7	20.3	32.3	18.1	950	5.4	11.9	22.6	41.8	18.3

Table 4-9: Year 6 & 7 responses to science attitude items

Item	Year	Boys						Girls					
		N	SA %	A %	U %	D %	SD %	N	SA %	A %	U %	D %	SD %
I look forward to science lessons	Primary	1583	31.6	37.8	17.1	9.4	4.1	1605	16.8	41.1	25.4	12.5	4.2
	Secondary	940	17.1	41.8	22.6	13.2	5.3	960	11.0	38.8	28.6	16.0	5.5
Science is more interesting when we use computers	Primary	1476	43.8	29.3	12.1	10.5	4.4	1444	27.6	36.6	19.1	13.6	3.0
	Secondary	807	24.9	21.9	23.2	22.3	7.7	774	10.6	30.1	29.3	25.2	4.8
The calculations we do in science are difficult	Primary	1399	7.8	28.7	37.2	19.7	6.5	1350	4.7	21.6	47.3	22.4	3.9
	Secondary	917	6.4	26.9	36.4	25.4	4.8	897	4.2	21.5	43.0	27.3	3.9
I don't like science lessons	Primary	1615	4.6	6.9	11.3	35.0	42.2	1622	4.4	8.5	15.4	41.6	30.1
	Secondary	961	5.2	7.8	15.6	35.9	35.5	977	4.2	10.5	14.9	41.1	29.2

Table 4-9 continued

Item	Year	Boys						Girls					
		N	SA %	A %	U %	D %	SD %	N	SA %	A %	U %	D %	SD %
Science has ruined the environment	Primary	1399	6.9	10.8	27.6	24.7	30.1	1329	5.0	9.9	31.2	28.9	25.0
	Secondary	871	6.9	10.2	27.2	26.4	29.3	870	3.7	6.7	32.3	31.8	25.5
There are too many facts to learn in science	Primary	1539	10.9	28.7	23.8	25.8	10.9	1547	7.3	26.6	27.9	29.8	8.3
	Secondary	937	9.8	29.3	24.3	27.3	9.2	945	6.2	31.5	24.9	30.4	7.0
Using a computer makes science so interesting I don't want to stop	Primary	1441	34.8	24.6	18.4	15.4	6.8	1418	20.4	27.9	22.9	21.3	7.5
	Secondary	786	16.0	19.3	26.8	25.7	12.1	760	7.9	14.1	33.4	31.8	12.8
There are too many new words to learn in science	Primary	1530	12.4	35.9	21.6	21.8	8.4	1527	9.5	32.4	25.8	26.8	5.6
	Secondary	958	13.5	34.6	19.4	25.5	7.1	956	9.1	36.2	20.9	29.0	4.8
I like doing experiments	Primary	1645	64.9	24.7	4.4	2.4	3.5	1649	52.9	36.6	5.3	2.7	2.4
	Secondary	975	74.8	19.6	2.3	1.3	2.1	986	58.0	33.8	4.0	2.0	2.2
When I use a computer in science I understand things better	Primary	1409	27.5	37.4	20.2	10.3	4.5	1328	18.8	35.2	28.8	13.5	3.7
	Secondary	749	15.2	26.6	37.1	15.9	5.2	724	7.7	20.4	47.7	18.5	5.7
I already know the science my teacher teaches us	Primary	1500	4.5	12.1	27.8	33.5	22.1	1484	3.0	9.5	26.9	40.6	20.0
	Secondary	931	4.2	9.9	29.4	38.2	18.3	945	3.5	8.8	27.2	45.9	14.6
Scientific discoveries do more harm than good	Primary	1351	7.3	12.7	37.9	25.8	16.3	1254	4.5	9.5	51.1	24.2	10.7
	Secondary	859	4.5	10.6	43.1	29.8	12.0	816	3.6	8.0	53.9	28.9	5.6
I'm not always sure how to write about experiments I have done	Primary	1599	12.1	45.2	18.2	18.9	5.6	1618	7.8	46.8	18.9	20.5	6.0
	Secondary	958	9.6	44.6	15.9	23.9	6.1	965	6.8	43.2	16.0	28.9	5.1
The ideas we learn about in science are too easy	Primary	1569	3.7	6.6	17.5	51.1	21.1	1586	1.9	4.9	21.7	56.4	15.2
	Secondary	952	2.3	4.5	20.4	56.6	16.2	952	1.4	3.8	19.0	63.0	12.8
Doing experiments is a waste of time	Primary	1621	3.1	2.6	5.1	26.5	62.7	1631	2.0	1.5	5.9	37.0	53.5
	Secondary	969	1.1	1.5	4.6	26.3	66.4	975	.8	1.7	4.9	34.3	58.3
I like doing calculations in science	Primary	1408	12.6	30.5	27.8	18.3	10.7	1356	8.0	27.9	37.7	18.0	8.4
	Secondary	901	5.8	21.5	32.2	25.4	15.1	879	4.0	15.4	42.1	27.1	11.5
Science is difficult when it involves writing	Primary	1584	13.5	22.3	20.1	33.6	10.4	1597	5.9	17.7	21.6	41.3	13.4
	Secondary	955	11.7	20.6	22.4	33.7	11.5	958	4.7	12.2	20.5	46.8	15.9
I enjoy going to science lessons	Primary	1568	33.7	37.6	16.4	7.0	5.4	1565	25.8	39.7	21.0	8.3	5.2
	Secondary	952	25.9	35.5	21.2	10.3	7.0	964	20.0	39.0	22.0	12.1	6.8
There are too many new ideas to learn about in science	Primary	1524	10.8	26.3	24.9	27.2	10.8	1501	6.2	25.0	28.5	32.4	7.9
	Secondary	932	8.6	25.6	24.4	32.4	9.0	925	4.4	26.7	26.5	35.2	7.1

Table 4-9 continued

Item	Year	Boys						Girls					
		N	SA %	A %	U %	D %	SD %	N	SA %	A %	U %	D %	SD %
I don't understand the calculations we do in science	Primary	1382	8.8	18.5	30.2	31.7	10.8	1326	5.7	17.2	39.8	29.9	7.4
	Secondary	898	5.7	13.8	32.7	37.4	10.4	865	4.3	14.7	38.8	34.6	7.6
Science is our worst enemy	Primary	1570	5.9	4.9	10.3	25.2	53.8	1585	4.7	4.9	13.2	33.8	43.4
	Secondary	935	6.8	5.2	11.9	25.5	50.6	945	4.4	5.3	13.3	33.8	43.2
I already know most of the science we have done this year	Primary	1490	5.2	14.8	20.8	39.5	19.7	1480	3.4	11.7	21.5	45.4	18.0
	Secondary	941	4.7	16.0	23.0	38.5	17.9	951	2.9	16.5	19.7	46.3	14.6
Writing about why I did an experiment is difficult	Primary	1539	14.0	31.6	22.2	21.7	10.4	1551	7.5	27.4	25.7	29.7	9.7
	Secondary	944	12.9	27.4	23.6	28.1	7.9	940	7.1	28.4	22.0	33.3	9.1

Table 4-10: Year 6 & 7 responses to classroom activity items

Item	Year	Boys %						Girls %					
		N	Never	Less than half lessons	Half of lessons	More than half lessons	Every lesson	N	Never	Less than half lessons	Half of lessons	More than half lessons	Every lesson
We use text books	Primary	1353	47.2	17.5	16.6	11.7	7.1	1356	52.9	17.1	14.7	8.9	6.3
	Secondary	921	3.8	27.3	21.6	29.0	18.3	943	4.7	27.7	22.9	29.4	15.4
We use library books	Primary	1377	19.1	40.2	22.2	12.6	5.9	1387	16.5	41.8	24.9	12.3	4.5
	Secondary	820	70.2	26.3	2.1	1.2	.1	813	69.7	25.8	2.7	1.2	.5
We copy the teacher's notes from the board or worksheet	Primary	1509	13.5	26.4	27.2	18.2	14.7	1510	12.8	29.1	29.1	17.4	11.6
	Secondary	948	2.4	19.2	24.9	28.2	25.3	959	2.2	24.3	25.1	26.9	21.5
We make up our own experiments and the teacher helps us to make a plan to do them	Primary	1362	37.0	25.3	16.2	12.8	8.7	1333	37.4	28.0	16.3	12.3	6.1
	Secondary	887	62.1	18.9	9.5	7.8	1.7	851	61.9	21.3	9.5	5.5	1.8
We choose the topics we want to study	Primary	1476	82.7	9.3	3.7	1.6	2.6	1446	81.1	11.8	4.3	1.6	1.2
	Secondary	903	92.6	5.5	1.0	.3	.6	901	94.2	4.2	1.0	.4	.1
We talk in a group about our ideas	Primary	1523	6.6	24.4	25.1	20.0	23.8	1536	6.4	25.5	27.1	17.4	23.4
	Secondary	916	13.4	27.5	25.7	19.3	14.1	908	9.7	33.0	25.0	18.7	13.5
We talk to the teacher about our ideas	Primary	1506	5.9	21.2	19.4	22.0	31.5	1517	5.6	23.5	22.8	20.3	27.8
	Secondary	907	10.1	23.7	23.5	23.6	19.1	897	8.6	27.3	24.6	20.3	19.2
We have tests on what we have learned	Primary	1356	21.8	34.4	18.1	14.4	11.2	1320	23.3	37.0	18.8	11.7	9.2
	Secondary	873	2.2	48.3	25.3	16.5	7.7	892	2.1	45.5	29.0	16.8	6.5
We work in small groups to do experiments	Primary	1502	5.1	16.6	24.2	24.6	29.4	1505	5.0	17.4	26.3	25.0	26.2
	Secondary	950	2.0	8.1	18.9	35.8	35.2	961	.9	8.3	18.5	41.1	31.1
We work on our own to do experiments	Primary	1479	44.6	27.5	14.5	8.6	4.9	1433	44.5	31.5	15.1	5.8	3.0
	Secondary	911	56.8	28.6	8.1	5.4	1.1	930	58.9	28.7	6.6	4.2	1.6
We watch the teacher do experiments	Primary	1471	30.2	30.1	16.5	11.4	11.9	1470	27.8	35.8	16.9	9.3	10.1
	Secondary	944	6.0	31.0	25.7	22.1	15.0	950	7.2	28.2	25.3	25.3	14.1
We use computers	Primary	1462	32.9	33.0	16.6	11.5	6.1	1439	33.4	33.3	17.8	10.8	4.7
	Secondary	896	72.9	21.5	3.5	2.0	.1	915	74.4	20.5	3.7	1.2	.1

4.2 TEACHERS

4.2.1 DESCRIPTIVE DATA

Table 4-11 Response rate for the teachers' questionnaire

Returns by main area of teaching	Primary		Secondary science	
	Count	%	Count	%
Initial returns	122	67.8	167	67.3
Returned after follow-up letter	17	9.4	24	9.7
Not returned	41	22.8	57	23.0
Response rate	139	77.2	191	77.0

Table 4-12 Number of teachers by gender and sector of teaching

Gender	Primary		Secondary science	
	n	%	n	%
Male	41	29.50	115	60.53
Female	98	70.50	75	39.47
Total	139	100.00	190	100.00

Table 4-13 Length of teaching employment

Length teaching employment	Primary		Secondary science	
	n	%	n	%
Up to 5 years	34	24.5	64	33.7
6 -1 0 years	18	12.9	27	14.2
11 - 20 years	42	30.2	47	24.7
21 - 30 years	38	27.3	42	22.1
31 or more years	7	5.0	10	5.3

Table 4-14 Responsibilities held

Post of responsibility	Primary		Secondary science	
	n	%	n	%
None	17	12.4	66	35.5
Primary science coordinator/secondary science responsibility	60	43.8	22	11.8
Maths/IT coordinator	21	15.3	2	1.1
Deputy head	21	15.3	6	3.2
Head	1	.7	1	.5
Other responsibility	17	12.4	64	34.4
Head of secondary science department			25	13.4

Table 4-15 Non-teaching employment

Non teaching employment	Primary		Secondary science	
	n	%	n	%
Science employment	8	4.47	46	24.08
Non-science employment	48	26.82	56	29.32
No other employment	123	68.7	89	46.6
Total	179	100	191	100

Table 4-16 INSET received in last five years

In-service training	Primary		Secondary science	
	n	%	n	%
Science - 20 days	6	4.4		
Science - 10 days	4	2.9	7	3.8
Science - 5 -9 days	2	1.5	19	10.4
Science - 4 days or less	31	22.6	103	56.3
Other training	68	49.6	35	19.1
None	26	19.0	19	10.4

Table 4-17 Science INSET received in last five years

INSET	Primary		Secondary science	
	n	%	n	%
Science INSET	43	31.39	129	70.49
No science INSET	94	68.61	54	29.51

Table 4-18 Highest qualification

Highest qualification	Primary		Secondary science	
	n	%	n	%
GCSE/GCE	5	3.6	1	.5
A-levels	4	2.9	3	1.6
Subject diploma	4	2.9	4	2.1
B Ed	29	21.0	2	1.0
Degree	83	60.1	162	84.8
Higher degree	13	9.4	19	9.9

Table 4-19 Highest science qualification

Highest science qualification	Primary		Secondary science	
	n	%	n	%
None	33	23.91	0	0
GCE/GCSE	72	52.17	3	1.57
A Levels	12	8.70	12	6.28
B Ed	12	8.70	14	7.33
Degree	8	5.80	144	75.39
Higher degree	1	0.72	18	9.42

Table 4-20 Subject of highest science qualification

Subject of highest science qualification	Primary		Secondary science	
	n	%	n	%
None	32	23.2	1	.5
General science	74	53.6	11	5.9
Biological	17	12.3	81	43.1
Chemistry/biochemistry	8	5.8	58	30.9
Geology	4	2.9	2	1.1
Physics	3	2.2	35	18.6
Total	138	100.0	188	100.0

4.2.2 QUESTIONNAIRE DATA

Table 4-21 Responses to section two of the teachers questionnaire

	Questionnaire items	Sig.	Sector	n	Very important	Quite important	Not important	Irrelevant	No response
					%	%	%	%	n
12	Making the connections between science, technology and society	ns	Primary	136	46.32	50.74	2.94		3
			Secondary	189	56.61	40.74	2.65		2
13	Showing that science knowledge is tentative and changing	ns	Primary	135	31.11	57.78	10.37	0.74	4
			Secondary	186	25.81	63.44	10.75		5
15	Providing opportunities for discussions of children's own scientific ideas	**	Primary	138	76.09	23.91			1
			Secondary	191	56.02	42.41	1.57		0
16	Passing on scientific knowledge	**	Primary	136	37.50	60.29	2.21		3
			Secondary	191	68.59	30.89	0.52		0
17	Selecting topics and activities which the children will enjoy	*	Primary	135	65.93	32.59	0.74	0.74	4
			Secondary	190	55.79	39.47	2.63	1.58	1
18	Using time to study applications of scientific concepts	ns	Primary	135	25.19	62.96	10.37	1.48	4
			Secondary	188	26.06	69.15	4.79		3
19	Supplementing the curriculum with challenging problems	ns	Primary	137	30.66	59.85	9.49		2
			Secondary	189	24.87	65.08	10.05		2
20	Using the curriculum content to illustrate the processes of science	ns	Primary	134	35.07	55.22	8.21	1.49	5
			Secondary	188	38.30	57 45	3.19	1.06	3
21	Ensuring sound knowledge of theoretical concepts and principles	**	Primary	137	25.55	54.74	18.98	0.73	2
			Secondary	190	64.74	33.16	2.11		1
22	Helping children to construct their own explanatory models	ns	Primary	137	45.26	46.72	6.57	1.46	2
			Secondary	191	41.88	49.21	8.38	0.52	0
23	Providing experimental results and information which explain the natural world	*	Primary	136	32.35	58.09	8.09	1.47	3
			Secondary	189	43.92	50.79	5.29		2
24	Illustrating that scientific knowledge is objective and true	ns	Primary	134	23.13	50.75	22.39	3.73	5
			Secondary	186	18.28	60.22	13.98	7.53	5
25	Matching materials to students level of ability	ns	Primary	138	88.41	10.14	1.45		1
			Secondary	191	86.39	13.61			0
26	Supplementing the curriculum with more detailed information	*	Primary	136	13.97	55.88	25.74	4.41	3
			Secondary	190	15.26	70.00	13.16	1.58	1

N.B. For primary teachers n=139, for secondary teachers n=191.

** Significant at the 0.01 level (2-tailed).

* Significant at the 0.05 level (2-tailed).

Table 4-22: Responses to section three of the teachers' questionnaire

		Sig.	Sector	Valid n	Strongly agree	Agree	Balanced view	Disagree	Strongly Disagree	No response
					%	%	%	%	%	n
V27	The object of scientific activity is to reveal reality	ns	Primary	120	5.83	33.33	48.33	10.83	1.67	19
			Secondary	169	7.10	40.83	40.24	9.47	2.37	22
V28	Scientists have no idea of the outcome of an experiment before they do it	*	Primary	136		1.47	24.26	56.62	17.65	3
			Secondary	189		3.70	15.87	47.62	32.80	2
V29	Scientific research is economically and politically determined	ns	Primary	129	21.71	46.51	20.93	8.53	2.33	10
			Secondary	187	22.99	50.80	20.32	5.35	0.53	4
V30	Science education should be more about the learning of scientific processes than the learning of scientific facts	**	Primary	135	30.37	44.44	20.74	3.70	0.74	4
			Secondary	188	13.30	35.11	34.57	13.83	3.19	3
V31	The way scientists work is independent of morals or ethics	**	Primary	128	1.56	13.28	24.22	46.09	14.84	11
			Secondary	187	2.14	6.42	13.90	49.20	28.34	4
V32	The most valuable part of a scientific education is what remains after the facts have been forgotten	*	Primary	122	23.77	40.98	21.31	12.30	1.64	17
			Secondary	170	15.88	37.65	25.88	15.88	4.71	21
V33	Scientific theories are valid if they work	ns	Primary	120	0.83	25.83	36.67	30.00	6.67	19
			Secondary	176	7.95	34.09	27.27	26.70	3.98	15
V34	New scientific knowledge is entirely the result of many new experiments and observations	ns	Primary	120	4.17	29.17	25.83	33.33	7.50	19
			Secondary	181	3.87	29.28	24.31	36.46	6.08	10
V35	There is no such thing as a true scientific theory	ns	Primary	86	4.65	27.91	32.56	29.07	5.81	53
			Secondary	164	10.98	25.61	27.44	28.66	7.32	27
V36	Human emotion plays no part in the creation of scientific knowledge	ns	Primary	121	1.65	9.09	9.92	61.98	17.36	18
			Secondary	180	1.11	5.00	14.44	57.22	22.22	11
V37	Scientific theories describe a real external world which is independent of human perception	ns	Primary	100	1.00	13.00	23.00	51.00	12.00	39
			Secondary	165	1.82	16.36	23.03	36.36	22.42	26
V38	Practical experience is not essential for the acquisition of scientific knowledge	ns	Primary	135	1.48	15.56	21.48	34.81	26.67	4
			Secondary	188	2.13	22.87	13.83	30.32	30.85	3
V39	Scientific theories have changed over time simply because experimental techniques have improved	ns	Primary	126	3.97	28.57	27.78	32.54	7.14	13
			Secondary	185	3.78	26.49	24.86	35.68	9.19	6
V40	'Scientific method' is transferable from one scientific investigation to another	**	Primary	130	8.46	71.54	16.92	2.31	0.77	9
			Secondary	180	23.89	62.78	10.56	2.78		11
V41	Scientists decide between theories purely by looking carefully at the results of experiments	ns	Primary	103	3.88	9.71	35.92	45.63	4.85	36
			Secondary	181	2.21	19.34	28.18	45.30	4.97	10
V42	Scientific theories are as much a product of imagination and intuition as inference from experimental results	**	Primary	122	6.56	33.61	31.97	22.13	5.74	17
			Secondary	184	16.30	47.83	18.48	13.04	4.35	7
V43	Scientific knowledge is different from other kinds of knowledge in that it is more objective	ns	Primary	127	1.57	30.71	33.86	28.35	5.51	12
			Secondary	180	4.44	36.11	31.67	22.22	5.56	11
V44	There are certain physical events in the universe which science can never explain	**	Primary	127	22.05	38.58	22.05	13.39	3.94	12
			Secondary	179	16.20	30.17	20.11	21.79	11.73	12
V45	Scientific knowledge is morally neutral – only the application of the knowledge is ethically determined	ns	Primary	118	6.78	49.15	20.34	18.64	5.08	21
			Secondary	173	13.87	42.77	15.61	20.81	6.94	18
V46	All scientific experiments and observations are determined by existing theories	ns	Primary	117		22.22	25.64	43.59	8.55	22
			Secondary	183	1.09	14.21	18.03	51.37	15.30	8
V47	Science is special because of the methods and processes it uses	ns	Primary	118	9.32	33.90	33.05	19.49	4.24	21
			Secondary	171	7.60	43.86	26.90	19.30	2.34	20

N.B. For primary teachers n=139, for secondary teachers n=191.

4.3 SCHOOLS DATA

4.3.1 DESCRIPTIVE DATA

Table 4-23 Size of school rolls

Size of roll	Primary schools		Secondary schools	
	n	%	n	%
0-100	5	6.8		
101-200	15	20.3		
201-300	28	37.8		
301-400	9	12.2		
401-500	11	14.9	2	6.1
501-600	4	5.4	3	9.1
601-700	2	2.7	4	12.1
701-800			4	12.1
801-900			1	3.0
901-1000			3	9.1
1001-1100			3	9.1
1101-1200			3	9.1
1201-1300			1	3.0
1301-1400			2	6.1
1401-1500			3	9.1
1501-1600			1	3.0
1601-1700			1	3.0
>1700			2	6.1
Total	74	100	33	100

Table 4-24 Secondary schools exam results

% of pupils in school with	5 or more A-C grades		5 or more A- G grades		1 or more A-G grade	
	n	%			n	%
0-20	2	6.1				
21-30	9	27.3				
31-40	7	21.2				
41-50	5	15.2				
51-60	3	9.1				
61-70	5	15.2				
71-80	0	0	1	3.0		
81-90	0	0	10	30.3	4	12.1
91-100	2	6.1	22	66.7	29	87.9

Table 4-25 % of children with special educational needs

Percentage of children with Special Educational Needs in the school	Primary schools		Secondary schools	
	n	%	n	%
0-10	16	21.6	10	30.3
10.1-20	35	47.3	20	60.6
20.1-30	21	28.4	2	6.1
Above 30	2	2.7	1	3.0

Table 4-26 % of free school meals

% of children in school taking free school meals	Primary schools		Secondary schools	
	n	%	n	%
0-10.00	28	37.8	14	42.4
10.01-20.00	19	25.7	12	36.4
20.01-30.00	17	23.0	6	18.2
30.01-40.00	8	10.8	1	3.0
40.01-50.00	1	1.4		
Above 50.00	1	1.4		

Table 4-27 Unauthorised absence in secondary schools

Unauthorised absences: % half days missed	n	%
.00	1	3.1
.10	7	21.9
.20	6	18.8
.40	2	6.3
.50	3	9.4
.60	1	3.1
.70	2	6.3
.80	1	3.1
1.00	1	3.1
1.10	1	3.1
1.20	1	3.1
1.30	1	3.1
1.40	1	3.1
1.60	1	3.1
1.80	1	3.1
2.20	1	3.1
2.50	1	3.1

Table 4-28 Other secondary school information

	n	%
LEA schools	10	30.3
GM schools	23	69.7
No sixth form	16	48.5
Sixth form	17	51.5
Mixed sex teaching	30	90.9
Single sex teaching	3	9.1
Non- selective school	30	90.9
Selective school	3	9.1

4.3.2 INTERVIEW DATA

Table 4-29Initial interviews

Primary schools (n=75)	Interviews n	Secondary schools (n=33)	Interviews n
Head teacher	38	Head teacher	1
Deputy head	4	Deputy head	0
Science coordinator	22	Heads of science	23
Year 6 class teacher	7	Responsibility post in science department	9
Total interviews	71	Total interviews	33

Table 4-30 Primary schools' teaching approaches

Science teaching approach	n	%
Topic-based	26	35.6
Mixed	16	21.9
Curriculum focused	12	16.4
Subject based	19	26.0
Missing	2	2.7
Total	75	100

Table 4-31 Secondary schools' science teaching approaches

	n	%
Integrated	24	72.7
Co-ordinated	2	6.1
BPC	5	15.2
Missing	2	6.1
Total	33	100.0

Table 4-32 Secondary schools' science teaching schemes

Secondary school scheme of work	n	%
Own scheme	11	31.4
Spotlight Science text book	6	17.1
Starting Science text book	5	14.3
Salters' scheme	4	11.4
Science Now text book	2	5.7
Science At Work text book	1	2.9
Active Science text book	1	2.9
Q Science text book	1	2.9
Science Companions text book	1	2.9
Understanding Science text book	1	2.9
Ginn Science text book	1	2.9
Oxford Science text book	1	2.9

Table 4-33 Use of CASE scheme in secondary schools

	n	%
CASE scheme not used	29	87.9
CASE scheme used	4	12.1
Total	33	100.0

Table 4-34 Ability grouping in science in secondary schools

Ability grouping	n	%
Mixed ability	20	60.6
Set/streamed/banded	13	39.4

Table 4-35 Primary heads' views of liaison

Primary school head teachers: views of liaison	n	%
Poor	3	4.17
Average	8	11.11
Good	38	52.78
Very good	23	31.94
Total	72	100

Table 4-36 Secondary heads' views of liaison

Secondary heads of science: views of the use of transfer information	n	%
Not used or not available	23	69.70
Some use	9	27.27
Very useful	1	3.03
Total	33	100

Table 4-37 Number of half days used for secondary induction

Number of half day sessions used for induction in secondary schools	n	%
0	1	3.33
1	8	26.67
2	14	46.67
3	1	3.33
4	5	16.67
8	1	3.33
Total	30	100

APPENDIX 5 STATISTICAL ANALYSES OF QUANTITATIVE DATA.

5.1 THE CHILDREN

5.1.1 FACTOR ANALYSIS OF QUESTIONNAIRE ITEMS

Table 5-1 Factor loadings for school items for Year 6 children

Questionnaire items		Factors	
		f1	f2
Q6	I enjoy everything about school	-0.5862	0.3117
Q7	I am bored most of the time at school	0.7520	
Q8	There are lots of school subjects I don't like	0.6914	
Q12	School is not very enjoyable	0.8004	
Q9	I get good marks for my work		0.7572
Q10	I always work as hard as I can at school		0.7318
Q11	I always behave badly at school		-0.5615

N.B. Only loadings above 0.3 are shown.

Table 5-2: Factor loadings for school items for Year 7children

Questionnaire items		Factors	
		f1	f2
Q6	I enjoy everything about school	-0.5983	
Q7	I am bored most of the time at school	0.7809	
Q8	There are lots of school subjects I don't like	0.7385	
Q12	School is not very enjoyable	0.8094	
Q9	I get good marks for my work		0.7599
Q10	I always work as hard as I can at school		0.7349
Q11	I always behave badly at school		-0.5774

N.B. Only loadings above 0.3 are shown.

Table 5-3: Factor loadings for science items for Year 6 children

Questionnaire items		Factors				
		f1	f2	f3	f4	f5
Q30	I enjoy going to science lessons	0.8250				
Q16	I don't like science lessons	-0.8145				
Q13	I look forward to science lessons	0.8105				
Q21	I like doing experiments	0.5840				
Q27	Doing experiments is a waste of time	-0.5504				
Q14	Science is more interesting when we use computers		0.8298			
Q19	Using a computer makes science so interesting I don't want to stop		0.8218			
Q22	When I use a computer in science I understand things better		0.7482			
Q20	There are too many new words to learn in science			0.7988		
Q18	There are too many facts to learn in science			0.7349		
Q31	There are too many new ideas to learn about in science			0.7289		
Q35	Writing about why I did an experiment is difficult				0.7828	
Q25	I'm not always sure how to write about experiments I have done				0.7441	
Q29	Science is difficult when it involves writing				0.7060	
Q34	I already know most of the science we have done this year					0.7990
Q23	I already know the science my teacher teaches us					0.7915
Q26	The ideas we learn about in science are too easy					0.6426

N.B. Only loadings above 0.3 are shown.

Table 5-4: Factor loadings for science items for Year 7 children.

Questionnaire items		Factors				
		f1	f2	f3	f4	f5
Q30	I enjoy going to science lessons	0.8315				
Q13	I look forward to science lessons	0.8313				
Q16	I don't like science lessons	-0.8143				
Q21	I like doing experiments	0.6434				
Q27	Doing experiments is a waste of time	-0.5996				
Q31	There are too many new ideas to learn about in science		0.7894			
Q20	There are too many new words to learn in science		0.7813			
Q18	There are too many facts to learn in science		0.7698			
Q19	Using a computer makes science so interesting I don't want to stop			0.8160		
Q14	Science is more interesting when we use computers			0.8070		
Q22	When I use a computer in science I understand things better			0.7829		
Q35	Writing about why I did an experiment is difficult				0.8194	
Q25	I'm not always sure how to write about experiments I have done				0.7922	
Q29	Science is difficult when it involves writing		0.3126		0.6496	
Q34	I already know most of the science we have done this year					0.7940
Q23	I already know the science my teacher teaches us					0.7817
Q26	The ideas we learn about in science are too easy					0.7078

Table 5-5: Factor loadings for activities items for Year 6 children.

No.	Questionnaire item	Factors			
		f1	f2	f3	f4
Q41	We talk in a group about our ideas	0.7750			
Q44	We work in small groups to do experiments	0.7499			
Q42	We talk to the teacher about our ideas	0.6594			
Q36	We use text books		0.6080		
Q47	We use computers		0.6825		
Q43	We have tests on what we have learned		0.6919		
Q45	We work on our own to do experiments			0.5989	0.3683
Q40	We choose the topics we want to study			0.6123	
Q39	We make up our own experiments and the teacher helps us to make a plan to do them			0.6569	
Q46	We watch the teacher do experiments				0.6874
Q38	We copy the teacher's notes from the board or worksheet				0.7318
Q37	We use library books	0.3285	0.3186		

N.B. Only loadings above 0.3 are shown.

Table 5-6: Factor loadings for activities items for Year 7 children.

No.	Questionnaire item	Factors				
		f1	f2	f3	f4	f5
Q41	We talk in a group about our ideas	0.8071				
Q42	We talk to the teacher about our ideas	0.7998				
Q39	We make up our own experiments and the teacher helps us to make a plan to do them	0.5072				
Q46	We watch the teacher do experiments		0.7263			
Q44	We work in small groups to do experiments		0.6089			
Q45	We work on our own to do experiments			0.7138		
Q43	We have tests on what we have learned		0.3901	0.4674		
Q40	We choose the topics we want to study	0.3745		0.4421	0.3231	
Q47	We use computers				0.7957	
Q37	We use library books				0.6024	
Q36	We use text books					0.8258
Q38	We copy the teacher's notes from the board or worksheet		0.3442			-0.5890

5.1.2 Reliability of factors

The reliability of each of the sub-scales was checked by calculating a Cronbach's α value for each of the factors. Cronbach'sα reflects the level of internal consistency of the responses to the set of items making up the sub-scales. It may be defined as follows,

$$\text{Alpha} = \frac{\text{between-subjects variance} - \text{error variance}}{\text{between-subjects variance}}$$

The larger the value of α the more reliable the scale: for good levels of reliability α should be 0.8 or above (Cramer, 1998). However the number of items in the test can also affect the value of α, as shown in the following equation,

$$\alpha = \frac{kr}{1 + (k-1)\,r}$$

where r is the average correlation between items in the index and k is the number of items in the test (Norusis, 1994).

e.g. If the average correlation between items is 0.2 on a 10 item scale, α is 0.71, but for a 25 item scale, α is 0.86.

Thus, given the small number of items used in calculating α, values of 0.7 and above were deemed to show quite good reliability of the scale. The values calculated are listed in Table 5-7 below.

Table 5-7 Internal consistency of attitude sub-scales from children's questionnaires

Attitude sub-scale	Number of items	Cronbach's α Y6	Cronbach's α Y7
Schoolwork	3	0.4894	0.5159
School enjoyment	4	0.6962	0.7509
The enjoyment of science	5	0.7818	0.8255
The difficulty of science	3	0.7035	0.7796
The use of computers in science	3	0.7282	0.7514
The difficulty of written work in science	3	0.6446	0.6929
Perceptions of continuity and progression in science	3	0.6300	0.6478
Collaborative activities	3	0.6059	0.5625
Standardised activities	3	0.4271	0.1262
Teacher-directed learning	2	0.2698	0.1953
Student directed learning	3	0.3220	0.2637

As in the pilot study the 'schoolwork' and 'continuity and progression' sub-scales had relatively low α values, and the results of further analyses involving these items will be treated with caution. The reliability of the 'attitudes to computers' sub-scale was high despite the relatively high proportions of children in each year who did not

respond to these items. Both validity and reliability are high for 'attitudes to computers' sub-scale, but it must be borne in mind that this reflects the views of a sub-set of the whole sample; approximately 84% of the children in year 6 and 67% of those in year 7).

The reliabilities of the classroom activities factors are quite low, and this is to be expected, since the frequencies of such activities will depend upon many other factors, including the teacher[1] and the scheme of work being used. However, as indicated in Chapter 4, page 208, the factors derived from the year 6 data may be a useful guide to children's perceptions of different sorts of classroom activities, and will be used in later analyses. The 'collaborative activities' factor appears to be fairly reliable, the low reliability of the other factors in this group will be taken into account when drawing conclusions from these analyses.

5.1.3 SUB-SCALES AND STANDARDISED SCORES.

As explained in Chapter 3 (page 158) the questionnaire was developed with the specific intention of producing 'attitude scores' by combining scores on individual responses from groups of items with similar meanings. The factor analysis confirmed that items designed to have similar meanings did have such meaning for the children, and the differences in responses on items within the same factor group but with slightly different wording confirmed the decision to use multiple items rather than rely on single items. The scoring of the items and the summation of items within each factor to give the sub-scale scores are described below.

---

[1] Some children had more than one teacher for science lessons, and so may have experienced classroom activities differently with each teacher.

The six-point Likert scale was scored so that the most positive response scored 5 and the most negative response scored 1. Thus positive items scored 5 for 'strongly agree' and 1 for 'strongly disagree' whereas for negative items the scores were reversed[1]. The sub-scale scores for each child were calculated by adding together their numerical score on each item within a single sub-scale. To allow for comparisons between sub-scales all were then standardised to give a minimum score of 1 and a maximum score of 5 by dividing each sub-scale score by the number of items in the sub-scale. For example, the 'attitudes to computers' sub-scale consisted of three items, 14,19 and 22, all positive.

The sub-scale score was: Item 14 + item 19 + item 22 = X

And the standardised score was: X/3

The mean values on the standardised sub-scales for primary and secondary school children are compared in Table 5-9 below. In each case the range is 1-5, where 1 indicates the least agreement with the concept, 5 indicates the most agreement, and 3 is the mid-point.

Table 5-8: Pupils' mean standardised sub-scale scores (longitudinal sample).

Sub-scale	Year 6			Year 7		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Enjoyment of science	1883	4.07	0.74	1815	4.00	.77
The difficulty of science	1807	3.03	0.90	1755	3.02	.94
The difficulty of science writing	1912	3.07	0.88	1810	2.95	.89
Attitude to computers in science	1650	3.68	0.94	1403	3.11	.93
View of progression	1764	3.68	0.75	1777	3.64	.73
Enjoyment of school	1851	3.57	0.78	1733	3.27	.83
Enjoyment of schoolwork	1710	3.88	0.64	1692	3.99	.58

[1] 'Don't know' scored 6 and 'no response' scored 0. These scores were separated out before the summation of the factor scores, and were used to show up problem areas within the questionnaire (as described on page 1-5 above) and to identify children who did not give valid answers in the survey.

Table 5-9 Pupils' mean standardised sub-scale scores (cross-sectional sample).

Sub-scale	Year 6			Year 7		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Enjoyment of science	2827	4.08	.73	2672	4.00	.76
Difficulty of science	2694	3.01	.90	2620	2.99	.94
Difficulty of science writing	2874	3.05	.87	2665	2.94	.89
Attitude to computers in science	2521	3.68	.94	1961	3.08	.93
View of progression	2655	3.67	.76	2613	3.63	.75
Enjoyment of school	2774	3.59	.78	2572	3.27	.84
Enjoyment of schoolwork	2568	3.89	.65	2484	3.96	.60

Paired t-tests were used to look for any significant similarities and differences between the attitude sub-scale scores for the longitudinal sample, in primary and secondary school (Table 5-10). The results indicate significant differences between attitudes in years 6 and 7 for all sub-scales except the 'difficulty of science' sub-scale; although the significance level for perceptions of continuity and progression is low ($p<0.05$).

Table 5-10: Paired Samples t-tests for attitude sub-scales

Paired Differences of:	Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Enjoyment of school	.2941	.8942	.0234	-.3401	-.2482	-12.551	1455	.000
Enjoyment of schoolwork	.0865	.7005	.0192	.0488	.1243	4.497	1324	.000
Enjoyment of science	-.0678	.9501	.0243	-.1154	-.0202	-2.796	1532	.005
The difficulty of science	.0183	1.0922	.0288	-.0382	.0748	.636	1436	.525
The difficulty of writing	.1081	.9945	.0252	.0587	.1575	4.294	1559	.000
Attitude to computers	-.5510	1.0804	.0332	-.6162	-.4859	-16.590	1057	.000
View of progression	.1536	2.6378	.0699	.0166	.2906	2.199	1425	.028

5.1.4 THE EFFECT OF THE CASE SCHEME ON SUB-SCALE SCORES

Table 5-11 ANOVA with enjoyment of science in Y7 as dependent variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	185.450	35	5.299	13.391	.000
Intercept	9.602	1	9.602	24.267	.000
GENDERP	3.546	1	3.546	8.961	.003
CASE	1.609	1	1.609	4.066	.044
TEACHING	3.433	2	1.717	4.338	.013
MEALSSGP	8.088	2	4.044	10.220	.000
ROLLGP	9.706	2	4.853	12.265	.000
ENJSCH7	19.208	1	19.208	48.545	.000
GROUP7	6.360	1	6.360	16.074	.000
TEACHING * ENJSCH7	2.370	2	1.185	2.995	.050
ENJSCH7 * GROUP7	3.299	1	3.299	8.337	.004
MEALSSGP * ENJSCH7	5.186	2	2.593	6.553	.001
ROLLGP * ENJSCH7	6.388	2	3.194	8.072	.000
GENDERP * CASE * MEALSSGP * ROLLGP	14.913	18	.829	2.094	.005
Error	392.516	992	.396		
Total	17454.320	1028			
Corrected Total	577.967	1027			

a R Squared = .321 (Adjusted R Squared = .297)

Table 5-12: Changes in collaborative work reported by CASE and non-CASE pupils

Reported change in frequency of collaborative work	CASE scheme not used		CASE scheme used	
	n	%	n	%
-11.00			1	.5
-10.00	1	.1	1	.5
-9.00	5	.4	2	1.1
-8.00	7	.6	1	.5
-7.00	22	1.9	10	5.4
-6.00	30	2.6	4	2.2
-5.00	52	4.5	12	6.5
-4.00	72	6.3	9	4.8
-3.00	97	8.5	14	7.5
-2.00	121	10.6	18	9.7
-1.00	148	12.9	19	10.2
.00	139	12.1	22	11.8
1.00	128	11.2	14	7.5
2.00	106	9.3	17	9.1
3.00	85	7.4	12	6.5
4.00	59	5.2	5	2.7
5.00	38	3.3	13	7.0
6.00	20	1.7	6	3.2
7.00	7	.6	3	1.6
8.00	4	.3	2	1.1
9.00	2	.2		
10.00	1	.1	1	.5
11.00	1	.1		

Table 5-13: Changes in teacher directed work reported by CASE and non-CASE pupils

Reported change in frequency of teacher directed work	CASE scheme not used		CASE scheme used	
	n	%	n	%
-7.00	1	.1		
-6.00	4	.3		
-5.00	5	.4	1	.5
-4.00	14	1.1	2	.9
-3.00	37	2.9	5	2.3
-2.00	78	6.1	11	5.0
-1.00	133	10.4	27	12.3
.00	229	17.9	24	11.0
1.00	210	16.4	30	13.7
2.00	206	16.1	40	18.3
3.00	165	12.9	30	13.7
4.00	96	7.5	20	9.1
5.00	57	4.5	14	6.4
6.00	31	2.4	7	3.2
7.00	8	.6	5	2.3
8.00	3	.2	3	1.4

Table 5-14: Descriptive statistics for CASE and non-CASE group

		N	Mean	Std. Deviation	Std. Error Mean
Reported change in frequency of collaborative work	No CASE	1145	-.3607	3.2160	.10
	CASE	186	-.4409	3.9537	.29
Reported change in frequency of teacher directed work	No CASE	1277	1.2060	2.2817	.06
	CASE	219	1.7078	2.4915	.17

Table 5-15:Independent sample t-tests for collaborative and teacher directed working with CASE and non-CASE groups

	Levene's Test for Equality of Variances			t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Reported change in frequency of teacher directed work	Equal variances assumed	2.86	.09	-2.97	1494.00	.00	-.50	.17	-.83	-.17
	Equal variances not assumed			-2.79	284.21	.01	-.50	.18	-.86	.15
Reported change in frequency of collaborative work	Equal variances assumed	13.82	.00	.30	1329.00	.76	.08	.26	-.44	.60
	Equal variances not assumed			.26	226.48	.79	.08	.31	-.52	.68

5.2 THE TEACHERS

5.2.1 FACTOR ANALYSIS OF TEACHERS' QUESTIONNAIRE ITEMS

The teachers' responses to items concerning their approaches to science teaching were subjected to factor analysis to establish groups of items relating to single constructs. The analysis was carried out using Varimax rotation and factor loadings above 0.3 are given in Table 4-35 below: four distinct factors emerged.

Table 5-16 Factor loadings for Section 2 of teachers' questionnaire

Questionnaire items	Factors			
	f1	f2	f3	f4
Ensuring sound knowledge of theoretical concepts and principles	0.7016			
Providing experimental results and information which explain the natural world	0.6669			
Passing on scientific knowledge	0.6668		-0.3533	
Illustrating that scientific knowledge is objective and true	0.6499			
Supplementing the curriculum with more detailed information	0.5433			
Making the connections between science, technology and society		0.6911		
Showing that science knowledge is tentative and changing		0.6490		
Using time to study applications of scientific concepts		0.6396		
Providing opportunities for discussions of children's own scientific ideas			0.7453	
Helping children to construct their own explanatory models			0.7448	
Selecting topics and activities which the children will enjoy				0.8258
Matching materials to students level of ability				0.6137

The items concerning teachers' views about the nature of science were next investigated. It will be recalled from Chapter 3 (Section 3.3.1.3) that there were many problems with the final section of the teachers' questionnaire during the pilot stages. The pre-service teachers had disliked the section, and many of them had found it difficult to understand some of the items. It had been hoped that when large numbers of practising teachers, including many science specialists, completed the questionnaire, these problems might be resolved. The validity and reliability of the questionnaire had also been in question at the pilot stage, but it was expected that factor analysis could be used with the main survey to validate and to check the reliability of the sub-scales. However, as we shall see below, these hopes were not entirely realised.

A number of teachers (both primary and secondary) made written comments in the margins of the questionnaire to indicate their dislike or lack of comprehension of some items, and many teachers, particularly at primary level, did not respond at all to some items[1]. Table 5-12 summarises the proportion of missing responses for

[1] In addition to these written comments, many primary school teachers remarked on this section when the questionnaires were collected from the schools. Comments such as: 'That last section was hard', or 'I didn't understand that last section' were volunteered.

each item in this section; shading has been used on 8 items, which have particularly high levels of 'missing' data (20% or more of all responses).

Table 5-17 Analysis of missing responses from section 3 of teachers' questionnaire

	Definite response		'Don't know'				No response				'missing' data	
	Primary	Secondary	Primary		Secondary		Primary		Secondary		Primary	Secondary
	n	n	n	%	n	%	n	%	n	%	%	%
V27	120	169	16	11.5	14	7.3	3	2.2	8	4.2	13.7	11.5
V28	136	189	2	1.4	0	0	1	0.7	2	1.0	2.1	1.0
V29	129	187	9	6.5	2	1.0	1	0.7	2	1.0	7.2	2.0
V30	135	188	2	1.4	2	1.0	2	1.4	1	0.5	2.8	1.5
V31	128	187	9	6.5	2	1.0	2	1.4	2	1.0	7.9	2.0
V32	122	170	14	10.1	15	7.9	3	2.2	6	3.1	12.3	11.0
V33	120	176	17	12.2	11	5.8	2	1.4	4	2.1	13.6	7.9
V34	120	181	16	11.5	7	3.7	3	2.2	3	1.6	13.7	5.3
V35	86	164	51	36.7	22	11.5	2	1.4	5	2.6	38.1	14.1
V36	121	180	16	11.5	9	4.7	2	1.4	2	1.0	12.9	5.7
V37	100	165	34	24.5	23	12.0	5	3.6	3	1.6	28.1	13.6
V38	135	188	2	1.4	0	0	2	1.4	3	1.6	2.8	1.6
V39	126	185	10	7.2	4	2.1	3	2.2	2	1.0	9.4	3.1
V40	130	180	7	5.0	6	3.1	2	1.4	5	2.6	6.4	5.7
V41	103	181	32	23.0	6	3.1	4	2.9	4	2.1	25.9	5.2
V42	122	184	15	10.8	3	1.6	2	1.4	4	2.1	14.2	3.7
V43	127	180	10	7.2	8	4.2	2	1.4	3	1.6	8.6	5.8
V44	127	179	10	7.2	9	4.7	2	1.4	3	1.6	8.6	6.3
V45	118	173	19	13.7	12	6.3	2	1.4	6	3.1	15.1	9.4
V46	117	183	20	14.4	5	2.6	2	1.4	3	1.6	15.8	4.2
V47	118	171	19	13.7	15	7.9	2	1.4	5	2.6	15.1	10.5

Clearly the items with such a high proportion of missing responses (27, 33,35,37, 41, 45, 46,and 47) cannot be included in further analysis or discussion with any confidence. There is also a distinct possibility that the whole section lacks validity in view of the proportion of 'don't know' and missing responses, and the amount of negative comment.

After exclusion of the eight items with particularly high proportion of missing or 'don't know' responses, factor analysis was carried out for the remaining items. Factor analysis of these items proved to be extremely problematic; the main difficulties were the multi-dimensional nature of many of the statements used, and a difference between the original proposed grouping of items and the teachers' groupings. Many of the items loaded fairly evenly across at least three factors

indicating that these items were not likely to be uni-dimensional, but probably represented more than one construct for the teachers' surveyed. Factor analysis of all the data from both primary and secondary teachers yielded a large number of factors, far more than the number anticipated. Furthermore, the factors bore little relation to the proposed theoretical constructs supposedly represented by each item. Nott and Wellington's original theoretical constructs (1996) used the following dichotomous scales:

- 'contextualism-decontextualism' (CD)
- 'inductivism-deductivism' (ID)
- 'process-content' (PC)
- 'relativism-positivism' (RP).
- 'intrumentalism-realism' (IR)

In the present study the items were derived from Nott and Wellington's groupings (Table 5-13) and were judged to represent the same theoretical constructs.

Table 5-18 Nature of Science constructs used in teachers' questionnaire

Nott & Wellington's theoretical constructs	Questionnaire item numbers					
CD items	29	31	36	39	41	45
ID items	28	34	42	46		
PC items	30	32	38	40	47	
RP items	35	37	39	41	43	44
IR items	27	33	35	37	44	

Further attempts at factor analysis were made, after excluding items that were multi-dimensional, using more homogeneous groups of teachers, for example: (a) secondary science specialists, (b) secondary specialists in physical sciences. However, apart from a group of items relating to the 'process-content' construct, none of these analyses simplified the number of factors to a significant extent. It was evident that factor analysis alone was unlikely to resolve this problem, and so

a more pragmatic approach was taken. First the proportion of missing responses for each construct was considered (see Tables 5-14 below).

Table 5-19: Number of missing responses for each Nature of Science construct

% missing responses for 'contextualism-decontextualism' (CD)		
Item numbers	**Primary**	**Secondary**
29	7.2	2.0
31	7.9	2.0
36	12.9	5.7
39	9.4	3.1
41	25.9	5.2
45	15.1	9.4
Average % missing responses	13.07	4.57
% missing responses for 'inductivism-deductivism' (ID)		
Item numbers	**Primary**	**Secondary**
28	2.1	1.0
34	13.7	5.3
42	14.2	3.7
46	15.8	4.2
Average % missing responses	11.45	3.55
% missing responses for 'process-content' (PC)		
Item numbers	**Primary**	**Secondary**
30	2.8	1.5
32	12.3	11.0
38	2.8	1.6
40	6.4	5.7
47	15.1	10.5
Average % missing responses	7.88	6.06
% missing responses for 'relativism-positivism' (RP).		
Item numbers	**Primary**	**Secondary**
35	38.1	14.1
37	28.1	13.6
39	9.4	3.1
41	25.9	5.2
43	8.6	5.8
44	8.6	6.3
Average % missing responses	19.78	8.02
% missing responses for 'instrumentalism-realism' (IR)		
Item numbers	**Primary**	**Secondary**
27	13.7	11.5
33	13.6	7.9
35	38.1	14.1
37	28.1	13.6
44	8.6	6.3
Average % missing responses	20.42	10.68

The most striking feature of this table is the difference in the response rates of primary and secondary teachers; apart from the 'process-content' items, primary teachers had a far higher proportion of missing responses. Since the overall response rates from primary and secondary school teachers were very similar and the response rates for the items in Section 2 were similar it seems likely that there is something significant about these differences. Perhaps the primary teachers were not able to respond because of a lack of knowledge or understanding about science, or because they had not been interested enough in science to develop their own views about the nature of science. Nevertheless, they were as likely as the secondary teachers to respond to the items about process and content. Since the process-content debate has engaged interest and debate in both sectors for a number of years perhaps primary teachers have had more opportunity to consider that specific issue. It may be that lack of opportunity to debate and consider these issues rather than lack of knowledge, understanding and interest, has caused the observed differences in the other constructs.

A large proportion of teachers in both sectors did not respond to 'instrumentalism and realism' and 'relativism-positivism' items, suggesting a possible lack of validity, and so these two groups of items were excluded from further analysis. The remaining items were then subjected to further factor analyses, but once again there was little similarity between the factors produced and the suggested groupings, apart from a small group of three items (30, 32 and 40) representing the process-content construct. Factor analysis was made list-wise throughout, and therefore only teachers responding to all items were included in analysis.

A second approach was to assume that the groupings *should* have validity because they had been judged to be valid by groups of experts (Wellington, 1997 – personal communication). Therefore, if factor analysis was carried out only for the items identified as forming a single construct, then this should produce only one factor. However, such an analysis did not produce single factors initially. In the CD group, item 29 had to be excluded, and in the ID group item 46 had to be excluded; in both cases the item excluded loaded strongly on more than one factor, suggesting multi-dimensionality. Finally, item 38 had to be excluded from the PC group of items. On the basis of these analyses, three new sub-scales could be created, representing aspects of teachers' views about the Nature of Science. The final groups of uni-dimensional items were:

- CD group: 31, 36 and 39
- ID group: 28, 34 and 42
- PC group: 32, 30 and 40

A Cronbach's α value was calculated for each of these factors (see Table 5-15); these values indicate low internal consistency for the factors.

Table 5-20: Cronbach's reliability coefficients for Teachers' Nature of Science scales

		Cronbach's α		
Factor	**Number of items**	**Primary teachers**	**Secondary teachers**	**All teachers**
CD	3	0.2578	0.3025	0.2975
PC	3	0.1880	0.4280	0.3316
ID	3	0.3724	0.2587	0.3118

5.2.2 COMPARING SUB-SCALE VALUES FOR PRIMARY AND SECONDARY TEACHERS.

Table 5-21 Average sub-scale scores from Sections 2 & 3 by teaching sector

Questionnaire section	Sub-scale	Main area of teaching	N	Mean score	Std. Deviation	Std. Error Mean
Approaches to science teaching	F1	Primary	127	10.26	2.25	.20
		Secondary	183	11.55	1.86	.14
	F2	Primary	134	5.63	.92	.08
		Secondary	185	5.69	.88	.06
	F3	Primary	137	6.12	.93	.08
		Secondary	191	5.87	.93	.07
	F4	Primary	135	6.50	.69	.06
		Secondary	190	6.35	.81	.06
Views about the Nature of Science	PC	Primary	136	2.14	.55	.05
		Secondary	190	2.36	.63	.05
	ID	Primary	137	3.41	.64	.05
		Secondary	190	3.61	.63	.05
	CD	Primary	133	3.50	.64	.06
		Secondary	190	3.69	.60	.04

Table 5-22 t-tests for sub-scale scores (Sections 2 & 3) by teaching sector

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PC	Equal variances assumed	2.86	.09	-3.24	324.00	.00	-.22	.07	-.35	-.09
ID	Equal variances assumed	.00	.95	-2.78	325.00	.01	-.20	.07	-.34	-.06
CD	Equal variances assumed	.89	.35	-2.73	321.00	.01	-.19	.07	-.33	-.05
F1	Equal variances assumed	3.48	.06	-5.51	308.00	.00	-1.29	.23	-1.75	-.83
F2	Equal variances assumed	.94	.33	-.58	317.00	.56	-.06	.10	-.26	.14
F3	Equal variances assumed	.25	.62	2.44	326.00	.02	.25	.10	.05	.46
F4	Equal variances assumed	1.11	.29	1.83	323.00	.07	.16	.09	-.01	.32

Table 5-23 Best model for ANOVA with F1 as dependent variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	162.484	8	20.311	5.176	.000
Intercept	17807.842	1	17807.842	4537.848	.000
MAINTEAC	76.778	1	76.778	19.565	.000
NONTCHGR	5.241	2	2.620	.668	.514
INSETSC	.240	1	.240	.061	.805
MAINTEAC * NONTCHGR	29.924	2	14.962	3.813	.023
INSETSC * NONTCHGR	37.229	2	18.615	4.743	.010
Error	906.512	231	3.924		
Total	31197.000	240			
Corrected Total	1068.996	239			

a R Squared = .152 (Adjusted R Squared = .123)

Table 5-24 Best model for ANOVA with ID as dependent variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	27.776	49	.567	1.718	.005
Intercept	183.704	1	183.704	556.861	.000
GENDER	.310	1	.310	.939	.334
MAINTEAC	2.165	1	2.165	6.563	.011
SCIQLUNI	.539	3	.180	.544	.652
INSETSC	.187	1	.187	.567	.452
YRSTCH2	4.295	3	1.432	4.340	.005
NONTCHGP	7.770E-02	1	7.770E-02	.236	.628
GENDER * SCIQLUNI	3.790	3	1.263	3.829	.011
MAINTEAC * SCIQLUNI	2.404	2	1.202	3.644	.028
MAINTEAC * YRSTCH2	3.876	3	1.292	3.916	.010
INSETSC * NONTCHGP	2.019	1	2.019	6.122	.014
SCIQLUNI * YRSTCH2	3.654	9	.406	1.231	.278
INSETSC * YRSTCH2	2.601	3	.867	2.628	.051
NONTCHGR	.674	2	.337	1.022	.362
GENDER * YRSTCH2	1.642	3	.547	1.659	.177
SCIQLUNI * NONTCHGR	3.030	6	.505	1.531	.170
YRSTCH2 * NONTCHGR	3.498	6	.583	1.767	.107
GENDER * MAINTEAC	.527	1	.527	1.598	.208
Error	67.628	205	.330		
Total	3326.222	255			
Corrected Total	95.403	254			

a R Squared = .291 (Adjusted R Squared = .122)

5.3 REGRESSION ANALYSES FOR YEARS 6 & 7

Table 5-25 Variables used in the regression analysis of year 6 data

Variable	Mean	Std. Deviation	N
ASIAN	.01	.12	2413
ESWI	.97	.16	2413
Gender	1.50	.50	2414
Free school meals %	17.59	11.31	2414
Number on roll	331.64	128.50	2393
Number on roll in year 6	64.13	31.30	2414
CURFOCUS	.18	.38	2327
SATS % level 4 or above in 1996 SATs tests	62.51	16.22	2380
Special educational needs % in primary school	17.59	7.30	2393
SUBJCT	.30	.46	2327
TOPIC	.27	.44	2327
F1	9.82	2.35	2178
F2	5.31	1.21	2306
F3	2.82	.91	2384
F4	2.50	.71	2360
Primary science INSET	1.33	.47	2387
QUALGP primary qualifications group	1.06	.24	2391
SCIQUGP primary science qualifications group	1.16	.37	2391
Length of non-teaching employment	1.60	1.27	1632
Length of primary teaching employment	1.66	1.21	2414
CD	3.54	.66	2318
ID	3.46	.65	2396
PC	2.16	.57	2384
Collaborative learning in year 6	7.43	2.75	2005
Standardised learning in year 6	3.65	2.42	1590
Teacher-directed learning in year 6	3.24	1.89	2036
Student-directed learning in year 6	2.49	2.03	1707
Enjoyment of school in year 6	3.61	.76	2116
Enjoyment of schoolwork in year 6	3.89	.65	1947

Table 5-26 Regression model summary for enjoyment of science in year 6

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.104	.011	.010	.7156	.011	11.537	1	1059	.001
2	.129	.017	.015	.7138	.006	6.387	1	1058	.012
3	.160	.026	.023	.7109	.009	9.758	1	1057	.002
4	.181	.033	.029	.7086	.007	7.889	1	1056	.005
5	.205	.042	.037	.7056	.009	9.990	1	1055	.002
6	.381	.145	.141	.6667	.103	127.656	1	1054	.000
7	.392	.153	.148	.6640	.008	9.703	1	1053	.002

1. Predictors: (Constant), gender
2. Predictors: (Constant), gender, Number on roll in yr 6
3. Predictors: (Constant), gender, Number on roll in yr 6, Length of non-teaching employment
4. Predictors: (Constant), gender, Number on roll in yr 6, Length of non-teaching employment, Knowledge factor for primary teachers
5. Predictors: (Constant), gender, Number on roll in yr 6, Length of non-teaching employment, Knowledge factor for primary teachers, Collaborative learning in yr 6
6. Predictors: (Constant), gender, Number on roll in yr 6, Length of non-teaching employment, Knowledge factor for primary teachers, Collaborative learning in year 6, Enjoyment of school in yr 6
7. Predictors: (Constant), gender, Number on roll in yr 6, Length of non-teaching employment, Knowledge factor for primary teachers, Collaborative learning in yr 6, Enjoyment of school in yr 6, Enjoyment of schoolwork in yr 6

Table 5-27 ANOVA for enjoyment of science in year 6

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	5.908	1	5.908	11.537	.001
	Residual	542.345	1059	.512		
	Total	548.253	1060			
2	Regression	9.163	2	4.581	8.991	.000
	Residual	539.090	1058	.510		
	Total	548.253	1060			
3	Regression	14.094	3	4.698	9.297	.000
	Residual	534.159	1057	.505		
	Total	548.253	1060			
4	Regression	18.055	4	4.514	8.990	.000
	Residual	530.198	1056	.502		
	Total	548.253	1060			
5	Regression	23.029	5	4.606	9.251	.000
	Residual	525.225	1055	.498		
	Total	548.253	1060			
6	Regression	79.769	6	13.295	29.911	.000
	Residual	468.484	1054	.444		
	Total	548.253	1060			
7	Regression	84.047	7	12.007	27.236	.000
	Residual	464.207	1053	.441		
	Total	548.253	1060			

Table 5-28 Coefficients for enjoyment of science in year 6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficient Beta	t	Sig.
1	(Constant)	4.316	.068		63.845	.000
	Gender	-.149	.044	-.104	-3.397	.001
2	(Constant)	4.431	.081		54.488	.000
	Gender	-.150	.044	-.104	-3.425	.001
	Number on roll in year 6	-1.771E-03	.001	-.077	-2.527	.012
3	(Constant)	4.365	.084		52.138	.000
	Gender	-.154	.044	-.107	-3.516	.000
	Number on roll in year 6	-2.002E-03	.001	-.087	-2.853	.004
	Length of non-teaching employment	5.400E-02	.017	.095	3.124	.002
4	(Constant)	4.612	.121		38.032	.000
	Gender	-.157	.044	-.109	-3.610	.000
	Number on roll in year 6	-1.849E-03	.001	-.080	-2.637	.008
	Length of non-teaching employment	5.762E-02	.017	.102	3.335	.001
	Knowledge factor for primary teachers	-2.618E-02	.009	-.086	-2.809	.005
5	(Constant)	4.439	.133		33.487	.000
	Gender	-.152	.043	-.105	-3.491	.001
	Number on roll in year 6	-1.799E-03	.001	-.078	-2.575	.010
	Length of non-teaching employment	5.328E-02	.017	.094	3.087	.002
	Knowledge factor for primary teachers	-2.803E-02	.009	-.092	-3.014	.003
	Collaborative learning in year 6	2.505E-02	.008	.096	3.161	.002
6	(Constant)	3.477	.151		22.960	.000
	Gender	-.227	.042	-.158	-5.461	.000
	Number on roll in year 6	-1.525E-03	.001	-.066	-2.309	.021
	Length of non-teaching employment	3.827E-02	.016	.068	2.339	.020
	Knowledge factor for primary teachers	-2.830E-02	.009	-.092	-3.220	.001
	Collaborative learning in year 6	1.920E-02	.008	.073	2.558	.011
	Enjoyment of school in year 6	.312	.028	.328	11.298	.000
7	(Constant)	3.20	.175		18.234	.000
	Gender	-.24	.042	-.169	-5.814	.000
	Number on roll in year 6	.00	.001	-.068	-2.375	.018
	Length of non-teaching employment	.04	.016	.072	2.486	.013
	Knowledge factor for primary teachers	-.03	.009	-.089	-3.091	.002
	Collaborative learning in year 6	.02	.007	.071	2.487	.013
	Enjoyment of school in year 6	.28	.030	.291	9.325	.000
	Enjoyment of schoolwork in year 6	.11	.035	.097	3.115	.002

Table 5-29 Regression model summary for difficulty of science in year 6

	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
Model					R Square Change	F Change	df1	df2	Sig. F Change
1	.074	.006	.005	.8826	.006	5.874	1	1062	.016
2	.099	.010	.008	.8811	.004	4.510	1	1061	.034
3	.120	.014	.012	.8795	.005	4.966	1	1060	.026
4	.343	.118	.114	.8324	.103	124.152	1	1059	.000

1. Predictors: (Constant), Length of non-teaching employment
2. Predictors: (Constant), Length of non-teaching employment, Length of primary teaching employment
3. Predictors: (Constant), Length of non-teaching employment, Length of primary teaching employment, Teacher-directed learning in year 6
4. Predictors: (Constant), Length of non-teaching employment, Length of primary teaching employment, Teacher-directed learning in year 6, Enjoyment of school in year 6

Table 5-30 ANOVA for difficulty of science in year 6

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.576	1	4.576	5.874	.016
	Residual	827.206	1062	.779		
	Total	831.781	1063			
2	Regression	8.077	2	4.039	5.202	.006
	Residual	823.704	1061	.776		
	Total	831.781	1063			
3	Regression	11.918	3	3.973	5.136	.002
	Residual	819.864	1060	.773		
	Total	831.781	1063			
4	Regression	97.949	4	24.487	35.338	.000
	Residual	733.832	1059	.693		
	Total	831.781	1063			

Table 5-31 Coefficients for difficulty of science in year 6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.07	.04		79.828	.000
	Length of non-teaching employment	-.05	.02	-.074	-2.424	.016
2	(Constant)	3.16	.06		54.338	.000
	Length of non-teaching employment	-.06	.02	-.086	-2.763	.006
	Length of primary teaching employment	-.05	.02	-.066	-2.124	.034
3	(Constant)	3.07	.07		43.236	.000
	Length of non-teaching employment	-.07	.02	-.095	-3.039	.002
	Length of primary teaching employment	-.05	.02	-.068	-2.201	.028
	Teacher-directed learning in year 6	.03	.01	.069	2.228	.026
4	(Constant)	4.43	.14		31.814	.000
	Length of non-teaching employment	-.05	.02	-.065	-2.188	.029
	Length of primary teaching employment	-.04	.02	-.061	-2.095	.036
	Teacher-directed learning in year 6	.03	.01	.053	1.834	.067
	Enjoyment of school in year 6	-.38	.03	-.323	-11.142	.000

Table 5-32 Regression model summary for the difficulty of science writing in year 6

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.143	.020	.019	.8528	.020	22.083	1	1064	.000
2	.159	.025	.024	.8510	.005	5.513	1	1063	.019
3	.343	.118	.115	.8101	.092	111.210	1	1062	.000
4	.357	.127	.124	.8061	.009	11.502	1	1061	.001

1. Predictors: (Constant), Gender
2. Predictors: (Constant), Gender, Number on roll in year 6
3. Predictors: (Constant), Gender, Number on roll in year 6, Enjoyment of school in year 6
4. Predictors: (Constant), Gender, Number on roll in year 6, Enjoyment of school in year 6, Enjoyment of schoolwork in year 6

Table 5-33 ANOVA for the difficulty of science writing in year 6

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.062	1	16.062	22.083	.000
	Residual	773.896	1064	.727		
	Total	789.958	1065			
2	Regression	20.055	2	10.027	13.845	.000
	Residual	769.903	1063	.724		
	Total	789.958	1065			
3	Regression	93.035	3	31.012	47.257	.000
	Residual	696.923	1062	.656		
	Total	789.958	1065			
4	Regression	100.509	4	25.127	38.669	.000
	Residual	689.449	1061	.650		
	Total	789.958	1065			

Table 5-34 Coefficients for the difficulty of science writing in year 6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.39	.08		42.191	.000
	Gender	-.25	.05	-.143	-4.699	.000
2	(Constant)	3.26	.10		33.711	.000
	Gender	-.24	.05	-.142	-4.686	.000
	Number on roll in year 6	.00	.00	.071	2.348	.019
3	(Constant)	4.43	.14		30.797	.000
	Gender	-.16	.05	-.094	-3.209	.001
	Number on roll in year 6	.00	.00	.062	2.140	.033
	Enjoyment of school in year 6	-.35	.03	-.308	-10.546	.000
4	(Constant)	4.78	.18		27.002	.000
	Gender	-.14	.05	-.082	-2.797	.005
	Number on roll in year 6	.00	.00	.063	2.191	.029
	Enjoyment of school in year 6	-.31	.04	-.268	-8.522	.000
	Enjoyment of schoolwork in year 6	-.14	.04	-.107	-3.391	.001

Table 5-35 Regression model summary for attitude to computers in science in Y6

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.139	.019	.018	.9304	.019	20.913	1	1063	.000
2	.210	.044	.042	.9190	.025	27.382	1	1062	.000
3	.218	.048	.045	.9177	.004	4.111	1	1061	.043
4	.264	.070	.066	.9074	.022	25.260	1	1060	.000
5	.272	.074	.070	.9057	.004	4.861	1	1059	.028
6	.287	.082	.077	.9020	.008	9.697	1	1058	.002
7	.293	.086	.080	.9007	.004	4.203	1	1057	.041

1. Predictors: (Constant), Gender
2. Predictors: (Constant), Gender, Free school meals % in primary school
3. Predictors: (Constant), Gender, Free school meals % in primary school, Number on roll in year 6
4. Predictors: (Constant), Gender, Free school meals % in primary school, Number on roll in year 6, Teacher-directed learning in year 6
5. Predictors: (Constant), Gender, Free school meals % in primary school, Number on roll in year 6, Teacher-directed learning in year 6, Standardised learning in year 6
6. Predictors: (Constant), Gender, Free school meals % in primary school, Number on roll in year 6, Teacher-directed learning in year 6, Standardised learning in year 6, Enjoyment of schoolwork in year 6
7. Predictors: (Constant), Gender, Free school meals % in primary school, Number on roll in year 6, Teacher-directed learning in year 6, Standardised learning in year 6, Enjoyment of schoolwork in year 6, Enjoyment of school in year 6

Table 5-36 ANOVA for attitude to computers in science in Y6

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.102	1	18.102	20.913	.000
	Residual	920.136	1063	.866		
	Total	938.238	1064			
2	Regression	41.230	2	20.615	24.407	.000
	Residual	897.008	1062	.845		
	Total	938.238	1064			
3	Regression	44.692	3	14.897	17.689	.000
	Residual	893.546	1061	.842		
	Total	938.238	1064			
4	Regression	65.490	4	16.372	19.885	.000
	Residual	872.748	1060	.823		
	Total	938.238	1064			
5	Regression	69.478	5	13.896	16.938	.000
	Residual	868.760	1059	.820		
	Total	938.238	1064			
6	Regression	77.367	6	12.895	15.847	.000
	Residual	860.870	1058	.814		
	Total	938.238	1064			
7	Regression	80.777	7	11.540	14.225	.000
	Residual	857.461	1057	.811		
	Total	938.238	1064			

Table 5-37 Coefficients for attitude to computers in science in Y6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.053	.088		46.203	.000
	Gender	-.261	.057	-.139	-4.573	.000
2	(Constant)	3.819	.098		39.146	.000
	Gender	-.258	.056	-.137	-4.571	.000
	Free school meals % in primary school	1.305E-02	.002	.157	5.233	.000
3	(Constant)	3.712	.111		33.471	.000
	Gender	-.257	.056	-.137	-4.562	.000
	Free school meals % in primary school	1.237E-02	.003	.149	4.925	.000
	Number on roll in year 6	1.838E-03	.001	.061	2.028	.043
4	(Constant)	3.511	.117		30.102	.000
	Gender	-.248	.056	-.132	-4.463	.000
	Free school meals % in primary school	1.177E-02	.002	.142	4.731	.000
	Number on roll in year 6	1.127E-03	.001	.038	1.242	.215
	Teacher-directed learning in year 6	7.533E-02	.015	.151	5.026	.000
5	(Constant)	3.428	.122		27.997	.000
	Gender	-.240	.056	-.128	-4.307	.000
	Free school meals % in primary school	1.137E-02	.002	.137	4.569	.000
	Number on roll in year 6	1.189E-03	.001	.040	1.312	.190
	Teacher-directed learning in year 6	6.891E-02	.015	.138	4.521	.000
	Standardised learning in year 6	2.594E-02	.012	.067	2.205	.028
6	(Constant)	2.955	.195		15.177	.000
	Gender	-.270	.056	-.144	-4.796	.000
	Free school meals % in primary school	1.096E-02	.002	.132	4.416	.000
	Number on roll in year 6	1.222E-03	.001	.041	1.354	.176
	Teacher-directed learning in year 6	6.794E-02	.015	.136	4.475	.000
	Standardised learning in year 6	2.571E-02	.012	.066	2.194	.028
	Enjoyment of schoolwork in year 6	.136	.044	.093	3.114	.002
7	(Constant)	3.098	.206		15.003	.000
	Gender	-.258	.057	-.138	-4.571	.000
	Free school meals % in primary school	1.093E-02	.002	.132	4.412	.000
	Number on roll in year 6	1.181E-03	.001	.039	1.310	.191
	Teacher-directed learning in year 6	6.629E-02	.015	.133	4.367	.000
	Standardised learning in year 6	2.684E-02	.012	.069	2.291	.022
	Enjoyment of schoolwork in year 6	.172	.047	.118	3.662	.000
	Enjoyment of school in year 6	-8.234E-02	.040	-.066	-2.050	.041

Table 5-38 Regression model summary for view of progression in year 6

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.072	.005	.004	.7140	.005	5.498	1	1054	.019
2	.103	.011	.009	.7124	.005	5.841	1	1053	.016
3	.150	.022	.020	.7085	.012	12.565	1	1052	.000
4	.172	.029	.026	.7063	.007	7.712	1	1051	.006
5	.182	.033	.028	.7053	.004	3.939	1	1050	.047

1. Predictors: (Constant), Primary teacher's score on ID scale
2. Predictors: (Constant), Primary teacher's score on ID scale, Length of primary teaching employment
3. Predictors: (Constant), Primary teacher's score on ID scale, Length of primary teaching employment, Teacher-directed learning in year 6
4. Predictors: (Constant), Primary teacher's score on ID scale, Length of primary teaching employment, Teacher-directed learning in year 6, Standardised learning in year 6
5. Predictors: (Constant), Primary teacher's score on ID scale, Length of primary teaching employment, Teacher-directed learning in year 6, Standardised learning in year 6, Student-directed learning in year 6

Table 5-39 ANOVA for view of progression in year 6

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.803	1	2.803	5.498	.019
	Residual	537.362	1054	.510		
	Total	540.165	1055			
2	Regression	5.768	2	2.884	5.682	.004
	Residual	534.398	1053	.508		
	Total	540.165	1055			
3	Regression	12.075	3	4.025	8.018	.000
	Residual	528.091	1052	.502		
	Total	540.165	1055			
4	Regression	15.921	4	3.980	7.980	.000
	Residual	524.244	1051	.499		
	Total	540.165	1055			
5	Regression	17.881	5	3.576	7.189	.000
	Residual	522.285	1050	.497		
	Total	540.165	1055			

Table 5-40 Coefficients for view of progression in year 6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.98	.12		33.96	.00
	Primary teacher's score on ID scale	-.08	.03	-.07	-2.34	.02
2	(Constant)	4.11	.13		31.94	.00
	Primary teacher's score on ID scale	-.09	.03	-.09	-2.78	.01
	Length of primary teaching employment	-.04	.02	-.08	-2.42	.02
3	(Constant)	4.22	.13		32.00	.00
	Primary teacher's score on ID scale	-.09	.03	-.08	-2.66	.01
	Length of primary teaching employment	-.04	.02	-.07	-2.36	.02
	Teacher-directed learning in year 6	-.04	.01	-.11	-3.54	.00
4	(Constant)	4.29	.13		32.08	.00
	Primary teacher's score on ID scale	-.09	.03	-.08	-2.60	.01
	Length of primary teaching employment	-.04	.02	-.08	-2.43	.02
	Teacher-directed learning in year 6	-.03	.01	-.09	-2.93	.00
	Standardised learning in year 6	-.03	.01	-.09	-2.78	.01
5	(Constant)	4.32	.13		32.13	.00
	Primary teacher's score on ID scale	-.09	.03	-.08	-2.60	.01
	Length of primary teaching employment	-.04	.02	-.08	-2.44	.01
	Teacher-directed learning in year 6	-.03	.01	-.08	-2.72	.01
	Standardised learning in year 6	-.02	.01	-.07	-2.35	.02
	Student-directed learning in year 6	-.02	.01	-.06	-1.98	.05

Table 5-41 Variables used in regression analysis of year 7 data

	Mean	Std. Deviation	N
ASIAN	5.882E-03	7.651E-02	1020
ESWI	.9843	.1243	1020
Gender	1.4318	.4955	1517
% with five or more A-C grades	42.2766	19.1920	1515
One or more A-G grades % in school	95.1960	3.0436	1515
Five or more A-G grades % in school	90.7901	5.0428	1515
Authorised absences % half days missed	8.2723	1.6603	1515
BPC	.1727	.3781	1517
CASE	.1266	.3326	1517
Number of half day sessions used for induction	2.3357	1.2322	1400
INTEGRAT	.7581	.4284	1517
Free school meals % in secondary school	13.5479	8.0665	1515
MSANDSS	.1430	.3502	1517
OWN	.2828	.4505	1517
PCTNEEDS	14.2806	6.7861	1517
PCTSTMNT	1.9637	1.7003	1517
Number on roll in secondary school	1028.1182	362.2229	1515
SALTERS	7.053E-02	.2561	1517
SATSAV	.8097	.3927	1377
SATSUSE	.2585	.4380	1377
Selective or non-selective school	8.581E-02	.2802	1515
Sixth form	.5987	.4903	1515
SPOTLITE	.2327	.4227	1517
STARTSCI	.1516	.3588	1517
TASAV	.7809	.4138	1515
Primary teacher assessments used	.2863	.4522	1390
Timetabled time available for liaison	.2397	.4271	1047
TRANSFRN Use of transfer information	.5124	.5000	1253
Type of school	1.8231	.3817	1515
Unauthorised absences % half days missed	.6492	.6513	1515
Number on roll in year 7	219.1149	68.0716	1515
F1	8.7214	1.9652	1493
F2	5.2732	1.0933	1486
F3	3.1226	.8422	1517
F4	2.6395	.7560	1509
INSETSC Secondary INSET	1.7500	.4332	1332
QUALGP7	1.9651	.1837	1517
SCIQUGP secondary science qualifications group	1.9183	.2741	1517
YRSEMPLY Length of non-teaching employment	1.6280	1.3714	1406
Length of secondary teaching employment	2.2787	1.3414	1514
CD	3.5564	.6265	1517
LID	3.7130	.5829	1517
PC	2.4446	.6249	1517
Collaborative learning in year 7	7.2328	2.4758	1306
Student-directed learning in year 7	1.4064	1.4718	1223
Standardised learning in year 7	4.3680	1.6955	1250
Teacher-directed learning in year 7	4.6455	1.7072	1419
Enjoyment of school in year 7	3.2741	.8368	1351
Enjoyment of schoolwork in year 7	3.9842	.5981	1309

Table 5-42 Regression model summary for enjoyment of science in year 7

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.152	.023	.021	.7357	.023	13.391	1	567	.000
2	.196	.038	.035	.7306	.015	9.000	1	566	.003
3	.221	.049	.044	.7271	.011	6.314	1	565	.012
4	.259	.067	.060	.7208	.018	10.947	1	564	.001
5	.284	.081	.073	.7161	.014	8.403	1	563	.004
6	.317	.101	.091	.7090	.020	12.367	1	562	.000
7	.372	.138	.127	.6947	.038	24.421	1	561	.000
8	.384	.148	.136	.6914	.010	6.350	1	560	.012
9	.393	.155	.141	.6892	.007	4.544	1	559	.033
10	.542	.294	.281	.6304	.139	110.182	1	558	.000
11	.554	.307	.294	.6250	.013	10.725	1	557	.001

1. Predictors: (Constant), CASE
2. Predictors: (Constant), CASE, Timetabled time available for liaison
3. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS
4. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor
5. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2

f6. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment

7. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment, Collaborative learning in year 7
8. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment, Collaborative learning in year 7, Standardised learning in year 7
9. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment, Collaborative learning in year 7, Standardised learning in year 7, Teacher-directed learning in year 7
10. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment, Collaborative learning in year 7, Standardised learning in year 7, Teacher-directed learning in year 7, Enjoyment of school in year 7
11. Predictors: (Constant), CASE, Timetabled time available for liaison, SALTERS, Secondary teacher's score on child-centred factor, F2, Length of secondary teaching employment, Collaborative learning in year 7, Standardised learning in year 7, Teacher-directed learning in year 7, Enjoyment of school in year 7, Enjoyment of schoolwork in year 7

Table 5-43 ANOVA for enjoyment of science in year 7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.248	1	7.248	13.391	.000
	Residual	306.882	567	.541		
	Total	314.129	568			
2	Regression	12.051	2	6.026	11.290	.000
	Residual	302.078	566	.534		
	Total	314.129	568			
3	Regression	15.390	3	5.130	9.702	.000
	Residual	298.740	565	.529		
	Total	314.129	568			
4	Regression	21.078	4	5.269	10.141	.000
	Residual	293.052	564	.520		
	Total	314.129	568			
5	Regression	25.387	5	5.077	9.900	.000
	Residual	288.742	563	.513		
	Total	314.129	568			
6	Regression	31.605	6	5.267	10.478	.000
	Residual	282.525	562	.503		
	Total	314.129	568			
7	Regression	43.390	7	6.199	12.844	.000
	Residual	270.739	561	.483		
	Total	314.129	568			
8	Regression	46.426	8	5.803	12.140	.000
	Residual	267.704	560	.478		
	Total	314.129	568			
9	Regression	48.584	9	5.398	11.364	.000
	Residual	265.545	559	.475		
	Total	314.129	568			
10	Regression	92.372	10	9.237	23.243	.000
	Residual	221.757	558	.397		
	Total	314.129	568			
11	Regression	96.561	11	8.778	22.474	.000
	Residual	217.568	557	.391		
	Total	314.129	568			

Table 5-44 Coefficients for enjoyment of science in year 7

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.089	.022		183.828	.000
	CASE	-.340	.093	-.152	-3.659	.000
2	(Constant)	4.150	.030		137.758	.000
	CASE	-.406	.095	-.182	-4.283	.000
	Timetabled time available for liaison	-.221	.074	-.127	-3.000	.003
3	(Constant)	4.185	.033		126.739	.000
	CASE	-.441	.095	-.197	-4.628	.000
	Timetabled time available for liaison	-.257	.075	-.148	-3.439	.001
	SALTERS	-.307	.122	-.106	-2.513	.012

Table 44 continued

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
4	(Constant)	4.566	.120		38.115	.000
	CASE	-.485	.095	-.217	-5.081	.000
	Timetabled time available for liaison	-.191	.077	-.110	-2.487	.013
	SALTERS	-.234	.123	-.080	-1.900	.058
	F3	-.127	.038	-.144	-3.309	.001
5	(Constant)	4.981	.186		26.773	.000
	CASE	-.521	.096	-.233	-5.446	.000
	Timetabled time available for liaison	-.201	.076	-.115	-2.631	.009
	SALTERS	-.243	.122	-.084	-1.985	.048
	F3	-.121	.038	-.137	-3.177	.002
	F2	-8.054E-02	.028	-.118	-2.899	.004
6	(Constant)	5.352	.212		25.210	.000
	CASE	-.553	.095	-.247	-5.810	.000
	Timetabled time available for liaison	-.253	.077	-.145	-3.285	.001
	SALTERS	-.375	.127	-.129	-2.959	.003
	F3	-.109	.038	-.124	-2.880	.004
	F2	-.116	.029	-.170	-3.952	.000
	Length of teaching employment	-8.673E-02	.025	-.156	-3.517	.000
7	(Constant)	4.825	.234		20.634	.000
	CASE	-.543	.093	-.243	-5.821	.000
	Timetabled time available for liaison	-.227	.076	-.130	-2.996	.003
	SALTERS	-.276	.126	-.095	-2.195	.029
	F3	-.110	.037	-.125	-2.957	.003
	F2	-.101	.029	-.148	-3.497	.001
	Length of teaching employment	-8.327E-02	.024	-.150	-3.445	.001
	Collaborative learning in year 7	5.930E-02	.012	.197	4.942	.000
8	(Constant)	5.034	.247		20.369	.000
	CASE	-.535	.093	-.239	-5.767	.000
	Timetabled time available for liaison	-.211	.076	-.121	-2.782	.006
	SALTERS	-.271	.125	-.093	-2.169	.031
	F3	-.109	.037	-.123	-2.941	.003
	F2	-.110	.029	-.162	-3.808	.000
	Length of teaching employment	-8.859E-02	.024	-.160	-3.668	.000
	Collaborative learning in year 7	6.446E-02	.012	.215	5.319	.000
	Standardised learning in year 7	-4.449E-02	.018	-.101	-2.520	.012
9	(Constant)	5.123	.250		20.504	.000
	CASE	-.523	.093	-.234	-5.634	.000
	Timetabled time available for liaison	-.213	.075	-.122	-2.823	.005
	SALTERS	-.254	.125	-.087	-2.030	.043
	F3	-.112	.037	-.126	-3.021	.003
	F2	-.102	.029	-.150	-3.495	.001
	Length of teaching employment	-9.061E-02	.024	-.163	-3.761	.000
	Collaborative learning in year 7	6.931E-02	.012	.231	5.638	.000
	Standardised learning in year 7	-4.045E-02	.018	-.092	-2.285	.023
	Teacher-directed learning in year 7	-3.758E-02	.018	-.086	-2.132	.033

Table 44 continued

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
10	(Constant)	3.919	.256		15.328	.000
	CASE	-.440	.085	-.197	-5.163	.000
	Timetabled time available for liaison	- 173	.069	-.099	-2.497	.013
	SALTERS	-.189	.115	-.065	-1.647	.100
	F3	-.101	.034	-.114	-2.973	.003
	F2	-9.691E-02	.027	-.142	-3.639	.000
	Length of secondary teaching employment	-9.115E-02	.022	-.164	-4.136	.000
	Collaborative learning in year 7	5.910E-02	.011	.197	5.237	.000
	Standardised learning in year 7	-3.081E-02	.016	-.070	-1.900	.058
	Teacher-directed learning in year 7	-2.702E-02	.016	-.062	-1.672	.095
	Enjoyment of school in year 7	.337	.032	.379	10.497	.000
11	(Constant)	3.483	.286		12.168	.000
	CASE	-.448	.085	-.201	-5.306	.000
	Timetabled time available for liaison	- 154	.069	-.088	-2.235	.026
	SALTERS	-.203	.114	-.070	-1.787	.074
	F3	-.105	.034	-.119	-3.138	.002
	F2	-9.841E-02	.026	-.145	-3.727	.000
	Length of teaching employment	-9.285E-02	.022	-.167	-4.249	.000
	Collaborative learning in year 7	5.513E-02	.011	.184	4.900	.000
	Standardised learning in year 7	-3.019E-02	.016	-.069	-1.878	.061
	Teacher-directed learning in year 7	-2.699E-02	.016	-.062	-1.685	.093
	Enjoyment of school in year 7	.292	.035	.328	8.409	.000
	Enjoyment of schoolwork in year 7	.159	.049	.128	3.275	.001

Table 5-45 Regression model summary for difficulty of science in year 7

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.128	.016	.015	.9318	.016	9.455	1	571	.002
2	.174	.030	.027	.9259	.014	8.320	1	570	.004
3	.196	.038	.033	.9229	.008	4.674	1	569	.031
4	.212	.045	.038	.9206	.007	3.900	1	568	.049
5	.242	.059	.050	.9147	.014	8.365	1	567	.004
6	.257	.066	.056	.9120	.007	4.309	1	566	.038
7	.274	.075	.064	.9082	.009	5.770	1	565	.017
8	.466	.217	.206	.8364	.142	102.096	1	564	.000

1. Predictors: (Constant), CASE
2. Predictors: (Constant), CASE, One or more A-G grades % in school
3. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school
4. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school, Secondary teacher's score on child-centred factor
5. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school, Secondary teacher's score on child-centred factor, Standardised learning in year 7
6. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school, Secondary teacher's score on child-centred factor, Standardised learning in year 7, Collaborative learning in year 7
7. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school, Secondary teacher's score on child-centred factor, Standardised learning in year 7, Collaborative learning in year 7, Teacher-directed learning in year 7
8. Predictors: (Constant), CASE, One or more A-G grades % in school, Selective or non-selective school, Secondary teacher's score on child-centred factor, Standardised learning in year 7, Collaborative learning in year 7, Teacher-directed learning in year 7, Enjoyment of school in year 7

Table 5-46 ANOVA for difficulty of science in year 7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.209	1	8.209	9.455	.002
	Residual	495.778	571	.868		
	Total	503.988	572			
2	Regression	15.342	2	7.671	8.948	.000
	Residual	488.646	570	.857		
	Total	503.988	572			
3	Regression	19.323	3	6.441	7.562	.000
	Residual	484.664	569	.852		
	Total	503.988	572			
4	Regression	22.629	4	5.657	6.675	.000
	Residual	481.359	568	.847		
	Total	503.988	572			
5	Regression	29.627	5	5.925	7.083	.000
	Residual	474.361	567	.837		
	Total	503.988	572			
6	Regression	33.212	6	5.535	6.655	.000
	Residual	470.776	566	.832		
	Total	503.988	572			
7	Regression	37.971	7	5.424	6.577	.000
	Residual	466.017	565	.825		
	Total	503.988	572			
8	Regression	109.400	8	13.675	19.546	.000
	Residual	394.588	564	.700		
	Total	503.988	572			

Table 5-47 Coefficients for difficulty of science in year 7

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.90	.03		103.20	.00
	CASE	.36	.12	.13	3.07	.00
2	(Constant)	6.41	1.22		5.27	.00
	CASE	.38	.12	.14	3.31	.00
	One or more A-G grades % in school	-.04	.01	-.12	-2.88	.00
3	(Constant)	5.73	1.25		4.58	.00
	CASE	.42	.12	.15	3.58	.00
	One or more A-G grades % in school	-.03	.01	-.10	-2.24	.03
	Selective or non-selective school	-.31	.14	-.09	-2.16	.03
4	(Constant)	4.79	1.34		3.59	.00
	CASE	.47	.12	.17	3.92	.00
	One or more A-G grades % in school	-.02	.01	-.07	-1.68	.09
	Selective or non-selective school	-.32	.14	-.09	-2.21	.03
	Secondary teacher's score on child-centred factor	.10	.05	.09	1.97	.05
5	(Constant)	4.83	1.33		3.64	.00
	CASE	.45	.12	.16	3.80	.00
	One or more A-G grades % in school	-.03	.01	-.08	-1.93	.05
	Selective or non-selective school	-.26	.14	-.08	-1.77	.08
	Secondary teacher's score on child-centred factor	.09	.05	.08	1.86	.06
	Standardised learning in year 7	.07	.02	.12	2.89	.00
6	(Constant)	4.70	1.33		3.55	.00
	CASE	.45	.12	.16	3.83	.00
	One or more A-G grades % in school	-.02	.01	-.07	-1.66	.10
	Selective or non-selective school	-.25	.14	-.07	-1.74	.08
	Secondary teacher's score on child-centred factor	.09	.05	.08	1.85	.06
	Standardised learning in year 7	.07	.02	.13	3.21	.00
	Collaborative learning in year 7	-.03	.02	-.09	-2.08	.04
7	(Constant)	4.05	1.35		3.01	.00
	CASE	.44	.12	.16	3.72	.00
	One or more A-G grades % in school	-.02	.01	-.06	-1.31	.19
	Selective or non-selective school	-.25	.14	-.08	-1.77	.08
	Secondary teacher's score on child-centred factor	.10	.05	.09	2.01	.04
	Standardised learning in year 7	.07	.02	.12	2.98	.00
	Collaborative learning in year 7	-.04	.02	-.10	-2.48	.01
	Teacher-directed learning in year 7	.06	.02	.10	2.40	.02
8	(Constant)	4.72	1.24		3.80	.00
	CASE	.34	.11	.12	3.16	.00
	One or more A-G grades % in school	-.01	.01	-.03	-.75	.45
	Selective or non-selective school	-.20	.13	-.06	-1.53	.13
	Secondary teacher's score on child-centred factor	.08	.04	.08	1.91	.06
	Standardised learning in year 7	.06	.02	.10	2.65	.01
	Collaborative learning in year 7	-.03	.01	-.07	-1.80	.07
	Teacher-directed learning in year 7	.04	.02	.08	2.03	.04
	Enjoyment of school in year 7	-.43	.04	-.38	-10.10	.00

Table 5-48 Regression model summary for difficulty of science writing in year 7

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.133	.018	.016	.8853	.018	10.241	1	571	.001
2	.166	.028	.024	.8816	.010	5.833	1	570	.016
3	.380	.145	.140	.8275	.117	77.941	1	569	.000
4	.402	.161	.155	.8202	.017	11.190	1	568	.001

1. Predictors: (Constant), Gender
2. Predictors: (Constant), Gender, CASE
3. Predictors: (Constant), Gender, CASE, Enjoyment of school in year 7
4. Predictors: (Constant), Gender, CASE, Enjoyment of school in year 7, Enjoyment of schoolwork in year 7

Table 5-49 ANOVA for difficulty of science writing in year 7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.026	1	8.026	10.241	.001
	Residual	447.500	571	.784		
	Total	455.525	572			
2	Regression	12.559	2	6.279	8.080	.000
	Residual	442.967	570	.777		
	Total	455.525	572			
3	Regression	65.925	3	21.975	32.094	.000
	Residual	389.600	569	.685		
	Total	455.525	572			
4	Regression	73.452	4	18.363	27.299	.000
	Residual	382.073	568	.673		
	Total	455.525	572			

Table 5-50 Coefficients for difficulty of science writing in year 7

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.306	.109		30.227	.000
	Gender	-.239	.075	-.133	-3.200	.001
2	(Constant)	3.275	.110		29.867	.000
	Gender	-.241	.074	-.134	-3.243	.001
	CASE	.267	.111	.100	2.415	.016
3	(Constant)	4.382	.162		27.008	.000
	Gender	-.168	.070	-.093	-2.387	.017
	CASE	.199	.104	.074	1.916	.056
	Enjoyment of school in year 7	-.368	.042	-.346	-8.828	.000
4	(Constant)	4.985	.242		20.636	.000
	Gender	-.136	.070	-.075	-1.927	.054
	CASE	.212	.103	.079	2.055	.040
	Enjoyment of school in year 7	-.310	.045	-.291	-6.908	.000
	Enjoyment of schoolwork in year 7	-.211	.063	-.142	-3.345	.001

Table 5-51 Regression model summary for attitude to computers in science in Y7

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.113	.013	.011	.9319	.013	7.400	1	571	.007
2	.174	.030	.027	.9244	.018	10.302	1	570	.001
3	.221	.049	.044	.9163	.019	11.184	1	569	.001
4	.250	.062	.056	.9106	.013	8.149	1	568	.004

1. Predictors: (Constant), Gender
2. Predictors: (Constant), Gender, CASE
3. Predictors: (Constant), Gender, CASE, Standardised learning in year 7
4. Predictors: (Constant), Gender, CASE, Standardised learning in year 7, Enjoyment of school in year 7

Table 5-52 ANOVA for attitude to computers in science in Y7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.427	1	6.427	7.400	.007
	Residual	495.901	571	.868		
	Total	502.327	572			
2	Regression	15.230	2	7.615	8.911	.000
	Residual	487.097	570	.855		
	Total	502.327	572			
3	Regression	24.620	3	8.207	9.775	.000
	Residual	477.707	569	.840		
	Total	502.327	572			
4	Regression	31.377	4	7.844	9.461	.000
	Residual	470.951	568	.829		
	Total	502.327	572			

Table 5-53 Coefficients for attitude to computers in science in Y7

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.36	.12		29.15	.00
	Gender	-.21	.08	-.11	-2.72	.01
2	(Constant)	3.31	.11		28.82	.00
	Gender	-.22	.08	-.11	-2.78	.01
	CASE	.37	.12	.13	3.21	.00
3	(Constant)	2.99	.15		20.03	.00
	Gender	-.22	.08	-.12	-2.86	.00
	CASE	.36	.11	.13	3.16	.00
	Standardised learning in year 7	.08	.02	.14	3.34	.00
4	(Constant)	3.40	.21		16.48	.00
	Gender	-.19	.08	-.10	-2.52	.01
	CASE	.34	.11	.12	2.96	.00
	Standardised learning in year 7	.07	.02	.13	3.21	.00
	Enjoyment of school in year 7	-.13	.05	-.12	-2.85	.00

Table 5-54 Regression model summary for view of progression in year 7

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.130	.017	.015	.7140	.017	9.739	1	565	.002
2	.166	.028	.024	.7107	.011	6.225	1	564	.013

1. Predictors: (Constant), Primary teacher assessments used
2. Predictors: (Constant), Primary teacher assessments used, Student-directed learning in year 7

Table 5-55 ANOVA for view of progression in year 7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.964	1	4.964	9.739	.002
	Residual	288.017	565	.510		
	Total	292.981	566			
2	Regression	8.109	2	4.054	8.027	.000
	Residual	284.872	564	.505		
	Total	292.981	566			

Table 5-56 Coefficients for view of progression in year 7

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.73	.03		140.91	.00
	Primary teacher assessments used	-.21	.07	-.13	-3.12	.00
2	(Constant)	3.79	.04		101.65	.00
	Primary teacher assessments used	-.19	.07	-.12	-2.81	.01
	Student-directed learning in year 7	-.05	.02	-.10	-2.50	.01

Table 5-57 Variables used in the regression analysis of enjoyment of school in Y6

	Mean	Std. Deviation	N
ESWI	.9782	.1461	3348
ASIAN	1.135E-02	.1059	3348
Gender	1.5019	.5001	3349
Free school meals % in primary school	17.8036	11.1635	3349
Number on roll in secondary school	339.1439	128.7176	3315
Special educational needs % in primary school	17.6125	7.2959	3315
Number on roll in year 6	65.4130	31.1005	3349
SATS % level 4 or above in 1996 SATs tests	62.7497	16.0283	3300
CURFOCUS	.1593	.3660	3226
SUBJCT	.3239	.4680	3226
TOPIC	.2827	.4504	3226

Table 5-58 Regression model summary for enjoyment of school in year 6

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.176	.031	.031	.7442	.031	84.643	1	2653	.000
2	.182	.033	.032	.7435	.002	5.784	1	2652	.016
3	.195	.038	.037	.7417	.005	14.108	1	2651	.000

1. Predictors: (Constant), Gender
2. Predictors: (Constant), Gender, ASIAN
3. Predictors: (Constant), Gender, ASIAN, TOPIC

Table 5-59 ANOVA for enjoyment of school in year 6

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46.873	1	46.873	84.643	.000
	Residual	1469.153	2653	.554		
	Total	1516.026	2654			
2	Regression	50.070	2	25.035	45.290	.000
	Residual	1465.956	2652	.553		
	Total	1516.026	2654			
3	Regression	57.831	3	19.277	35.045	.000
	Residual	1458.196	2651	.550		
	Total	1516.026	2654			

Table 5-60 Coefficients for enjoyment of school in year 6

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.204	.045		70.804	.000
	Gender	.266	.029	.176	9.200	.000
2	(Constant)	3.200	.045		70.742	.000
	Gender	.266	.029	.176	9.210	.000
	ASIAN	.328	.136	.046	2.405	.016
3	(Constant)	3.165	.046		68.702	.000
	Gender	.266	.029	.176	9.251	.000
	ASIAN	.338	.136	.047	2.489	.013
	TOPIC	.120	.032	.072	3.756	.000

Table 5-61Variables used in the regression analysis of enjoyment of school in Y7

	Mean	Std. Deviation	N
ESWI	.9819	.1332	1551
ASIAN	8.382E-03	9.120E-02	1551
Gender	1.4780	.4996	2385
Free school meals % in secondary school	13.1377	8.3854	2383
AC5 % with five or more A-C grades	44.2799	21.3170	2383
One or more A-G grades % in school	95.0827	3.3592	2383
AG5 Five or more A-G grades % in school	90.7230	5.4644	2383
Number on roll in secondary school	1053.3533	379.9687	2383
PCTNEEDS	13.4687	6.6204	2385
PCTSTMNT	1.8029	1.5749	2385
TEACHING teaching approach	1.5392	.8611	2383
Number on roll in year 7	220.2329	69.9167	2383
Selective or non-selective school	.1066	.3087	2383
MSANDSS	.2004	.4004	2385
Number of half day sessions used for induction	2.2101	1.2695	2151

Table 5-62 Regression model summary for enjoyment of school in year 7

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.153	.023	.022	.8374	.023	22.161	1	930	.000
2	.205	.042	.040	.8297	.019	18.200	1	929	.000
3	.219	.048	.045	.8276	.006	5.740	1	928	.017

a Predictors: (Constant), Gender
b Predictors: (Constant), Gender, Five or more A-G grades % in school
c Predictors: (Constant), Gender, Five or more A-G grades % in school, CASE
d Dependent Variable: Enjoyment of school in year 7

Table 5-63 ANOVA for enjoyment of school in year 7

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.539	1	15.539	22.161	.000
	Residual	652.098	930	.701		
	Total	667.637	931			
2	Regression	28.069	2	14.034	20.385	.000
	Residual	639.569	929	.688		
	Total	667.637	931			
3	Regression	32.000	3	10.667	15.573	.000
	Residual	635.637	928	.685		
	Total	667.637	931			

Table 5-64 Coefficients for enjoyment of school in year 7

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	2.876	.083		34.657	.000
	Gender	.259	.055	.153	4.708	.000
2	(Constant)	.951	.459		2.074	.038
	Gender	.258	.054	.152	4.742	.000
	Five or more A-G grades % in school	2.123E-02	.005	.137	4.266	.000
3	(Constant)	.967	.458		2.114	.035
	Gender	.258	.054	.152	4.754	.000
	Five or more A-G grades % in school	2.132E-02	.005	.138	4.296	.000
	CASE	-.196	.082	-.077	-2.396	.017

APPENDIX 6 QUALITATIVE DATA FROM YEARS 6 AND 7

CHILDREN, TEACHERS AND SCHOOLS.

6.1 INTERVIEWS WITH CHILDREN

6.1.1 EXAMPLES OF VIEWS FROM YEAR 6 INTERVIEWS

Table 6-1 Examples of notes taken on feelings about science and practical work

Gender	Feelings about science	Feelings about experiments	Comments about disliked experiments
B	Agree/like experiments/writing up not so good, it gets a bit boring	Not a waste of time/you find out things if you do experiments	
G	Don't always like	Sometimes/some hard to understand /circuits good	Making magnetic compass
G	Like sometimes/don't like new words	Yes a lot/ islands - turn salt water to drinking water	No
G	Like when work in groups but don't like when teacher does it		
B	Most of time depends what we do	Like experiment, don't like writing up. Yeast experiment	Stuff when you know what happens
B	No	Quite good fun, better to know it even if you don't use it later	
G	No /depends what science -if its nature I like it, don't like group work	Yes -some/not investigations. Like nature, like things that are diff & doing own work	Sand investigation because group work
B	No -boring	Its a waste of time-don't use it when you're older	
G	No -boring/most of it's writing		
G	No I don't really like science because mine always go wrong	Not a waste of time but don't like doing them/hard to write about it	Iceberg melted before I showed it
B	No -let scientists do it, better at secondary school	No-better at secondary school but forces experiment ok	It and both said boring
B	Not a big fan of science/sometimes get bored things we do/writing	Yes	Teacher goes on about it/writing
G	Ok, like group work and experiments, but write up can be hard & the charts		
G	Ok/doesn't matter what topic you do, always group work, mostly good	Yes, some -nature/light bulbs/interesting finding out	
G	Quite good especially experiments on forces doing investigations is best	Yes -nice doing electricity experiments	
G	Quite like it but like practical more than book research	Yes	
G	Some-link to exp	Not always-liked water thro soils	

Table 6-1 continued.

Gender	Feelings about science	Feelings about experiments	Comments about disliked experiments
G	Sometimes if its a good experiment	Yes/adding things together.	Magnets/blow on paper-lift experiment
B	Sometimes/don't like it when she talks about it/hard to understand		
B	Undecided/doesn't like writing/liked a chemical separating experiment		
B	Yes	Yes-electrical circuits	
B	Yes	Yes -prefers more complicated	Soils too easy but liked
B	Yes	Yes/also mentioned chemicals & magnesium flames /fun to do	
B	Yes	Yes/particular mention of chemicals and candles used & liked	
B	Yes	Orary made/planets/like	
B	Yes	Show course of river/tray sand & water	
G	Yes	Yes-soil/cloth-water porosity	
G	Yes /they're fun/some are	Yes/electrical circuits brilliant	Agrees/both start to say notes hard
G	Yes agree/like doing all the experiments & finding out about things	Yes/light experiment using prisms-it was good/I enjoy doing exp like that	
B	Yes favourite subject	Yes cars on different surfaces - friction	
B	Yes like a lot	Yes/a lot/testing mould on bread	No
G	Yes -like finding out	No-boring but forces experiment they did + it was ok but knew what would happen	Steam/condense -teacher did
B	Yes, like science, its fun sometimes. Liked water experiment, ice cube & hot water/group work	Yeast experiment/ surprised by the result	
B	Yes like/mum a teacher/like the world & finding out things		

Table 6-2 Understanding the concept of calculations in Y6

Gender	Do you understand the sentences about calculations?	What do you guess calculations are?
B	Calc/experiments	Using data
B	Knows	Calc/results/graphs
G	Knows	Calc/results/graphs
B	Knows	Graphs
B	Knows	Results/graphs
B	Not sure	
B	Not sure	Do circuits work
B	Not sure	Sums
B	Not sure	Results?
G	Not sure	How you've done it
G	Not sure	How you've done it
G	Don't do	
G	Don't do	
B	Don't know	Predictions
G	Don't know	Maths-I'm good at maths
B	Don't know	Like maths but harder
B	Don't know	Doing practical
B	Don't know	
B	Don't know	Maths?
B	Don't know	
B	Don't know	Think same as x
B	Don't know	Maybe measuring?
B	Don't know	Predictions
G	Don't know	Doing practical
G	Don't know	Writing
G	Don't know	Maths
G	Don't know	How you did it
G	Don't know	Results
G	Don't know	Charts/graphs
G	Don't know	Charts/graphs
G	Don't know	What we do in experiments
G	Don't know	Working out from results

Table 6-3 Use of computers in year 6

Gender	Do you use computers in science lessons?	Which do you think is better –doing experiments yourself or using the computer to do the experiment (simulations).
G	Yes + use a lot	
B	Yes + use a lot	
G	Doesn't remember science use	Don't know
B	We have! Graphs of experimental data	More accurate/better
G	Not used	Easier to do no equip problems
B	Not used for science – use to play games	Better - no writing to do
B	Only games	
B	Mainly games + writing	
B	None-but would like to	
B	None-but would like to	
G	None	
G	None	
G	Don't use	
G	Don't use	
B	Don't do	
B	Don't do	
G	Not much in science	
G	Not much in science	
B	Not really	Better to work it out yourself
B	Yes/not used much/weather program	
G	Not used except for writing	
G	Writing on it & weather thing	Its just the same as doing yourself
B	Yes/ writing on it / but they do charts	Disc might not tell truth
G	Yes/got 2/don't use much	Too easy on computer
B	No/not for science	Good/make own model more fun
B	No	Better/easier/trust own results more
B	Yes & use a lot/got 2/writing & graphs	Do it yourself best/computer gets best result
G	Yes/use a lot/ no science just writing/graphs	Computer best/comp result best
G	Never used for science	Yourself – you can fiddle about with it/not sure result better
G	Don't know about it/got2/wrting	Do it yourself quicker/own results better

6.1.2 EXAMPLES OF VIEWS FROM YEAR 7 INTERVIEWS

Table 6-4 Feelings about science and practical work in year 7

	I love ...		POSITION ON GRID FOR EACH SUBJECT[1]		I hate ...
SEX	**5 FAVOURITE SUBJECT**	**4**	**3**	**2**	**1 LEAST FAVOURITE SUBJECT**
?	MUSIC		SCIENCE		THEORY /ART
B			SCIENCE		
B	SCIENCE				
B	SCIENCE				
B			SCIENCE		THEORY
B	ART	SCIENCE			THEORY
B	HISTORY	SCIENCE			THEORY
B	SCIENCE				THEORY
B	PE/SCIENCE				THEORY
B		SCIENCE		THEORY	
B	MATHS	SCIENCE		THEORY	
B	HISTORY/SCIENCE			THEORY	ART
B	MATHS	SCIENCE	THEORY	FRENCH	
B	IT		SCIENCE/ GEOGRAPHY		THEORY
B	MATHS/PE		SCIENCE	GEOGRAPHY	THEORY
B	TECHNOLOGY		SCIENCE		THEORY/ GEOGRAPHY
B	ART	SCIENCE	GEOGRAPHY		THEORY
B	IT/SCIENCE				THEORY/GEOGRAPHY
B	SCIENCE		THEORY		GEOGRAPHY
B	PE/SCIENCE				GERMAN THEORY
B	PE	SCIENCE		THEORY	GERMAN
B	MUSIC		SCIENCE	HISTORY	THEORY
B	PE	SCIENCE		HISTORY	THEORY
B	IT	SCIENCE		THEORY	MATHS
B	PE	SCIENCE	THEORY	MUSIC	
B	HISTORY/SCIENCE		THEORY/MUSIC		
B	DRAMA/SCIENCE				RE/ THEORY
B	IT/SCIENCE				RE /THEORY
B	IT/SCIENCE	SCIENCE		THEORY	RE
B	PE	SCIENCE		THEORY	RE
G		SCIENCE			
G			SCIENCE		THEORY
G		RE/SCIENCE			THEORY
G	ENGLISH/SCIENCE				THEORY
G			SCIENCE	THEORY	
G	ART	SCIENCE		THEORY	
G	SCIENCE		HISTORY	THEORY	
G	SCIENCE	THEORY			
G	SCIENCE	THEORY			
G	DRAMA	SCIENCE		THEORY	ENGLISH
G	DRAMA/SCIENCE		ENGLISH/FRENCH		THEORY
G		ENGLISH	SCIENCE	GEOGRAPHY	THEORY
G	PE	SCIENCE	GEOGRAPHY		THEORY
G	ART		SCIENCE	THEORY	GEOGRAPHY
G	ART	SCIENCE	GEOGRAPHY/THEORY		
G	PE/SCIENCE		THEORY		GEOGRAPHY
G	ART	SCIENCE		THEORY	HISTORY
G		DRAMA	SCIENCE		THEORY/HUMANITIES
G	GEOGRAPHY	SCIENCE	THEORY	MATHS	
G	SCIENCE	ART	THEORY	MATHS	
G	DRAMA/SCIENCE				THEORY/ RE
G	PE	SCIENCE		THEORY/ RE	

[1] Grid used to mark favourite and least favourite lessons plus position that represents feelings about science, with and without practical work. 'Theory' is used to denote science lessons without practical work.

6.2 TEXT ANALYSIS OF CHILDREN'S WRITTEN RESPONSES

6.2.1 STATISTICS RELATING TO WRITTEN RESPONSES

Table 6-5: Response rate for free-response section of survey.

	Primary		Secondary	
	n	%	n	%
Total written responses	1730	76.62	1583	70.11
Total involved in longitudinal study	2258	100	2258	100

Table 6-6: Proportions of responses by gender at primary and secondary school

	Primary Girls		Primary Boys		Secondary Girls		Secondary Boys	
	n	%	n	%	n	%	n	%
No written response	279	24.4	249	22.3	313	27.4	362	32.4
Written response	863	75.6	867	77.7	829	72.6	754	67.6

Table 6-7 Independent samples t-test comparing the numbers of responses by boys and girls at primary and secondary schools.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Primary	Equal variances assumed	.40	.52	-.32	2255.00	.75	-.01	.02	-.04	.03
	Equal variances not assumed			-.32	2253.54	.75	-.01	.02	-.04	.03
Secondary	Equal variances assumed	20.12	.00	-2.25	2255.00	.02	-.04	.02	-.08	-.01
	Equal variances not assumed			-2.25	2247.81	.02	-.04	.02	-.08	-.01

Table 6-8: Qualitative & quantitative responses compared

	YEAR 6				YEAR 7			
	Makes no written response		Makes a written response		Makes no written response		Makes a written response	
Quantitative score indicates:	n	%	n	%	n	%	n	%
Does not enjoy	1	1.6	61	98.4	11	14.9	63	85.1
Not sure	19	7.1	248	92.9	34	10.7	284	89.3
Enjoys	99	7.9	1162	92.1	151	11.9	1114	88.1

Table 6-9 Independent samples t-test comparing the numbers of responses by enjoyment of science scores at primary and secondary schools.

		Levene's Test for Equality of Variance		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Primary	Equal variances assumed	3.14	.08	.82	1583.00	.41	.04	.05	-.06	14
	Equal variances not assumed			.86	82.45	.39	.04	.05	-.06	.14
Secondary	Equal variances assumed	.05	.82	-.11	1468.00	.91	-.01	.05	-.10	.09
	Equal variances not assumed			-.11	86.82	.91	-.01	.05	-.10	.09

6.2.2 STAGES IN ANALYSIS OF TEXT

1. The first set of coding:

- Reference code of respondent
- Sex of respondent
- Primary or secondary response
- % of free school meals at the primary and the secondary school of the respondent
- Attitudes to science and school from questionnaire responses via a link with SPSS

2. The second set of coding:

- Text searches for individual words describing types of responses that had been found to occur frequently in earlier readings.

3. The third set of coding:

- Tree building – building levels into the coding

4. Analysis of text.

1. Frequency of comments about particular issues (e.g. feelings, repeated work).
2. Frequency of comments by particular groups of children (e.g. sex, year, FSM, questionnaire responses)
3. Relationships between issues (e.g. feelings about repeated work) and further coding as new groups emerged.
4. Relationships between issues for particular groups.

Table 6-10 Example of coding used on children's comments

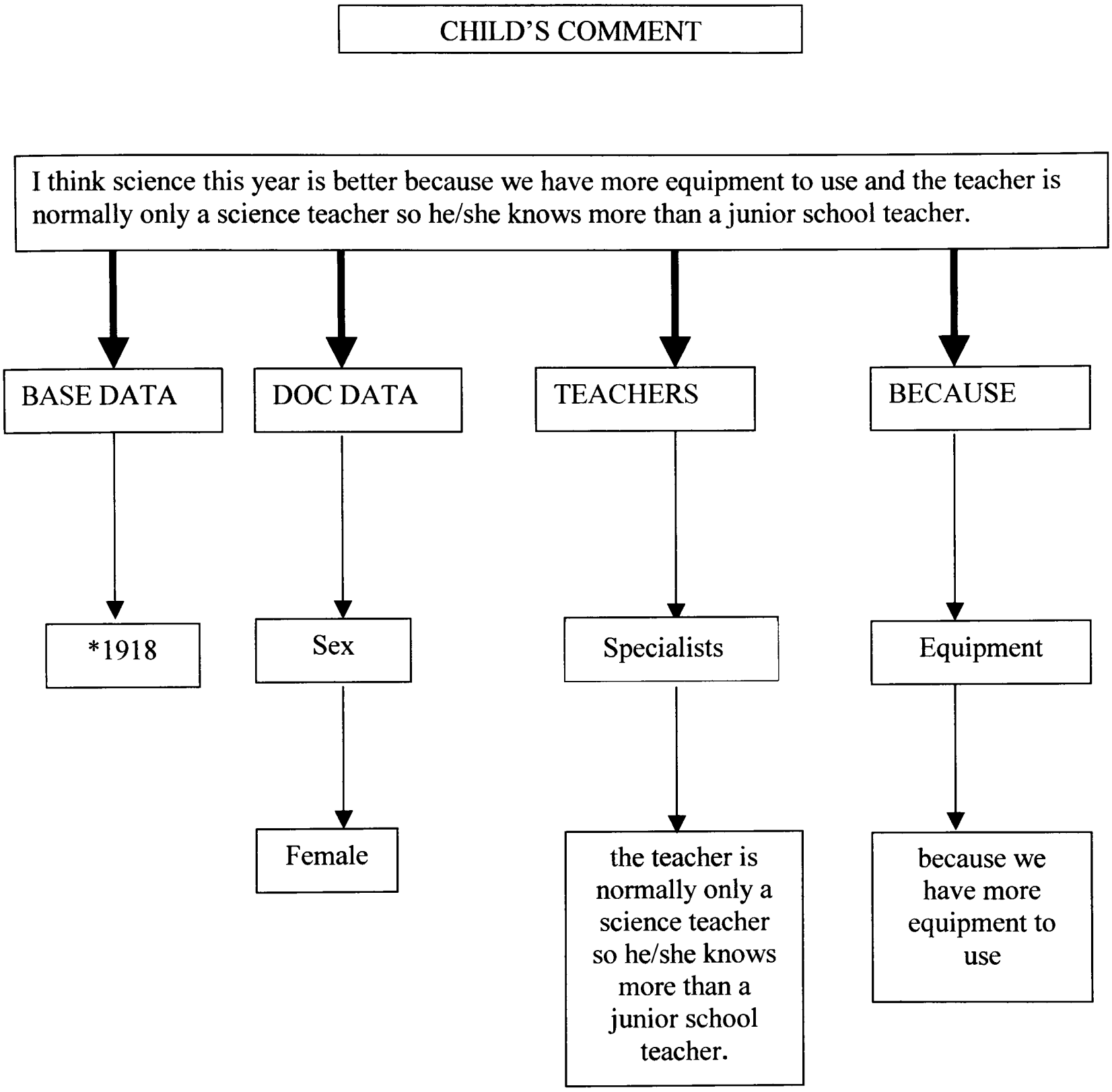


Table 6-11 Simplified tree of coding used in analysis of children's responses

		CODING LEVEL		
	1st	2nd	3rd	
(1)	base data	Individual reference numbers for pupils		
(2)	docdata	Coding from SPSS associated with individual reference numbers in base data		
(3)	sims and diffs			
(4)	TEACHERS	feelings	teaching methods	expects at sec
		specialists	activities	happens at prim
		teacher demonstrations		happened at prim
		directs	STRICT	happens at sec
		less help	different	
		allows	active	
		more help	passive	
(5)	autonomy			
(6)	contrasts			
(7)	learning			
(8)	year	Primary/ secondary		
(9)	BECAUSE	equipment	less write	more
		write	more write	better
		experiments		harder
		safe	easier write	writing up
		chemistry	harder write	danger
		books	same write	own
		dissection	fun experiment	
		homework	curriculum	
		computers	burner bunsen	
		laboratory	experiment	
		danger	secdiscuss	
(10)	subjects			
(11)	views			
(12)	feelings			
(14)	Year7coding			
(15)	teachchange			
(16)	secmeals			
(17)	attributions			
(18)	facility			
(19)	bio vs phys			
(20)	Year 6 views			
(21)	Year 7 views			
(24)	comparisons			

6.2.3 EXAMPLES OF WORD SEARCHES

In Table 6-7 below one example of each word is given, but the text was searched for all variations in terms of grammar and spelling, for example:

Hard: harder, less hard/difficult, more difficult, less difficult, not as hard/difficult, more hard/difficult, plus all spelling variations.

Table 6-12 Examples of words used in initial searches

Feelings	**Experimental**	**Writing**	**Autonomy**	**Teachers**
Good	Experiment	Write	Will let	Understand
Enjoy	Practical	Word	Will not do	Explain
Excellent	Investigate	Spelling	Ourselves	Teach more
Like		Vocabulary	Myself	Teach better
Love	**Equipment**	Copy	We can do	Ideas
Look forward	Lab(oratory)	Board	Allow	
Fun	Special room	Note	Trust	**Qualified**
Cool	Proper room	Sheet	Responsible	Specialist
Wicked	Science room	Book	Grown up	Experienced
Great	Bunsen		Older	Knows more
Brilliant	Burner	**Homework**	Independent	Proper teacher
Fond	Gas	Tests	Free	Proper science
Adore	Electricity	Repeat		
Prefer	Fire	Do again	**Group**	**Strict**
Interest	Flame	The same	Pair	Not as good
Better	Equipment	Go over	Twos/threes etc	Teach less
Easy	Apparatus	Revise	Together	
Hate	Glass		Not alone	
Dislike	Tube	**Work faster**	Not on our own	
Boring	Wire	Rush	Not by ourselves	
Stupid	Bottle	Hurry		
Rubbish	Computer	Not enough time	**Talk**	
Worse		Less time	Discuss	
Bad	**Chemical**	More work	Debate	
Don't like	Acid	Work slower		
Hard	Bubble	More time		
Difficult	Fizz	Less work		
Will not/do not	Liquid			
Dull	Fluid	**New work**		
Challenge	Powder	New things		
Worried	Alkali			
Scared				
Frightened	**Dissect**			
Nervous	Animal	**Learn more**		
Angry	Creature	Learn new		
Cross	Living	Learn less		
	Dead			
	Cut up			
	Open up			
	Look inside			

Table 6-13 Examples of results of search for references to teachers

Pupil number	Response
242	teacher will be more strict, we will use different equipment.
262	different teacher who is specialised in science,
267	We also do more, and now we have a proper science teacher which is fully a science teacher.
284	I think science at secondary school is better than primary because the teachers trust you
420	Better computers. More equipment. Better teachers.
447	The teachers don't always explain it as much as they did in primary school.
519	rarely did experiments and we did not even have a proper science
705	we have a teacher that has learnt all about science and not other
774	I think we will have a proper science room and a proper science teacher.
826	We will use more Scientific instroments and will have a teacher who noes only about science.
833	It is better having one teacher for one subject than having one
860	it is better equiped and the teachers teach you more.
888	and Mrs [X] explains them more.
889	teachers more stern
900	we will have more qualifed teachers who do science all the time
979	I like Miss [X] she let's us do things
1070	The teacher is not as strict at secondary school.
1073	At junior school the teacher would have to heat the liquids and
1297	in [X]school science teachers explain the experiments more than the primary school teachers.
1298	Teachers specify in one subject.
1299	We will have a science teacher next year
1302	Computers, a science lab, a special teacher, equipment, books,
1311	We will do more experiments. We will have a proper science teacher,
1315	Computers, science teacher, science rooms and labs.
1427	we will have a teacher that knows
1485	We will do harder experiments and the teachers will now more
1488	The teacher's are more expearents because They only do science.
1491	We'll have a proper science teacher
1492	We will have a proper science teacher
1543	It is much better , and we have got a better teacher.
1954	It will be harder. We will have a science teacher, we will work in a proper science
1977	Having a proper science teacher.
2121	The teachers at secondary school are only qualified in science
2128	and also we will have a science teacher.
2140	The Science teachers we have at secondary school are proper qualified science teachers.
2150	Teachers will be more strict.
2183	I think we will have a science teacher every lesson

Table 6-8 continued

Pupil number	Response
2268	secondary school I find it much harder and the teachers are much more strict
2334	I think the teacher will be different and probably very strict.
2419	The teachers will be more strict.
2472	qualified teacher to teach me.
2532	I allso think that the teacher will be more strict
2533	I also think that the teachers will be stricer than our teachers now.
2559	We have a proper scince room We have proper equipment we have
2735	we will have a proper science teacher.
2751	I think it will be more interesting, the teacher in science will be specialist,
2768	You go in a lab, it's harder, there are more classes, you get specialists and better teachers.
3199	normal teachers in [X] we work with property scientists. I enjoy it more here we
3202	not property science teachers and did not have as much knowledge.
3232	Harder Stricter Teachers
3233	using lots of different equipment having proper science teachers

Table 6-14 Results of search for references to writing

	n	%
Same writing	81	3.6
More/harder writing	60	2.7
Less/easier writing	40	1.8

Total number of responses =2258

Table 6-15 Examples of text resulting from search for references to writing

Pupil number	**Response**
*667	Same;. We write about the subject we were studying on.
*2922	The same as it was ... because we do writing from the booklets.
*1287	The thing that is the same is you have to write up your experiments
*1293	The things that are the same are that we have to write,
*2119	We never used to write up experiments in junior school
*359	harder experiments, more writting.
*1372	We do more writing,
*3147	In science w e do more experiments and more writing but we do less listening to the teacher
*3233	And we don't have to do loads of writing.
*2187	Last year we didn't do any thing but write all lesson, and we had to watch the teacher.
*503,	We use more complecated equipments. We don't wright as much
*1719	I like science better at secondary school because we hardly do any writing,

TABLE 6-16 RESULTS OF SEARCH FOR REFERENCES TO DISSECTION

Secondary school code number	Primary		Secondary	
	Boys n	Girls n	Boys n	Girls n
9	6	5		
3	4	6		
19	3	2		
20	2	4		
32	2	3		
6		2		
5	1	1		
8	1			
14	1			
24	1			
26	1			1
29	1			
35	1			
7		1		1
11		1		
16		1		
18		1		
27		1		
31		1		
1				
2				
4				
12				
13				
15				
21				
22				
25				
28				
30				
33				
34				
Total number of references	24	29	0	2

Table 6-17 Examples of text resulting from the search for references to dissection

PUPIL	RESPONSES FROM PUPILS IN YEAR 6
	Pupils moving to secondary school 3
*2145	We wil use dead animals and cut them up
*2158	We will proberly be experimenting on things like frogs.
*2159	We will experiment on insects and animals
*3186	we get to look inside pigs Brains
*3189	and we will use rats and mice and micerescopes
*3190	We will be useing the bunce and burner disacating harts/eyes
*3216	It will be a lot different because we will use different tools and be doing things like disepting a hart (later on in are secondary school)
*3218	We will be allowed to open up animals which I don't think I'm going to like very much
*3236	We will see animals and we will experiment on them.
	Pupils moving to secondary school 9
*374	Dissecting animals, setting stuff alight, blowing stuff up.
*375	Science will be different because you cut animals open,
*376	Dissecting animals,
*377	More people will be there and we cut animals open.
*378	I think that dissecting in a rat or an eye ball will be good
*424	you work with animals,
*1267	We will be finding out about animals.
*1268	dissecting animals
*1272	looking at real dead animals in jars,
*1293	We would work on animals.
*1326	Animals in jars.

Table 6-18 Major areas of comment linked with children's feelings

Topics	Primary	Secondary
	Number of responses about each topic associated with positive and negative comments	
Facilities	406	371
Learning	210	225
Teachers	117	187
Curriculum	98	146
Comparisons	0	132
Autonomy	24	82

6.2.4 TEXT ANALYSIS WITH REFERENCE TO THE CASE SCHEME

Table 6-19 Positive about secondary science (grouped by use of CASE scheme)

Positive responses	Girls				Boys			
	CASE		no CASE		CASE		no CASE	
	n=165	%	n=974	%	n=167	%	n=951	%
Positive about secondary	22	13.3	188	19.3	27	16.2	120	12.6
Negative about primary	6	3.6	49	5.0	13	7.8	23	2.4
All	28	16.9	237	24.3	40	24.0	143	15.0

Table 6-20 Negative about secondary science (grouped by use of CASE scheme)

Negative responses	Girls				Boys			
	CASE		no CASE		CASE		no CASE	
	n=165	%	n=974	%	n=167	%	n=951	%
Negative about secondary	3	1.8	26	2.7	2	1.2	13	1.4
Positive about primary	6	3.6	14	1.4	4	2.4	13	1.4
All	9	5.4	40	4.1	6	3.6	26	2.8

Table 6-21 The difficulty of science (grouped by use of CASE scheme)

	Girls				Boys			
	CASE		no CASE		CASE		no CASE	
	n=165	%	n=974	%	n=167	%	n=951	%
Hard/harder at secondary	33	20.0	128	13.1	15	9.0	82	8.6
Easy/easier at secondary	0	0	8	0.8	0	0	12	1.3

Table 6-22 Views about autonomy (grouped by use of CASE scheme)

	girls				boys			
	CASE		no CASE		CASE		no CASE	
	n=165	%	n=974	%	n=167	%	n=951	%
groups	4	2.4	37	3.8	0	0.0	14	1.5
talk	1	0.6	19	2.0	0	0.0	16	1.7
trust	1	0.6	20	2.1	0	0.0	13	1.4
independence	1	0.6	21	2.2	1	0.6	13	1.4

6.2.5 EXAMPLES OF TEXT OF RESPONSES ABOUT AUTONOMY MADE BY CHILDREN IN CASE AND NON-CASE SCHOOLS

Children in CASE schools

GROUPS

*2026 The science in this school is harder, more interesting, more equiptment used, more lessons of it. In the junior school we used computers but unfortuanatly we dont here. I have found out a lot from this school but already new a lot of it to. I like doing experiments but when we don't, science is quit boring. In science wehn I want to sit next to my other friends, I am sometimes not aloud to, and that makes me angry. (Girl)

*1788 Very hard. The difference is we used to have bunsen burners at our old school and we never used to matches the same things are we still in groups of 4 or 5. (Girl)

*1244 In secondary school we learn a lot more than we do at junior school. We do a lot more experiments, work and homework. I some times find it quite difficult when we do experiments, because when we work in groups every one has different opinions so we end up arguing. (Girl)

INDEPENDENCE

*2740 At this school we can do experiments by our selfs. (Boy)

*1128 When I came to [X] science was more complicated and we had to think for ourselves more. (Girl)

TRUST

*498 At my old school we would have a scince leson every Tuesday afternoon. At secondary school we use bunson burners, so we are trusted with better things. There are not a lot of things that are the same. But we use stop watches hear and in my old school. (Girl)

TALK

*517 Well the Science we do now is harder than the little of science we did and when I came to this school I first went to my first science lesson and it was hard because at [primary] we did'nt do that much science but sometimes I enjoy it and sometimes I dont because we get horrible warnings if we talk. In science we talk about of experiments instead of writing. (Girl)

Children in non-CASE schools

GROUPS

*2174 We still do experiments in groups and some times copy charts or writing from the board, and the teacher some times shows us what to do as well. (boy)

*1752 We use different equipment, have different teachers and do more experiments with out writing we, I or they. We still do experiments in groups and find out similar things eg. Evaporation, condensation and changes. (girl)

*2135 We used to do more group work and look things up more in library books.
We also some times decide what we wanted to test, from a choice we were given at my old school. (girl)

*1668 In primary we only did about **4** experiments in the whole year, and that was all together as a class like a group. (girl)

*3169 In secondary school we do better experiments and its easier because we can work with friend we would not work with your friends in Primary School. (boy)

INDEPENDENCE

*1287 I like science a lot more now I am at secondary school because at junior school it was a lot more just writing what was on the board. Here we do a lot more experiments and working out for ourselves. (girl)

*262 Now that we are in secondary school we do a lot more science than before, we also have a different different teacher who is specialised in science, we are allowed to use a bunsen burner. We also didn't do very much our selfs, the teacher did most of what we did, all we did was write up the experiment. (boy)

*2579 Science is more intresting as in primary school are Teachers told us what happened but now we find out for ourselves. (boy)

*668 In secondary school we get to actually do the practical, were as in primary school we had to watch and learn. I find it easier doing it myself. (girl)

*3025 Well in primary school we used to do science, but if it was some thing like lighting a match, the teacher would do it but here you can do it your self. Here they treat you more grown up but in primary school they made you feel small. (girl)

TRUST

*1311 You do lots more experiments at senior school and you are trusted to do things on your own. (girl)

*1073 Science is different because we use bunsen burners, tripods, gas, glass, flammable liquids, dangerous substances. At junior school the teacher woud have to heat the liquids and do nearly every thing for us, at secondary school in science the teacher seems to trust us more and give us independance. (girl)

*2189 In secondary school we do experiments with Bunsenburners and poisonus chemicals and that, but in primary we wee only allowed to dissolve things and that by shaking a bottle of water and sugar or some thing. (boy)

*478 In junior school, se used to usually watch a video, or listen to the teacher talk. If we did any experiments, we had the equiptment set up for us, and we didn't use anything that was potentially dangerous. e.g. Bunsen Burner, glassware. At secondary school, we set up our own experiments, and are allowed to use dangerous stuff. (boy)

*2941 We learn things in more detail. Computers are an important part of our learning It is much more exciting + enjoyable. You get to use proper equipment and are trusted to use it properly. We have more resposibilites in the classroom. (girl)

*284 I think science at secondary school is better than primary because the teachers trust you more, because your older. (boy)

TALK

*2395 Science at secondary is better, because you do more experiments. One of the things that is the same is that we talk to the class about our ideas. One of the things that are different is that we actually do more experiments oneself. (girl)

*1376 The science was very different at our old school, we mainly talked about it and did pictures. (girl)

*2162 At my old school we didn't do many experiments. We mostly just talked about the science. Now we do lots of experiments and talk about them. I think that when you do the experiments it is more fun and you learn more things. (boy)

*1949 We do a lot more practical work at secondary school. The lessons are more exciting as we talk about things. We also do more "write ups". (boy)

*2931 Science is good in secondary school some things are the same like we have discusstions. (boy)

*798 It is different because in our old school we did not do any practicals, we just talked about it, read books, and use the computer. (girl)

*2380 Things that are different are we do more experiments more writing, more discussions and its more interesting. The things that are the same is nothing really (boy)

6.3 TEXT ANALYSIS OF TEACHERS' WRITTEN RESPONSES

Table 6-23 Teachers' feelings about science by sector and by science education

Teacher responses	Primary teachers				Secondary teachers			
	University science N=17		School science only N=106		University science N=152		School science only N=11	
	n	%	n	%	n	%	n	%
Enjoys science teaching	2	11.8	12	11.3	22	14.5	1	9.1
Is positive about science teaching	5	29.4	19	17.9	37	24.3	4	36.4
Is negative about science teaching	0	0	21	19.8	4	2.6	0	0
Finds science difficult to teach	0	0	44	41.5	4	2.6	0	0

Table 6-24 Teachers' feelings about science (grouped by use of CASE scheme)

Secondary teacher responses	CASE n=29		No CASE n=133	
	n	%	n	%
Teacher enjoys	5	17.24	20	15.04
Negative aspects	2	6.90	6	4.51
Difficulty in motivating children	6	20.69	16	12.03
Difficult to teach science	0	0.00	5	3.76
National Curriculum issues	0	0.00	10	7.52
Science should be fun	1	3.45	26	19.55
Positive aspects	5	17.24	42	31.58

Table 6-25 CASE and non-CASE teachers representations of science teaching

Secondary teacher responses	CASE n=29		No CASE n=133	
	n	%	n	%
Theories	8	27.59	27	20.30
Theoretical	6	20.69	17	12.78
Ideas	4	13.79	14	10.53
All 'theoretical'	18	62.1	58	43.6
Knowledge	7	24.14	25	18.80
All 'knowledge & theoretical'	25	86.2	83	62.4
Experiential	2	6.90	10	7.52
Exploration	1	3.45	2	1.50
Discussion	0	0.00	3	2.26
Active	0	0.00	6	4.51
All 'Active'	3	10.3	21	15.8
Science and technology links	4	13.79	11	8.27
Context	5	17.24	9	6.77
Relevance	3	10.34	18	13.53
All 'contextual'	12	41.4	38	28.6
Understanding the world	1	3.45	17	12.78
Wonder of the world	1	3.45	7	5.26
Knowledge of the world	7	24.14	43	32.33
All 'world'	9	31.0	67	72.9

Table 6-26 Teachers' responses mentioning children (grouped by use of CASE)

Secondary teacher responses	CASE		No CASE	
	n=29	%	n=133	%
Children's development	2	6.9	16	12.0
Children's thinking	4	13.8	7	5.3
Children's understanding	6	20.7	34	25.6

6.3.1 EXAMPLES OF RESPONSES BY CASE AND NON-CASE SCHOOL TEACHERS

CASE teacher's responses about understanding

*60 Teaching children about science getting children to understand the world around them and how it is important to create life + keep the balance right so as nature is not disrupted by environmental pollution etc.

*62 Teaching children about science should be concerned with the one of any approach which stimulates interest and the desire to gain a deeper understanding of the world around them and themselves.

*86 is all about teaching them to understand the world in which they live, to give them the theoretical knowledge and understanding to solve problems (technology) and to design and evaluate experiments through which they can gain new knowledge or put their ideas to the test

*91 is important because they need to know and understand the natural phenomena around them and the applications of science to their everyday lives.

*92 A helps them to understand how we know what we know as well as some of what we know

*94 Presenting scientific understanding at an appropriate level to illustrate our current understanding.

Non-CASE teachers' comments about understanding

*27 Teaching children about science must be made enjoyable to ensure an understanding of the subject. It must also be taught at a level they understand and many of their ideas must be incorporated into lesson not just a right or wrong answer.

*31 Teaching children about science at first and fore most capture their interest in the natural world and draw their attention to the natural phenomena. It should equip them with a scientific understanding of phenomena through an approach that develops their skill of scientific inquiry, whether through discussion, use of secondary sources or practical investigation.

*34 Teaching children about science is to oversee the development of processes, and understanding, which are important to a more full understanding of what goes on around us. This involves taking every day experiences, and leading children to greater inquisitiveness, so that they have the ability to question what they "see". Only by inquiry and discussion can the process be wholly effective, and understanding be taken to more profound levels.

*42 Teaching children about science helps them to understand the world around them and gives them an interest in nature

*58 Teaching children about science is rewarding because it helps foster inquisitiveness about the world around them, and helps them to understand themselves and the interdependence of all living processes + organisms

*133 should be fun and help them to explain and understand the world about them.

CASE teachers comments about thinking

*80 Teaching children about science should inspire and motivate them to seek explanations for natural phenomena. It should develop their cognitive skills by helping them to think logically, analyse data and explain the results of their practical investigations.

*81 Teaching children about science is taking children's own ideas and putting them into scientific theory at the correct level of ability.

*86 is all about teaching them to understand the world in which they live, to give them the theoretical knowledge and understanding to solve problems (technology) and to design and evaluate experiments through which they can gain new knowledge or put their ideas to the test.

*89 should reflect their natural starting points, be progressive and tentative about its conclusions. We ought to be teaching thinking and ways of thinking. Metacognition seems to be the crucial aspect of learning about science.

*90 is encouraging them to investigate their surrounding and to enhance their thinking and investigative skills.

*94 presenting scientific understanding at an appropriate level to illustrate our current understanding.

*199 is extremely important because it enables them to practice a method of logical thinking similar to the processes scientists use to test ideas and gain knowledge. Science information is also a pre-requisite when making decisions about the environment and to make informed political decisions.

Non-CASE teachers comments about thinking

*11 Teaching children about science fosters clear, objective thinking as well as providing knowledge about the natural world.

*19 Teaching children about science is an attempt to explain the world around them. To teach them to think for them selves and not accept that some thing is true just because they are told it is. To develop powers of deduction and observation. * truth is a relative term which varies according to political and social norms prevailing at a particular time.

*117 should develop their abilities to think clearly and imaginatively. It should also help them in using equipment accurately and effectively. It should also develop their interests in science and for some provide motivation to follow careers in this area.

*69 Teaching children about science explains how the world works and helps with logical thought. Expands the mind so that the student can see more of the width of the world.

*114 will only enhance their everyday lives. It will help them to think logically. To apply knowledge in other subjects. To understand and appreciate what and why things happen. To learn different ways of researching materials and develop their own theories

APPENDIX 7 CHANGE DATA FOR YEARS 6 AND 7

Table 7-1 Changes in scores for Section 1 of the children's questionnaire

				Change in score								
				-4.00	-3.00	-2.00	-1.00	.00	1.00	2.00	3.00	4.00
No.	Item		N	%	%	%	%	%	%	%	%	%
6	I enjoy everything about school	Boys	872	.1	1.0	4.6	17.2	33.7	25.8	12.8	4.4	.3
		Girls	895		.4	3.2	11.4	35.5	30.4	14.7	3.7	.6
7	I am bored most of the time at school	Boys	904	.7	3.3	9.0	21.1	35.3	18.5	8.6	2.8	.8
		Girls	916	.5	2.5	8.8	23.7	41.9	15.1	5.6	1.9	
8	There are lots of school subjects I don't like	Boys	903	1.2	5.0	12.0	18.2	32.8	18.4	8.0	4.0	.6
		Girls	904	.9	4.3	12.2	21.5	37.4	16.3	5.4	2.0	.1
9	I get good marks for my work	Boys	741	.3	2.4	7.7	27.5	38.1	17.5	4.6	1.8	.1
		Girls	743	.3	1.7	4.2	27.2	44.4	18.2	3.2	.8	
10	I always work as hard as I can at school	Boys	912	.7	2.6	6.7	21.9	41.1	17.2	8.0	1.3	.4
		Girls	931	.2	1.1	5.7	21.3	43.8	21.1	4.9	1.8	.1
11	I always behave badly at school	Boys	875	.2	1.5	3.3	17.4	47.3	21.6	6.6	1.5	.6
		Girls	916	.1	.3	1.5	18.2	56.1	20.7	2.3	.3	.3
12	School is not very enjoyable	Boys	894	1.8	6.8	11.3	22.7	28.7	18.6	5.8	3.8	.4
		Girls	911	1.4	3.6	10.6	26.2	37.7	13.3	5.2	1.5	.4

Table 7-2 Changes in scores for Section 2 of the children's questionnaire

				Change in score								
				-4.00	-3.00	-2.00	-1.00	.00	1.00	2.00	3.00	4.00
No.	Item		N	%	%	%	%	%	%	%	%	%
13	I look forward to science lessons	Boys	887	.6	2.7	6.4	17.2	31.0	24.5	11.4	4.6	1.6
		Girls	908	.4	1.9	7.0	18.3	35.2	22.0	9.9	4.3	.9
14	I don't like science lessons	Boys	700	2.1	4.6	8.0	20.0	35.8	17.5	7.9	3.2	.9
		Girls	661	.5	1.1	5.3	13.2	28.9	25.9	16.6	7.4	1.2
16	There are too many facts to learn in science	Boys	925	1.1	3.2	9.5	19.2	33.4	18.3	10.6	3.9	.8
		Girls	939	.9	3.4	9.3	19.1	36.0	19.1	8.0	3.3	1.1
18	Science is more interesting when we use computers	Boys	875	.6	2.3	5.1	12.4	31.1	22.4	15.0	8.4	2.6
		Girls	868	.2	3.7	9.8	20.4	35.1	18.3	8.8	2.8	.9
19	Using a computer makes science so interesting I don't want to stop	Boys	662	1.1	1.8	6.5	13.7	29.3	20.2	15.4	9.2	2.7
		Girls	624	.3	1.3	3.4	13.1	28.0	28.4	16.2	7.1	2.2
20	There are too many new words to learn in science	Boys	868	.9	4.3	9.8	19.7	30.1	18.9	12.2	3.5	.7
		Girls	872	.5	3.6	10.0	18.2	33.7	21.8	9.5	2.5	.2
21	I like doing experiments	Boys	952	2.5	2.4	3.2	17.1	60.1	10.8	1.4	1.1	1.5
		Girls	956	1.4	1.7	4.4	21.5	50.2	16.9	2.0	1.0	.8
22	When I use a computer in science I understand things better	Boys	624	.3	1.8	5.1	16.5	30.0	26.6	13.5	5.0	1.3
		Girls	586		1.7	3.1	13.1	32.4	30.7	14.7	2.9	1.4
23	I already know the science my teacher teaches me	Boys	832	1.1	2.6	9.3	19.7	36.1	20.6	7.1	3.1	.5
		Girls	837	.6	2.0	9.1	18.6	38.5	21.4	8.0	1.8	
25	I'm not always sure how to write about experiments I have done	Boys	915	.5	2.2	9.5	15.6	36.3	19.8	12.1	3.5	.4
		Girls	926	.4	2.2	9.1	15.7	37.8	17.6	14.0	3.0	.2
26	The ideas we learn about in science are too easy	Boys	886	.6	1.4	5.6	23.9	42.8	17.4	5.4	2.3	.7
		Girls	898	.1	.8	4.9	18.9	46.8	23.4	3.9	1.0	.2
27	Doing experiments is a waste of time	Boys	937	.6	1.1	2.3	14.8	55.7	17.5	4.2	2.6	1.2
		Girls	939	.3	.9	3.1	15.9	52.5	20.6	3.6	1.6	1.6
29	Science is difficult when it involves writing	Boys	900	.9	3.4	8.3	18.0	31.3	22.6	8.9	5.6	1.0
		Girls	902	.4	1.9	6.4	17.7	37.3	21.3	10.9	3.5	.6
30	I enjoy going to science lessons	Boys	888	1.6	3.5	6.3	18.2	30.7	21.6	10.6	4.5	2.9
		Girls	903	1.4	1.2	6.6	18.4	36.0	20.9	9.2	4.9	1.3
31	There are too many new ideas to learn in science	Boys	849	.7	2.9	9.7	17.6	31.9	22.1	10.4	3.3	1.4
		Girls	827	.5	2.1	7.9	20.4	36.4	20.6	9.1	2.3	.8
34	I already know most of the science we have done this year	Boys	837	.2	4.5	9.6	19.5	35.4	18.2	10.0	2.3	.4
		Girls	845	.5	2.0	8.0	21.9	36.8	20.1	9.1	1.1	.5
35	Writing about why I did an experiment is difficult	Boys	869	1.4	3.0	8.2	17.5	30.3	23.2	11.4	4.4	.7
		Girls	865	.7	2.7	9.4	18.0	36.0	21.0	8.7	2.8	.8

Table 7-3 Changes in scores on Section 3 of the children's questionnaire

				Change in score								
				%	%	%	%	%	%	%	%	%
No.	Item		N	-4.00	-3.00	-2.00	-1.00	.00	1.00	2.00	3.00	4.00
36	We use textbooks	Boys	725	.1	1.2	4.8	9.0	16.6	25.4	19.6	13.5	9.8
		Girls	752	.4	1.6	4.1	7.2	14.5	28.1	22.3	15.2	6.6
37	We use library books	Boys	690	3.6	7.7	20.1	36.7	26.4	4.6	.7	.1	
		Girls	674	2.7	7.4	20.9	38.6	24.6	4.5	1.2	.1	
38	We copy the teacher's notes from the board or worksheet	Boys	868	.2	2.4	5.3	14.6	25.3	21.9	17.9	9.9	2.4
		Girls	864	.2	2.1	6.0	16.3	24.8	23.7	15.0	9.0	2.8
39	We make up our own experiments and the teacher helps us to make a plan to do them	Boys	737	4.5	9.9	12.6	21.2	32.4	11.5	4.7	2.8	.3
		Girls	674	3.1	8.3	13.2	25.8	29.4	11.9	5.8	2.1	.4
40	We choose the topics we want to study	Boys	808	1.9	1.2	2.8	8.7	79.3	4.5	.9	.4	.4
		Girls	775	1.2	1.2	5.3	10.5	78.7	2.2	.8	.1	.1
41	We talk in a group about our ideas	Boys	846	2.6	7.6	14.3	19.7	29.0	13.8	8.0	4.3	.7
		Girls	825	2.3	7.6	13.7	21.7	25.1	16.2	9.6	3.5	.2
42	We talk to the teacher about our ideas	Boys	820	2.4	6.7	13.8	22.8	26.8	15.1	7.7	4.0	.6
		Girls	809	2.1	7.0	11.4	21.8	28.6	14.8	9.1	3.8	1.4
43	We have tests	Boys	708		4.2	10.5	14.0	25.6	26.3	11.9	6.2	1.4
		Girls	705	.1	3.5	8.4	13.0	28.4	24.8	14.8	5.1	1.8
44	We work in small groups to do experiments	Boys	856	.6	3.0	7.9	16.2	27.5	22.2	13.3	6.5	2.7
		Girls	850	.2	1.5	7.4	15.3	29.3	23.9	15.4	5.3	1.6
45	We work on our own to do experiments	Boys	820	2.3	5.7	11.0	19.9	39.3	14.3	4.8	2.4	.4
		Girls	784	1.3	2.3	11.4	23.3	40.9	14.8	3.7	1.5	.8
46	We watch the teacher do experiments	Boys	827	.5	3.6	5.4	13.3	22.5	24.5	16.4	9.6	4.1
		Girls	830	.7	1.3	5.4	11.9	27.2	23.4	16.6	10.0	3.4
47	We use computers	Boys	787	3.6	7.9	12.6	28.0	37.9	7.6	1.8	.8	
		Girls	768	3.0	9.0	14.6	27.1	35.9	7.9	2.0	.5	

Table 7-4 Average changes in enjoyment of science and of school by school

Secondary school code number	FSM %	Sample n	Change in attitude to science lessons	Change in attitude to school
1	17.43	24	-.90	-.67
17 (CASE)	13.92	37	-.44	-.17
5	26.00	94	-.42	-.63
26 Secondary modern (CASE)	35.07	35	-.39	-.05
36	16.16	23	-.39	-.11
13 (CASE)	12.18	97	-.34	-.57
19	6.00	65	-.29	-.22
31	15.63	38	-.29	-.29
12	9.46	13	-.25	-.45
25 (CASE)	6.00	51	-.25	-.50
7 Girls Grammar School	1.33	25	-.24	-.74
33	8.18	44	-.24	-.07
29 Boys Grammar School	1.67	9	-.22	.18
2	27.54	28	-.12	-.96
3	5.46	88	-.11	-.33
28	15.93	41	-.05	-.23
35	4.60	88	-.05	-.10
32	13.23	54	-.04	-.16
15	7.15	21	-.02	-.32
6	23.99	34	-.01	-.04
8	13.88	83	-.01	-.17
14	17.85	42	-.01	-.52
22	3.15	20	.01	-.01
16	26.62	40	.04	-.39
27	23.11	47	.04	-.21
4	12.70	34	.14	.00
30	8.08	63	.17	-.33
34	22.52	9	.20	-.84
24	7.34	66	.24	-.27
9	10.31	76	.36	-.14
20 Single-sex teaching comprehensive	5.34	88	.37	-.26
11	6.61	46	.38	-.06
21	11.55	10	.44	.13

Table 7-5Average changes in enjoyment of science by school and gender

Secondary school code number	Change in attitude to science lessons	
	Boys	Girls
1	-.96	-.73
12	-.77	.37
5	-.47	-.38
17 (CASE)	-.41	-.45
3	-.30	.06
25 (CASE)	-.30	-.20
33	-.28	-.22
13 (CASE)	-.27	-.42
14	-.25	.24
31	-.25	-.36
32	-.24	.22
Girls' and boys' grammar schools (7 & 29)	-.22	-.24
19	-.18	-.40
22	-.17	.11
27	-.17	.17
2	-.12	-.12
28	-.11	-.01
8	-.04	.02
35	-.04	-.06
6	-.03	.03
36	-.02	-.63
26 secondary modern (CASE)	.02	-.89
30	.03	.27
34	.04	.40
16	.13	-.05
20 Single-sex teaching comprehensive	.15	.59
24	.19	.29
15	.20	-.22
11	.37	.40
4	.39	-.04
9	.39	.32
21	.63	.15

APPENDIX 8 REGRESSION ANALYSIS AND SUPPLEMENTARY STATISTICAL TESTS ON CHANGE DATA

Table 8-1 Variables included in the regression analysis of the change data

Variables included in the analysis of the change data	
Gender	Timetabled time available for liaison
ESWI	TASAV
ASIAN	Primary teacher assessments used
TOPIC	SATSAV
SUBJECT	SATSUSE
CURFOCUS	Unauthorised absences % half days missed
% level 4 or above in 1996 SATS tests	Integrat
Number on roll in year6	BPC
Number on roll in school	SALTERS
Free school meals %	OWN
% Children with special needs	STARTSCI
Primary teachers' f1 factor	SPOTLITE
Primary teachers' f2 factor	TRANSFRN Use of transfer information
Primary teachers' f3 factor	MSANDSS
Primary teachers f4 factor	Pctstmnt
Inductive-deductive scale score of primary teachers	Pctneeds
Contextualist-decontextualist scale score of primary teachers	Secondary teacher gender
Process-content scale score of primary teachers	Finallcd
Length of primary teachers' non-teaching employment	Secondary teacher's score on the process-content factor
Length of primary teachers' teaching employment	Finllid
Primary teachers' science qualifications group	Secondary teachers' f1 factor
Primary teachers' qualifications group	Secondary teacher's score on science & technology factor
Primary teacher gender	Secondary teacher's score on child-centred factor
Primary teacher INSET	Secondary teachers' f4 factor
% with five or more A-C grades	Length of secondary teaching employment
Five or more A-G grades % in school	Secondary science qualifications group
Secondary school use of ability grouping	Secondary INSET
Secondary school use of CASE	QUALGP7
Authorised absences % half days missed	Length of non-teaching employment
Number on roll in secondary school	Change in amount of teacher-directed learning
Number on roll in year 7	Change in amount of standardised learning
Secondary free school meals %	Change in amount of student-directed learning
Number of half day sessions used for induction by secondary school	Change in amount of collaborative learning
One or more A-G grades	Change in attitude to schoolwork
Selective school	Change in enjoyment of school
Sixth form	

Table 8-2 Variables used in the regression analysis of the change in attitude to science lessons

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.139	.019	.017	.9309	.019	8.545	1	435	.004
2	.180	.033	.028	.9257	.013	5.938	1	434	.015
3	.206	.042	.036	.9220	.010	4.424	1	433	.036
4	.226	.051	.042	.9189	.009	3.982	1	432	.047
5	.260	.068	.057	.9119	.017	7.667	1	431	.006
6	.400	.160	.148	.8664	.093	47.376	1	430	.000

1. Predictors: (Constant), TRANSFRN Use of transfer information
2. Predictors: (Constant), TRANSFRN Use of transfer information, BPC
3. Predictors: (Constant), TRANSFRN Use of transfer information, BPC, TASAV
4. Predictors: (Constant), TRANSFRN Use of transfer information, BPC, TASAV, Secondary teacher's score on science & technology factor
5. Predictors: (Constant), TRANSFRN Use of transfer information, BPC, TASAV, Secondary teacher's score on science & technology factor, Change in amount of collaborative learning
6. Predictors: (Constant), TRANSFRN Use of transfer information, BPC, TASAV, Secondary teacher's score on science & technology factor, Change in amount of collaborative learning, Change in enjoyment of school

Table 8-3 ANOVA - Change in attitude to science lessons

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.405	1	7.405	8.545	.004
	Residual	376.968	435	.867		
	Total	384.373	436			
2	Regression	12.494	2	6.247	7.290	.001
	Residual	371.880	434	.857		
	Total	384.373	436			
3	Regression	16.255	3	5.418	6.373	.000
	Residual	368.119	433	.850		
	Total	384.373	436			
4	Regression	19.617	4	4.904	5.808	.000
	Residual	364.757	432	.844		
	Total	384.373	436			
5	Regression	25.992	5	5.198	6.252	.000
	Residual	358.381	431	.832		
	Total	384.373	436			
6	Regression	61.559	6	10.260	13.666	.000
	Residual	322.814	430	.751		
	Total	384.373	436			

Table 8-4 Coefficients - Change in attitude to science lessons

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.212	.053		-4.016	.000
	TRANSFRN Use of transfer information	.262	.090	.139	2.923	.004
2	(Constant)	-.250	.055		-4.567	.000
	TRANSFRN Use of transfer information	.245	.089	.130	2.739	.006
	BPC	.294	.121	.115	2.437	.015
3	(Constant)	-.545	.151		-3.620	.000
	TRANSFRN Use of transfer information	.337	.099	.179	3.396	.001
	BPC	.512	.159	.201	3.226	.001
	TASAV	.294	.140	.142	2.103	.036
4	(Constant)	-1.118	.324		-3.451	.001
	TRANSFRN Use of transfer information	.356	.099	.189	3.588	.000
	BPC	.530	.158	.208	3.344	.001
	TASAV	.338	.141	.163	2.396	.017
	Secondary teacher's score on science & technology factor	7.802E-02	.039	.095	1.995	.047
5	(Constant)	-1.035	.323		-3.203	.001
	TRANSFRN Use of transfer information	.333	.099	.176	3.363	.001
	BPC	.503	.158	.197	3.192	.002
	TASAV	.304	.141	.147	2.163	.031
	Secondary teacher's score on science & technology factor	7.385E-02	.039	.090	1.902	.058
	Change in amount of collaborative learning	3.658E-02	.013	.130	2.769	.006
6	(Constant)	-.776	.309		-2.509	.012
	TRANSFRN Use of transfer information	.241	.095	.128	2.534	.012
	BPC	.386	.151	.151	2.565	.011
	TASAV	.174	.135	.084	1.286	.199
	Secondary teacher's score on science & technology factor	7.331E-02	.037	.089	1.987	.048
	Change in amount of collaborative learning	2.725E-02	.013	.096	2.158	.031
	Change in enjoyment of school	.326	.047	.311	6.883	.000

Table 8-5 Model Summary - change in attitude to science lessons for boys only

	R					Change Statistics				
Model	**Boys (Selected)**	**Boys (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.130		.017	.012	.9456	.017	3.898	1	228	.050
2	.186		.035	.026	.9390	.018	4.213	1	227	.041
3	.228		.052	.040	.9326	.017	4.158	1	226	.043
4	.280		.078	.062	.9217	.026	6.352	1	225	.012
5	.390	.441	.152	.133	.8858	.074	19.608	1	224	.000

1. Predictors: (Constant), One or more A-G grades % in school
2. Predictors: (Constant), One or more A-G grades % in school, Timetabled time available for liaison
3. Predictors: (Constant), One or more A-G grades % in school, Timetabled time available for liaison, BPC
4. Predictors: (Constant), One or more A-G grades % in school, Timetabled time available for liaison, BPC, Change in amount of collaborative learning
5. Predictors: (Constant), One or more A-G grades % in school, Timetabled time available for liaison, BPC, Change in amount of collaborative learning, Change in enjoyment of school

Table 8-6 ANOVA - change in attitude to science lessons for boys only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.485	1	3.485	3.898	.050
	Residual	203.877	228	.894		
	Total	207.362	229			
2	Regression	7.200	2	3.600	4.083	.018
	Residual	200.162	227	.882		
	Total	207.362	229			
3	Regression	10.816	3	3.605	4.146	.007
	Residual	196.546	226	.870		
	Total	207.362	229			
4	Regression	16.212	4	4.053	4.771	.001
	Residual	191.150	225	.850		
	Total	207.362	229			
5	Regression	31.597	5	6.319	8.054	.000
	Residual	175.765	224	.785		
	Total	207.362	229			

Table 8-7 Coefficients - change in attitude to science lessons for boys only

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-3.939	1.940		-2.030	.044
	One or more A-G grades % in school	4.012E-02	.020	.130	1.974	.050
2	(Constant)	-4.006	1.927		-2.078	.039
	One or more A-G grades % in school	4.155E-02	.020	.134	2.058	.041
	Timetabled time available for liaison	-.301	.147	-.134	-2.053	.041
3	(Constant)	-3.815	1.916		-1.991	.048
	One or more A-G grades % in school	3.908E-02	.020	.126	1.945	.053
	Timetabled time available for liaison	-.345	.147	-.154	-2.345	.020
	BPC	.346	.170	.134	2.039	.043
4	(Constant)	-3.340	1.903		-1.755	.081
	One or more A-G grades % in school	3.427E-02	.020	.111	1.718	.087
	Timetabled time available for liaison	-.323	.146	-.144	-2.216	.028
	BPC	.341	.168	.132	2.035	.043
	Change in amount of collaborative learning	4.543E-02	.018	.162	2.520	.012
5	(Constant)	-1.860	1.859		-1.000	.318
	One or more A-G grades % in school	1.937E-02	.019	.063	.995	.321
	Timetabled time available for liaison	-.312	.140	-.139	-2.228	.027
	BPC	.337	.161	.130	2.093	.037
	Change in amount of collaborative learning	3.446E-02	.017	.123	1.969	.050
	Change in enjoyment of school	.285	.064	.280	4.428	.000

Table 8-8 Variables used in the regression analysis of change in attitude to science lessons for girls only

	R					Change Statistics				
Model	**Girls (Selected)**	**Girls (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.197		.039	.034	.8820	.039	8.120	1	202	.005
2	.443	.328	.196	.188	.8086	.157	39.307	1	201	.000

1. Predictors: (Constant), CASE
2. Predictors: (Constant), CASE, Change in enjoyment of school

Table 8-9 ANOVA - change in attitude to science lessons for girls only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.317	1	6.317	8.120	.005
	Residual	157.138	202	.778		
	Total	163.455	203			
2	Regression	32.020	2	16.010	24.483	.000
	Residual	131.435	201	.654		
	Total	163.455	203			

Table 8-10 Coefficients - change in attitude to science lessons for girls only

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	3.730E-02	.037		1.020	.309
	CASE	-.501	.176	-.197	-2.850	.005
2	(Constant)	.186	.041		4.537	.000
	CASE	-.450	.161	-.177	-2.788	.006
	Change in enjoyment of school	.422	.067	.397	6.270	.000

Table 8-11 Variables used in the regression analysis of the change in perception of the difficulty of written work in science

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.114	.013	.011	.9830	.013	5.719	1	437	.017
2	.282	.080	.075	.9503	.067	31.621	1	436	.000
3	.301	.090	.084	.9457	.011	5.178	1	435	.023

1 Predictors: (Constant), Free school meals % in secondary school

2 Predictors: (Constant), Free school meals % in secondary school, Change in enjoyment of school

3 Predictors: (Constant), Free school meals % in secondary school, Change in enjoyment of school, Change in attitude to schoolwork

Table 8-12 ANOVA - change in perception of the difficulty of written work in science

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.527	1	5.527	5.719	.017
	Residual	422.266	437	.966		
	Total	427.792	438			
2	Regression	34.081	2	17.040	18.871	.000
	Residual	393.712	436	.903		
	Total	427.792	438			
3	Regression	38.712	3	12.904	14.427	.000
	Residual	389.081	435	.894		
	Total	427.792	438			

Table 8-13 Coefficients - change in perception of the difficulty of written work in science

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.296	.081		-3.669	.000
	Free school meals % in secondary school	1.396E-02	.006	.114	2.392	.017
2	(Constant)	-.351	.079		-4.461	.000
	Free school meals % in secondary school	1.174E-02	.006	.096	2.075	.039
	Change in enjoyment of school	-.286	.051	-.259	-5.623	.000
3	(Constant)	-.318	.080		-3.987	.000
	Free school meals % in secondary school	1.120E-02	.006	.091	1.989	.047
	Change in enjoyment of school	-.243	.054	-.220	-4.480	.000
	Change in attitude to schoolwork	-.157	.069	-.111	-2.275	.023

Table 8-14 Variables used in the regression analysis of change in perception of the difficulty of written work in science for boys only

	R					Change Statistics				
Model	**Boys (Selected)**	**Boys (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.156		.024	.020	.9895	.024	5.711	1	229	.018
2	.328		.107	.100	.9485	.083	21.218	1	228	.000
3	.363	.230	.132	.121	.9374	.025	6.428	1	227	.012

1 Predictors: (Constant), Free school meals % in secondary school

2 Predictors: (Constant), Free school meals % in secondary school, Change in enjoyment of school

3 Predictors: (Constant), Free school meals % in secondary school, Change in enjoyment of school, Change in attitude to schoolwork

Table 8-15 ANOVA - change in perception of the difficulty of written work in science for boys only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.591	1	5.591	5.711	.018
	Residual	224.199	229	.979		
	Total	229.790	230			
2	Regression	24.679	2	12.339	13.716	.000
	Residual	205.111	228	.900		
	Total	229.790	230			
3	Regression	30.327	3	10.109	11.505	.000
	Residual	199.463	227	.879		
	Total	229.790	230			

Table 8-16 Coefficients - change in perception of the difficulty of written work in science for boys only

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-.393	.114		-3.448	.001
	Free school meals % in secondary school	1.974E-02	.008	.156	2.390	.018
2	(Constant)	-.417	.109		-3.809	.000
	Free school meals % in secondary school	1.636E-02	.008	.129	2.057	.041
	Change in enjoyment of school	-.310	.067	-.289	-4.606	.000
3	(Constant)	-.373	.110		-3.403	.001
	Free school meals % in secondary school	1.625E-02	.008	.128	2.067	.040
	Change in enjoyment of school	-.245	.071	-.229	-3.437	.001
	Change in attitude to schoolwork	-.221	.087	-.168	-2.535	.012

Table 8-17 Variables used in the regression analysis of change in perception of the difficulty of written work in science for girls only

	R					Change Statistics				
Model	**Girls (Selected)**	**Girls (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.227	.297	.051	.047	.9349	.051	11.090	1	205	.001

1 Predictors: (Constant), Change in enjoyment of school

Table 8-18 ANOVA - change in perception of the difficulty of written work in science for girls only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.694	1	9.694	11.090	.001
	Residual	179.192	205	.874		
	Total	188.885	206			

Table 8-19 Coefficients - change in perception of the difficulty of written work in science for girls only

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-.183	.039		-4.653	.000
	Change in enjoyment of school	-.256	.077	-.227	-3.330	.001

Table 8-20 Variables used in the regression analysis of change in the perceived difficulty of science

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.115	.013	.011	1.0731	.013	5.817	1	435	.016
2	.153	.024	.019	1.0687	.010	4.594	1	434	.033
3	.181	.033	.026	1.0648	.009	4.195	1	433	.041
4	.398	.158	.150	.9945	.125	64.332	1	432	.000

1 Predictors: (Constant), Use of transfer information

2 Predictors: (Constant), Use of transfer information, Secondary teacher's score on the process-content factor

3 Predictors: (Constant), Use of transfer information, Secondary teacher's score on the process-content factor, Change in amount of teacher-directed learning

4 Predictors: (Constant), Use of transfer information, Secondary teacher's score on the process-content factor, Change in amount of teacher-directed learning, Change in enjoyment of school

Table 8-21 ANOVA - change in the perceived difficulty of science

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.698	1	6.698	5.817	.016
	Residual	500.921	435	1.152		
	Total	507.619	436			
2	Regression	11.945	2	5.972	5.229	.006
	Residual	495.675	434	1.142		
	Total	507.619	436			
3	Regression	16.701	3	5.567	4.910	.002
	Residual	490.918	433	1.134		
	Total	507.619	436			
4	Regression	80.332	4	20.083	20.304	.000
	Residual	427.288	432	.989		
	Total	507.619	436			

Table 8-22 Coefficients - change in the perceived difficulty of science

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.124	.061		2.036	.042
	Use of transfer information	-.249	.103	-.115	-2.412	.016
2	(Constant)	.572	.218		2.627	.009
	Use of transfer information	-.281	.104	-.130	-2.706	.007
	Secondary teacher's score on the process-content factor	-.186	.087	-.103	-2.143	.033
3	(Constant)	.522	.218		2.393	.017
	Use of transfer information	-.302	.104	-.140	-2.906	.004
	Secondary teacher's score on the process-content factor	-.184	.086	-.102	-2.133	.033
	Change in amount of teacher-directed learning	4.521E-02	.022	.097	2.048	.041
4	(Constant)	.297	.206		1.443	.150
	Use of transfer information	-.217	.098	-.100	-2.223	.027
	Secondary teacher's score on the process-content factor	-.154	.081	-.085	-1.905	.057
	Change in amount of teacher-directed learning	3.010E-02	.021	.065	1.454	.147
	Change in enjoyment of school	-.431	.054	-.358	-8.021	.000

Table 8-23 Variables used in the regression analysis of change in the perceived difficulty of science for boys only

	R					Change Statistics				
Model	**Boys (Selected)**	**Boys (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.172		.030	.025	1.0940	.030	7.007	1	229	.009
2	.229		.052	.044	1.0834	.023	5.472	1	228	.020
3	.276		.076	.064	1.0723	.023	5.771	1	227	.017
4	.403	.310	.163	.148	1.0230	.087	23.383	1	226	.000

1 Predictors: (Constant), Timetabled time available for liaison

2 Predictors: (Constant), Timetabled time available for liaison, AG5 Five or more A-G grades % in school

3 Predictors: (Constant), Timetabled time available for liaison, AG5 Five or more A-G grades % in school, Number on roll in secondary school

4 Predictors: (Constant), Timetabled time available for liaison, AG5 Five or more A-G grades % in school, Number on roll in secondary school, Change in enjoyment of school

Table 8-24 ANOVA - change in the perceived difficulty of science for boys only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.385	1	8.385	7.007	.009
	Residual	274.063	229	1.197		
	Total	282.448	230			
2	Regression	14.808	2	7.404	6.308	.002
	Residual	267.640	228	1.174		
	Total	282.448	230			
3	Regression	21.444	3	7.148	6.217	.000
	Residual	261.004	227	1.150		
	Total	282.448	230			
4	Regression	45.917	4	11.479	10.968	.000
	Residual	236.532	226	1.047		
	Total	282.448	230			

Table 8-25 Coefficients - change in the perceived difficulty of science for boys only

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-.165	.052		-3.183	.002
	Timetabled time available for liaison	.450	.170	.172	2.647	.009
2	(Constant)	2.639	1.200		2.200	.029
	Timetabled time available for liaison	.528	.172	.203	3.081	.002
	Five or more A-G grades % in school	-3.106E-02	.013	-.154	-2.339	.020
3	(Constant)	2.912	1.193		2.441	.015
	Timetabled time available for liaison	.677	.181	.260	3.748	.000
	Five or more A-G grades % in school	-4.103E-02	.014	-.203	-2.977	.003
	Number on roll in secondary school	5.187E-04	.000	.168	2.402	.017
4	(Constant)	1.812	1.161		1.561	.120
	Timetabled time available for liaison	.614	.173	.235	3.547	.000
	Five or more A-G grades % in school	-2.864E-02	.013	-.142	-2.138	.034
	Number on roll in secondary school	4.386E-04	.000	.142	2.122	.035
	Change in enjoyment of school	-.356	.074	-.300	-4.836	.000

Table 8-26 Variables used in the regression analysis of change in the perceived difficulty of science for girls only

	R					Change Statistics				
Model	**Girls (Selected)**	**Girls (Unselected)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.425	.375	.181	.177	.9492	.181	45.055	1	204	.000

1 Predictors: (Constant), Change in enjoyment of school

Table 8-27 ANOVA - change in the perceived difficulty of science for girls only

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.591	1	40.591	45.055	.000
	Residual	183.789	204	.901		
	Total	224.381	205			

Table 8-28 Coefficients - change in the perceived difficulty of science for girls only

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.154	.040		-3.862	.000
	Change in enjoyment of school	-.525	.078	-.425	-6.712	.000

Table 8-29 Variables used in the regression analysis of change in attitude to using computers in science

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.129	.017	.014	1.0680	.017	6.914	1	410	.009
2	.170	.029	.024	1.0625	.012	5.233	1	409	.023
3	.199	.040	.033	1.0579	.011	4.569	1	408	.033
4	.224	.050	.041	1.0534	.010	4.494	1	407	.035

1 Predictors: (Constant), Timetabled time available for liaison
2 Predictors: (Constant), Timetabled time available for liaison, CASE
3 Predictors: (Constant), Timetabled time available for liaison, CASE, Change in attitude to schoolwork
4 Predictors: (Constant), Timetabled time available for liaison, CASE, Change in attitude to schoolwork, Change in enjoyment of school

Table 8-30 ANOVA - change in attitude to using computers in science

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.886	1	7.886	6.914	.009
	Residual	467.659	410	1.141		
	Total	475.545	411			
2	Regression	13.794	2	6.897	6.109	.002
	Residual	461.751	409	1.129		
	Total	475.545	411			
3	Regression	18.908	3	6.303	5.631	.001
	Residual	456.637	408	1.119		
	Total	475.545	411			
4	Regression	23.895	4	5.974	5.383	.000
	Residual	451.649	407	1.110		
	Total	475.545	411			

Table 8-31 Coefficients - change in attitude to using computers in science

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.625	.037		-16.913	.000
	Timetabled time available for liaison	.326	.124	129	2.629	.009
2	(Constant)	-.697	.049		-14.361	.000
	Timetabled time available for liaison	.412	.129	.163	3.197	.001
	CASE	.354	.155	.117	2.288	.023
3	(Constant)	-.713	.049		-14.581	.000
	Timetabled time available for liaison	.418	.128	.165	3.254	.001
	CASE	.357	.154	.118	2.321	.021
	Change in attitude to schoolwork	.159	.074	.104	2.138	.033
4	(Constant)	-.756	.053		-14.351	.000
	Timetabled time available for liaison	.421	.128	.167	3.296	.001
	CASE	.341	.153	.112	2.220	.027
	Change in attitude to schoolwork	.219	.079	.143	2.762	.006
	Change in enjoyment of school	-.132	.062	-.110	-2.120	.035

Table 8-32 Variables used in the regression analysis of change data for school attitude

ASIAN
ESWI
Gender
CURFOCUS
Free school meals % in primary school
Number on roll in secondary schoolP number on roll
SATS % level 4 or above in 1996 SATs tests
Special educational needs % in primary school
SUBJCT
TOPIC
Number on roll in year 6
Length of non-teaching employment
Length of primary teaching employment
MFF
QUALGP6
AC5 % with five or more A-C grades
One or more A-G grades % in school
AG5 Five or more A-G grades % in school
AUTHABS Authorised absences % half days missed
GROUPING ability grouping
Free school meals % in secondary school
MSANDSS
PCTNEEDS
PCTSTMNT
Number on roll in secondary school
Selective or non-selective school
Unauthorised absences % half days missed
Number on roll in year 7
INDUCT Number of half day sessions used for induction
CASE

Table 8-33 Variables used in the regression analysis of change in enjoyment of school

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.095	.009	.007	.8251	.009	4.005	1	438	.046
2	.138	.019	.015	.8219	.010	4.462	1	437	.035
3	.219	.048	.041	.8106	.029	13.234	1	436	.000

1 Predictors: (Constant), Gender
2 Predictors: (Constant), Gender, TOPIC
3 Predictors: (Constant), Gender, TOPIC, INDUCT Number of half day sessions used for induction

Table 8-34 ANOVA - change in enjoyment of school

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.726	1	2.726	4.005	.046
	Residual	298.182	438	.681		
	Total	300.908	439			
2	Regression	5.740	2	2.870	4.249	.015
	Residual	295.168	437	.675		
	Total	300.908	439			
3	Regression	14.435	3	4.812	7.323	.000
	Residual	286.473	436	.657		
	Total	300.908	439			

Table 8-35 Coefficients - change in enjoyment of school

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-4.590E-02	.120		-.382	.703
	Gender	-.158	.079	.095	-2.001	.046
2	(Constant)	-2.832E-03	.121		-.023	.981
	Gender	-.159	.078	-.096	-2.020	.044
	TOPIC	-.206	.097	-.100	-2.112	.035
3	(Constant)	.206	.133		1.552	.121
	Gender	-.125	.078	-.076	-1.606	.109
	TOPIC	-.140	.098	-.068	-1.434	.152
	Number of half day sessions used for induction	-.109	.030	-.174	-3.638	.000

Table 8-36 Kruskall Wallis test rankings: classroom activities/secondary teacher science and technology factor scores

	F2 group	N	Mean Rank
Collaborative learning in year 7	1.00	588	820.85
	2.00	668	823.11
	3.00	417	882.03
	Total	1673	
Student-directed learning in year 7	1.00	565	779.58
	2.00	616	748.56
	3.00	390	854.43
	Total	1571	
Standardised learning in year 7	1.00	533	786.69
	2.00	644	770.45
	3.00	400	821.95
	Total	1577	
Teacher-directed learning in year 7	1.00	653	990.41
	2.00	731	877.74
	3.00	449	874.14
	Total	1833	
Change in amount of teacher-directed learning	1.00	376	557.24
	2.00	457	494.85
	3.00	227	557.98
	Total	1060	
Change in amount of standardized learning	1.00	242	338.54
	2.00	301	350.11
	3.00	141	333.05
	Total	684	
Change in amount of student-directed learning	1.00	278	395.83
	2.00	343	377.53
	3.00	164	420.56
	Total	785	
Change in amount of collaborative learning	1.00	322	463.57
	2.00	408	470.18
	3.00	210	481.75
	Total	940	

Table 8-37 Kruskall Wallis test statistics: classroom activities/secondary teacher science and technology factor scores

	Chi-Square	df	Asymp. Sig.
Collaborative learning in year 7	4.900	2	.086
Student-directed learning in year 7	14.216	2	.001
Standardised learning in year 7	3.289	2	.193
Teacher-directed learning in year 7	20.097	2	.000
Change in amount of teacher-directed learning	11.082	2	.004
Change in amount of standardised learning	.879	2	.644
Change in amount of student-directed learning	4.139	2	.126
Change in amount of collaborative learning	.576	2	.750

Grouping Variable: Secondary teachers science and technology factor group

Table 8-38 Secondary teachers' science and technology factor group by level of student-directed classroom activity

Student-directed learning in year 7	Secondary teachers' science and technology factor group					
	Low		Average		High	
	n	%	n	%	n	%
.00	214	37.9	245	39.8	116	29.7
1.00	134	23.7	170	27.6	104	26.7
2.00	97	17.2	83	13.5	76	19.5
3.00	77	13.6	67	10.9	38	9.7
4.00	31	5.5	26	4.2	35	9.0
5.00	3	.5	15	2.4	12	3.1
6.00	4	.7	8	1.3	6	1.5
7.00	3	.5			1	.3
8.00	2	.4	2	.3	2	.5

Table 8-39 Secondary teachers' science and technology factor group by level of teacher-directed classroom activity

Teacher-directed learning in year 7	Secondary teachers' science and technology factor group					
	Low		Average		High	
	n	%	n	%	n	%
.00	2	.3	1	.1	1	.2
1.00	6	.9	22	3.0	14	3.1
2.00	52	8.0	79	10.8	42	9.4
3.00	88	13.5	116	15.9	78	17.4
4.00	130	19.9	140	19.2	93	20.7
5.00	139	21.3	174	23.8	95	21.2
6.00	110	16.8	112	15.3	73	16.3
7.00	75	11.5	51	7.0	35	7.8
8.00	51	7.8	36	4.9	18	4.0

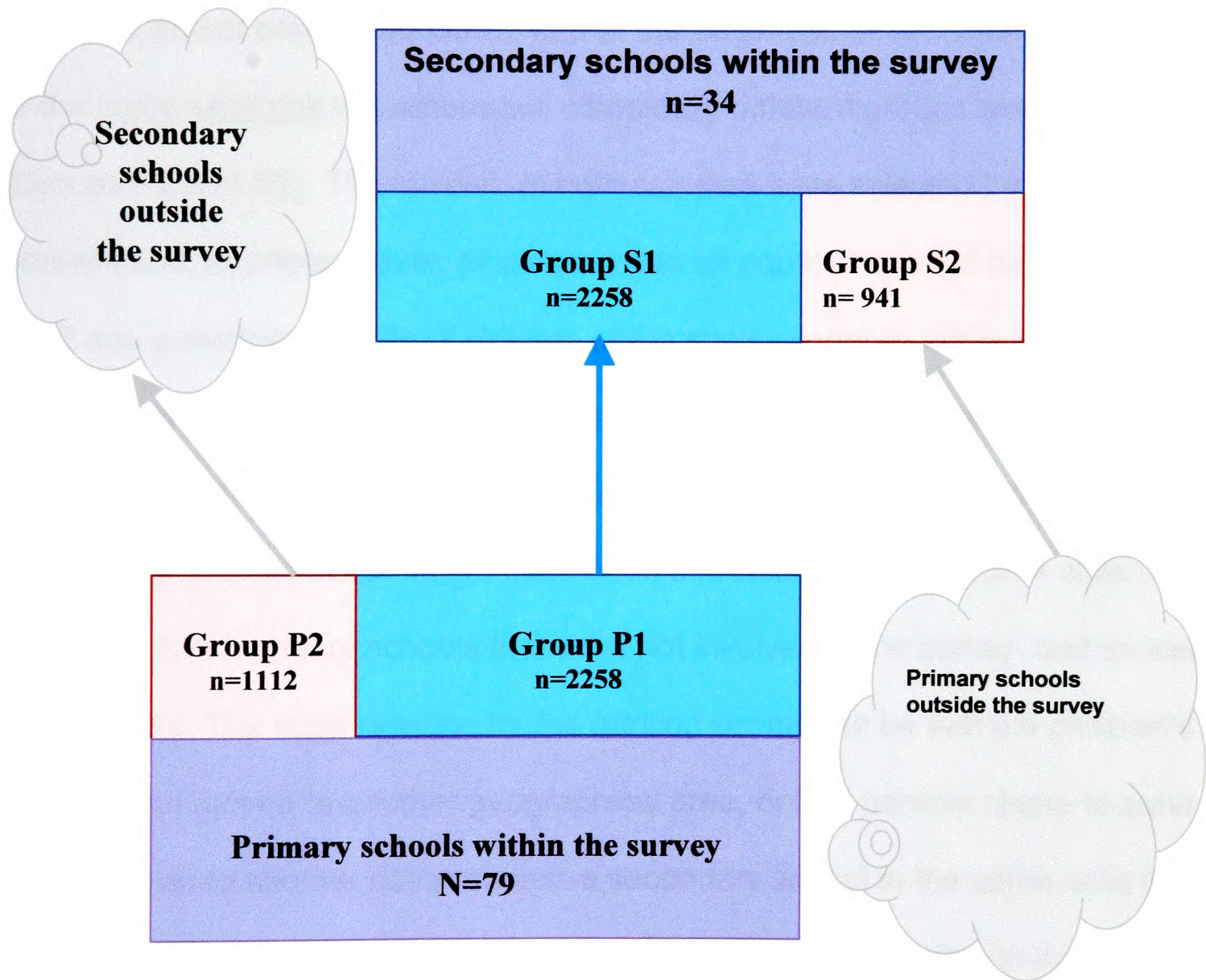
Table 8-40 Secondary teachers' science and technology factor group by change in teacher-directed classroom activity

Change in amount of teacher-directed learning	Secondary teachers' science and technology factor group					
	LOW		AVERAGE		HIGH	
	n	%	n	%	n	%
-7.00			1	.2		
-6.00	1	.3	3	.7		
-5.00	1	.3	1	.2	1	.4
-4.00	6	1.6	4	.9	1	.4
-3.00	3	.8	20	4.4	10	4.4
-2.00	23	6.1	31	6.8	8	3.5
-1.00	33	8.8	57	12.5	22	9.7
.00	56	14.9	75	16.4	34	15.0
1.00	61	16.2	78	17.1	32	14.1
2.00	65	17.3	64	14.0	40	17.6
3.00	58	15.4	46	10.1	39	17.2
4.00	32	8.5	42	9.2	18	7.9
5.00	24	6.4	17	3.7	11	4.8
6.00	11	2.9	9	2.0	9	4.0
7.00	2	.5	7	1.5	1	.4
8.00			2	.4	1	.4

APPENDIX 9 COMPARING CROSS-SECTIONAL AND LONGITUDINAL METHODS

During the present study, circumstances provided an opportunity to make comparisons between cross-sectional and longitudinal data (Figure 9-1).

Figure 9-1 The longitudinal and cross-sectional groups involved in the survey



Over 1000 children who were part of the survey when at primary school moved to secondary schools outside the survey group (Group P2). In some of the secondary schools the complete populations of year 7 were surveyed, and not only those children studied the previous year. This led to the addition of more than 900 children at secondary school, who were not part of the original sample (Group S2). So, in effect, two separate data sets were obtained: a longitudinal set, where the same group of children (Group P1 / S1), were surveyed on two separate occasions, i.e. at the end of primary schooling and at the beginning of secondary schooling, and a cross-sectional set, where two completely different groups were surveyed (Groups P2 and S2). The children in both samples were selected by the same process and, at primary level, all children had an equal chance of being selected, so, it was a random sample of children in the survey schools. Although these original samples were random and representative, the subsequent longitudinal and cross-sectional samples may have elements of bias within them. In the case of the longitudinal group, attrition might have been a problem because some children moved on to secondary schools that were not involved in the survey, and so were not included. The main reasons for the attrition seemed to be that the children's families had moved to another geographical area, or that parents chose to send their children to another comprehensive secondary school in the same area (but not selected for the survey), or to a selective school (only possible in half of the 6 Essex LEA divisions). So an element of social selection may have been operating. As regards the secondary school cross-sectional sample, the potential for bias here arose from the unknown background of the group. Although the children making up the cross-sectional group were attending the same schools as those in the longitudinal group, their originating primary schools were not known. In cross-

sectional surveys the two groups should be representative, non- biased and large (for example see Robson, 1996), but for these present groups neither of the first two criteria was exactly met.

Although the total sample sizes were similar, (cross-sectional n= 2053 and longitudinal n= 2258: see Table 9.1 below), the sample size at each stage was different; the longitudinal sample in both years was approximately twice as large as the cross-sectional sample. The sample size has a bearing on the standard error, the larger the sample the smaller the error and the higher the degree of confidence in the results. The improved accuracy from larger samples is not always worth the additional cost and time, but when *attitudes* are under investigation there is likely to be a large amount of variability, and consequently a larger sample is required.

Table 9-1 Size of cross-sectional and longitudinal samples

Type of sample	Year of schooling	Number of children
Cross-sectional	Y6	1112
	Y7	941
Longitudinal	Y6	2258
	Y7	2258

The primary school samples can be considered comparable since the children were a random group, they came from the same group of schools and their sub-scale scores show no significant differences. However, the year seven data must be treated with more caution. As Table 9.2 indicates the secondary cross-sectional sample probably had a higher proportion of children from more affluent areas, since these schools had better academic results, a lower proportion of children with special needs, free school meals and absences.

Table 9-2 Comparison of school structural data for secondary schools in cross-sectional and longitudinal samples.

	Longitudinal		Cross-sectional	
	Mean	Valid N	Mean	Valid N
% with five or more A-C grades	42.58	2258	49.71	941
One or more A-G grades	95.45	2258	95.48	941
Five or more A-G grades % in school	90.81	2258	92.06	941
Authorised absences % half days missed	8.26	2258	7.83	941
Free school meals %	13.37	2230	9.61	941
School roll	1146.66	2230	898.97	941
Unauthorised absences % half days missed	0.67	2258	0.47	941
% with special needs	13.15	2230	11.76	943
% with statement	1.59	2230	1.96	943

These differences probably arose because the year seven populations of two grammar schools were included. Unfortunately, this aspect of potential bias cannot be removed by simply excluding the grammar schools from the analysis, because it is reasonable to assume that some of the children from group P2 moved on to grammar schools[1]. So, excluding the grammar schools from the secondary school groups (S1 & S2) would mean that group P2 would then contain a greater proportion of the more able, or affluent, section of society, than group P1. Consequently, the bias would simply be moved from secondary to primary level.

In the following section, these two data sets will be compared and the following issues will be discussed:

1. The conclusions arising from the cross-sectional and the longitudinal survey data will be compared, and their reliability assessed.
2. The relative usefulness of the two sets of results.

[1] Some of the children in Group P2, who were interviewed at primary school, said that they had taken the 11+ examination and were hoping to go on to a grammar school.

9.1 CROSS-SECTIONAL AND LONGITUDINAL COMPARISONS

When mean differences are examined, both cross-sectional and longitudinal data indicate the same trends (Figures 9.2-9.5). Overall, on transfer, there is a decline in the enjoyment of science and of school (Figures 9.2 & 9.3).

Figure 9-2 Comparison of changes in enjoyment of science on transfer for longitudinal and cross-sectional data

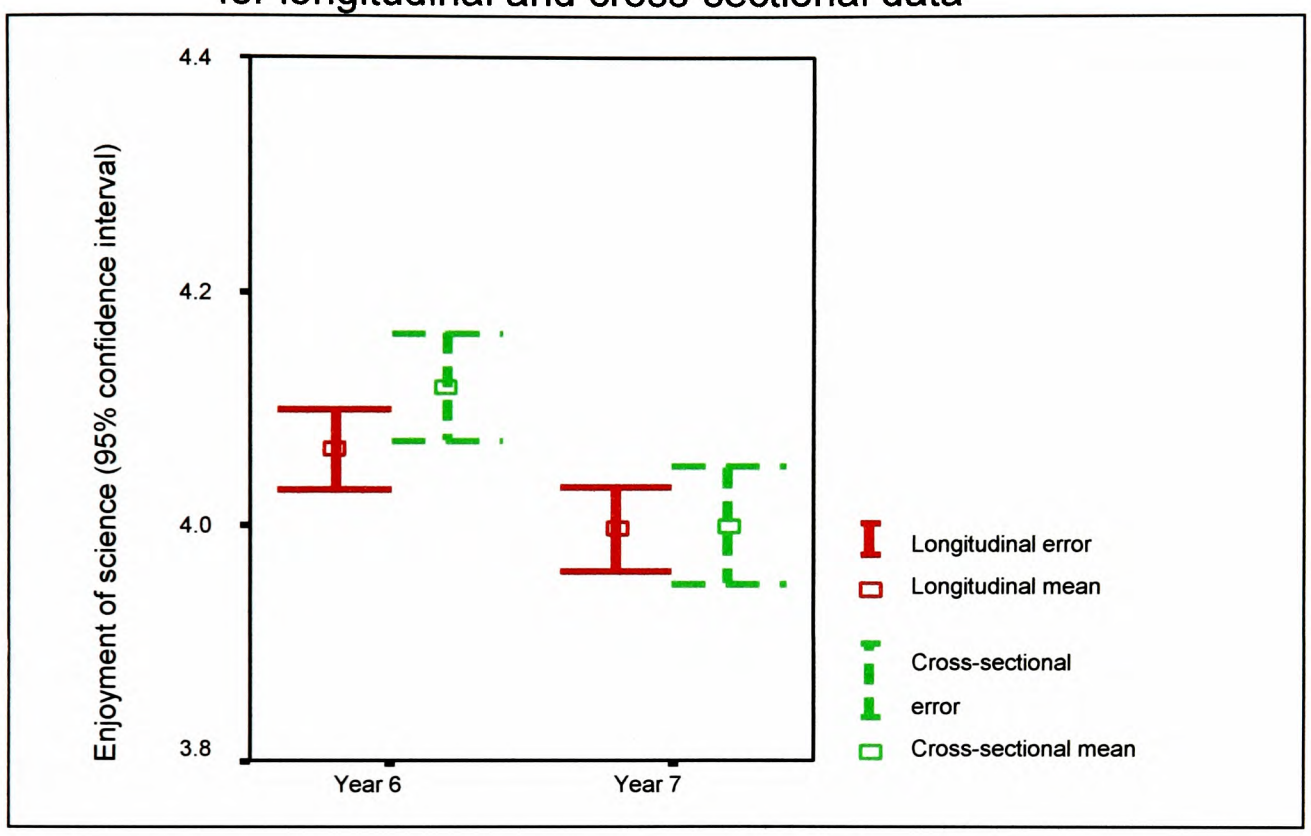
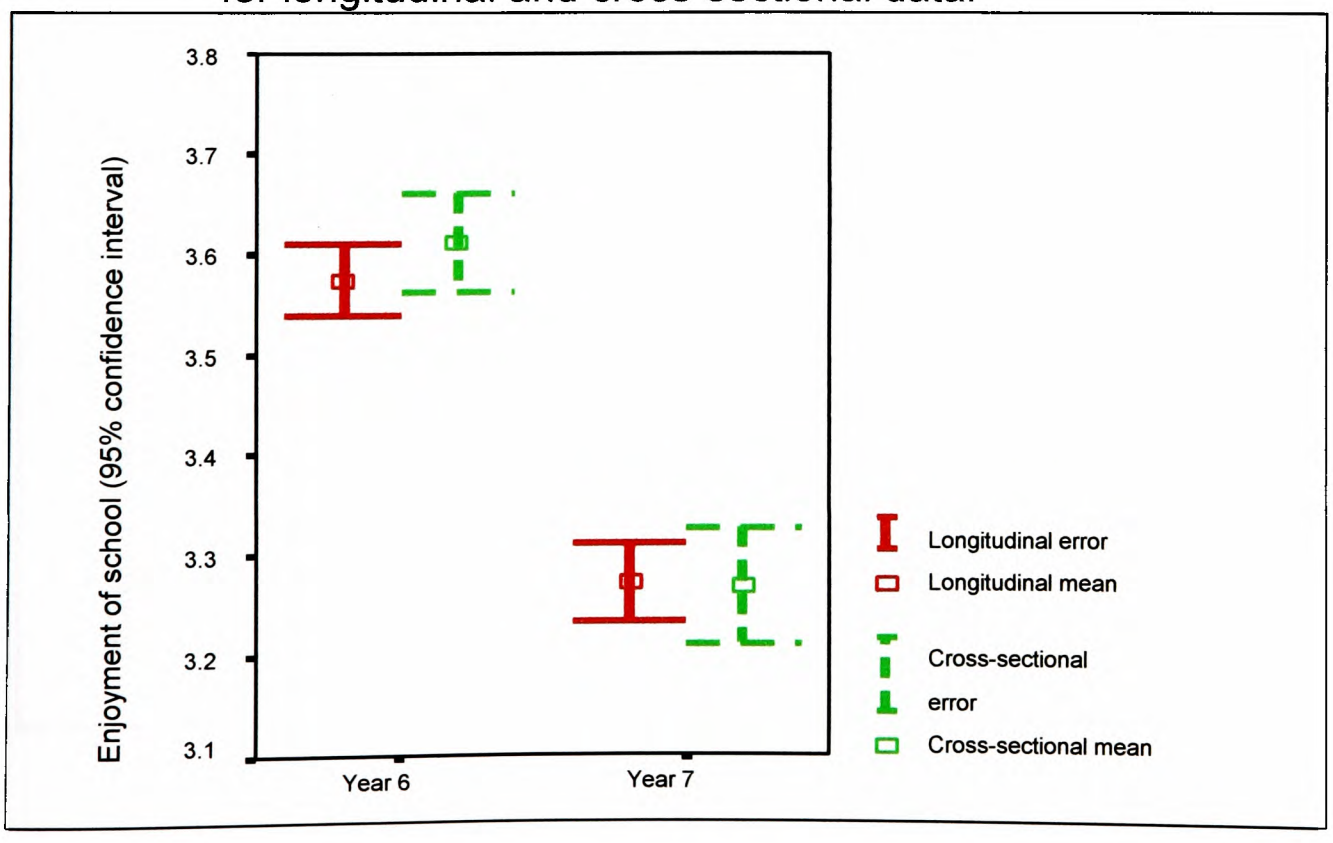


Figure 9-3 Comparison of changes in enjoyment of school on transfer for longitudinal and cross-sectional data.



However, the 'facility' of science improves and written work is regarded as considerably easier (Figures 9.4 & 9.5) at secondary school.

Figure 9-4 Comparison of changes in facility of science on transfer for longitudinal and cross-sectional data.

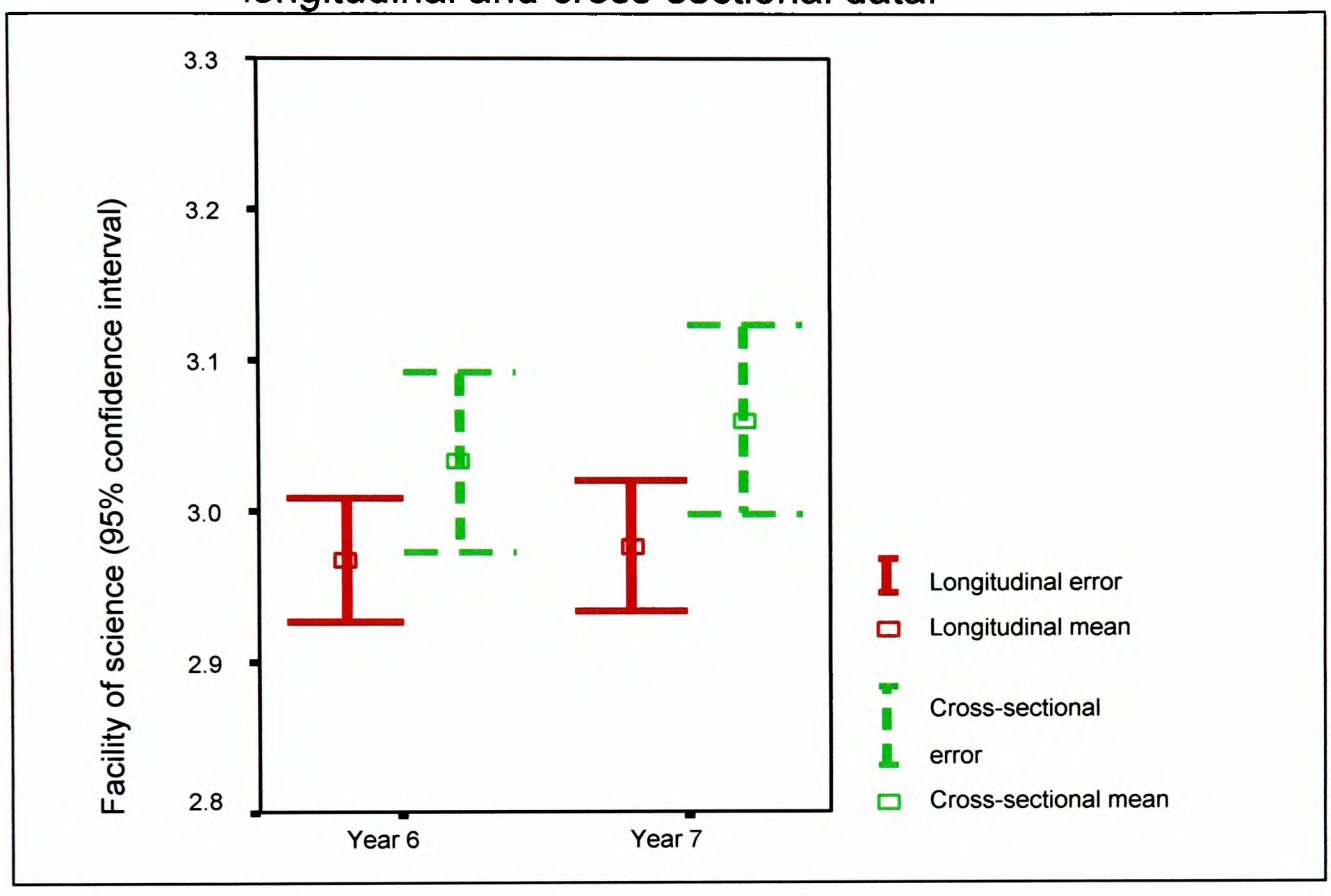
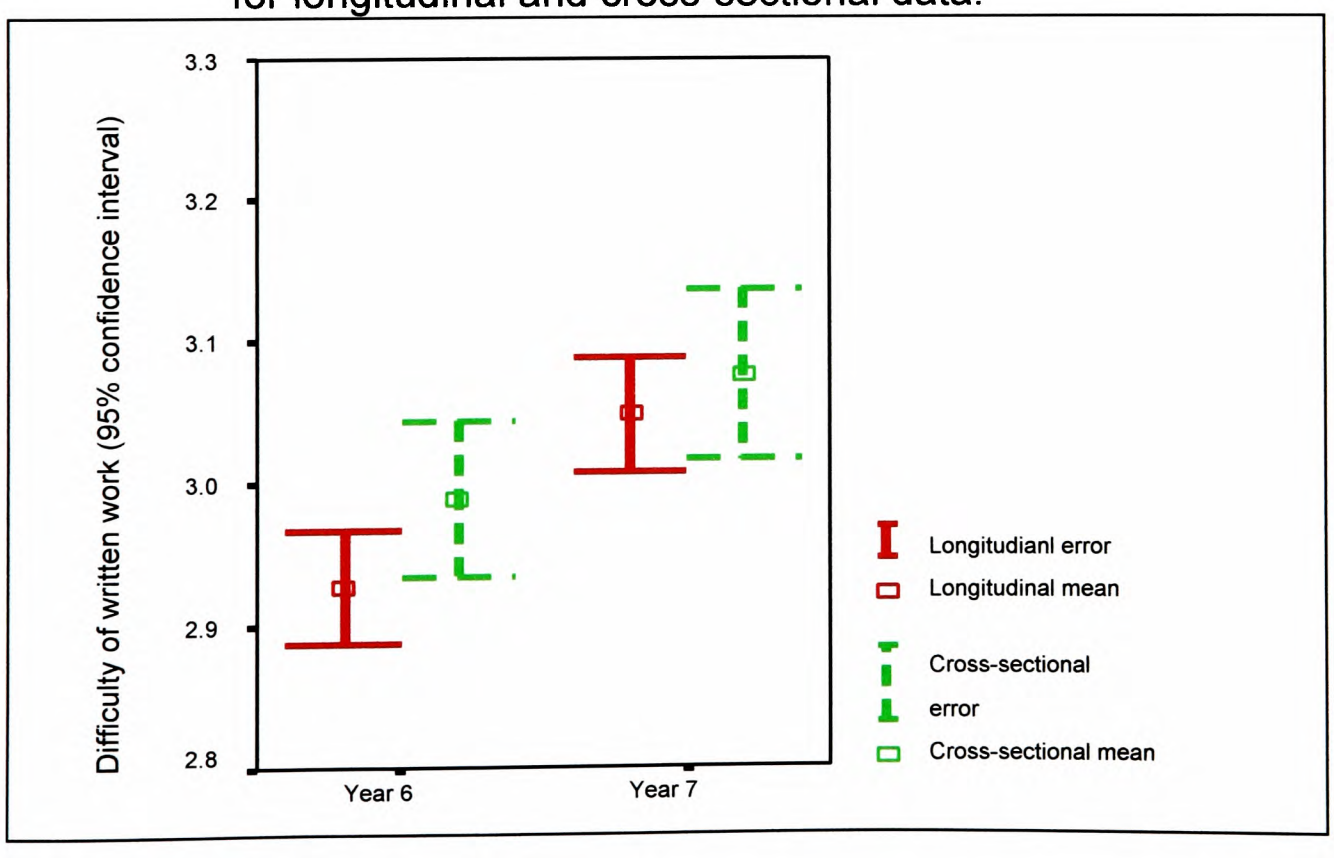


Figure 9-5 Comparison of changes in difficulty of science writing on transfer for longitudinal and cross-sectional data.



So, there appear to be no significant differences between these two data sets. However, inconsistencies emerge when gender differences are investigated. The longitudinal data analyses indicate that there are significant differences between the attitudes of boys and girls in both years six and seven (Figure 9.6). With respect to these findings, it was argued earlier that gender differences exist in primary school and continue across the divide into secondary school. However, the cross-sectional data seems to suggest a different view (Figure 9.7). The enjoyment of science seems to be greater for boys than for girls in year six, but on transfer, t-tests suggest that there is no significant difference between boys' and girls' enjoyment. Using this cross-sectional evidence alone, it might be thought that gender differences become insignificant on transfer to secondary school. However, all of the above analysis relies on comparisons of mean values using t-tests with a 95% confidence interval.

Figure 9-6 Comparison by gender of changes in enjoyment of science on transfer: longitudinal sample.

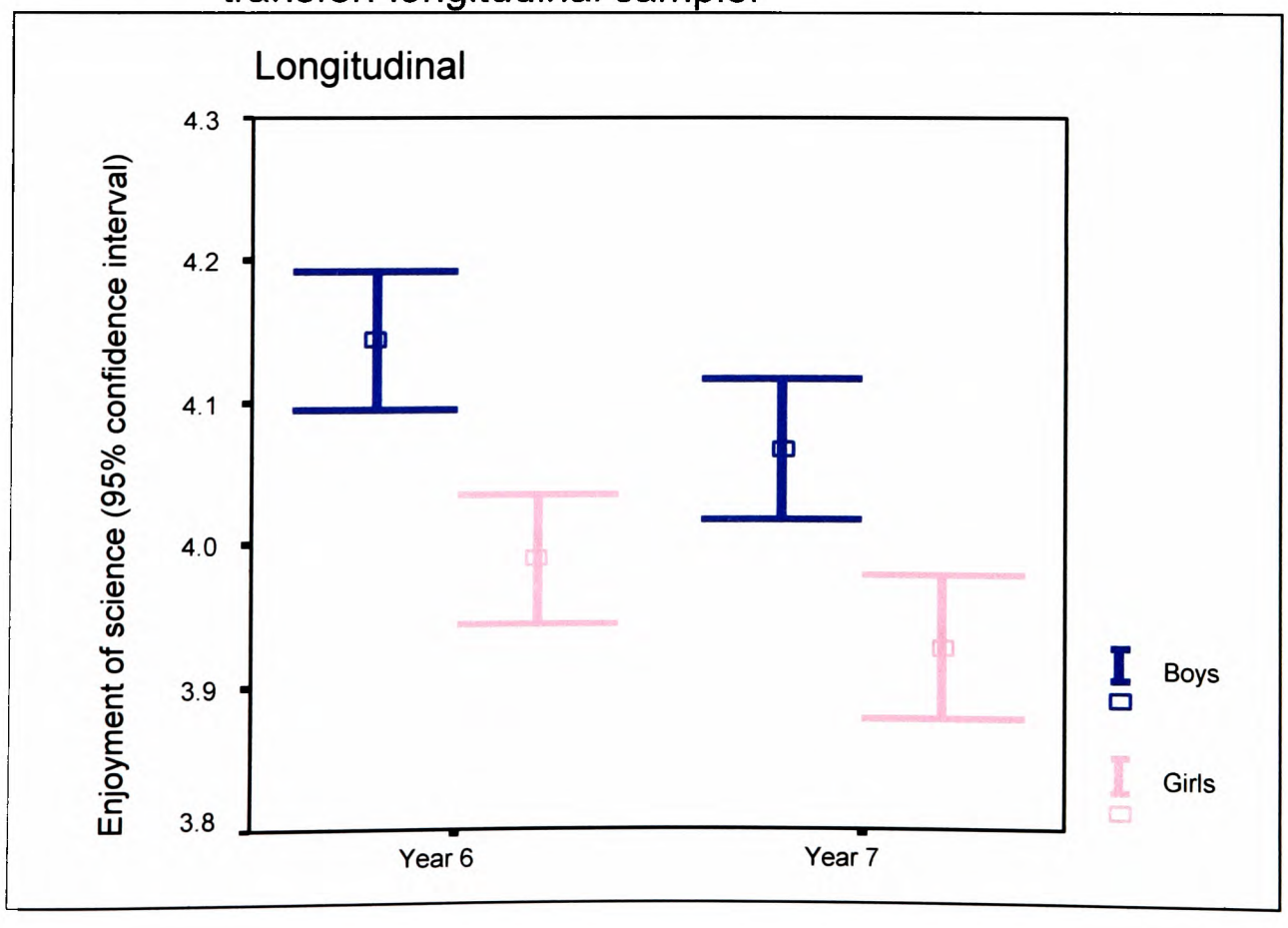
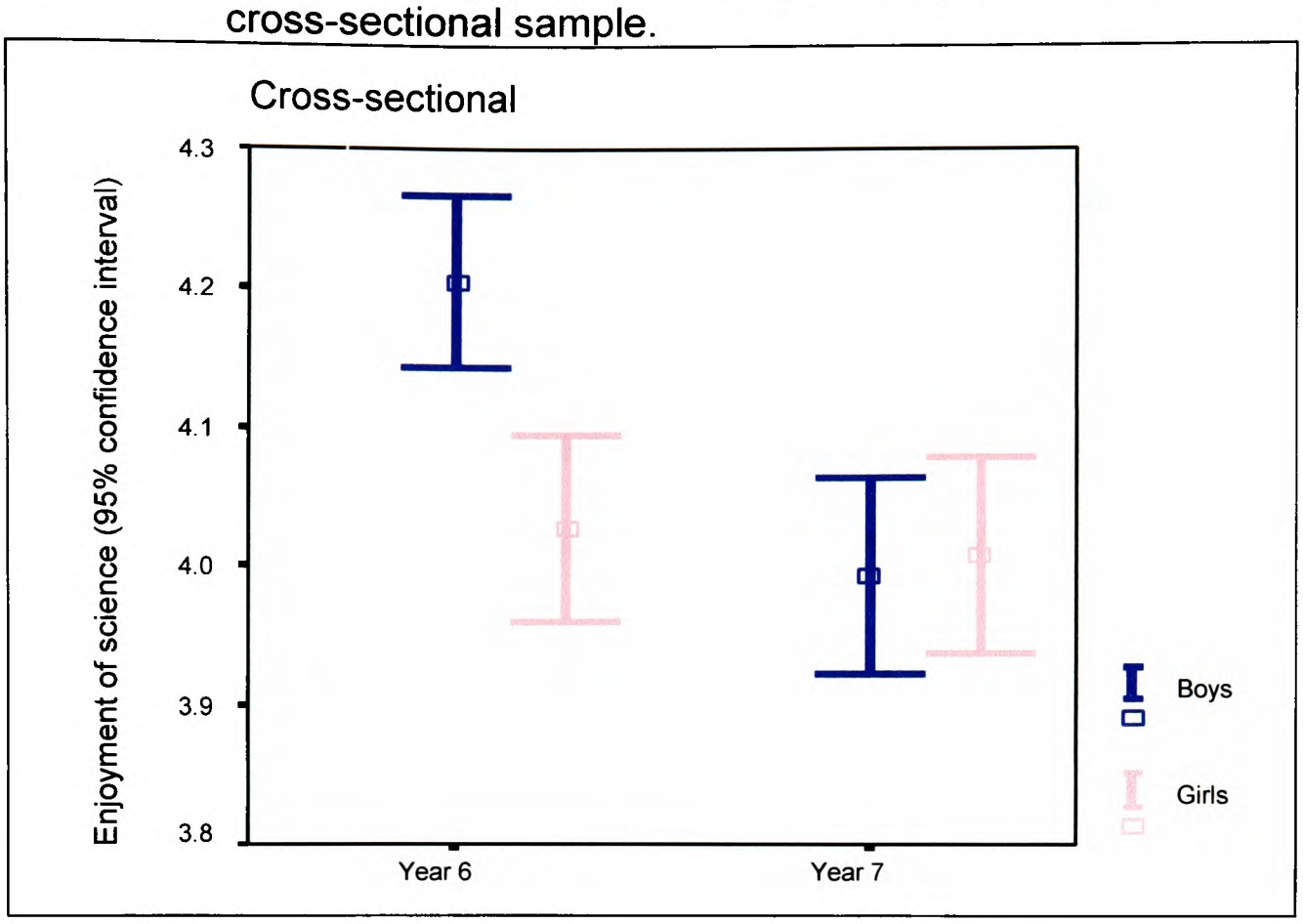


Figure 9-7 Comparison by gender of changes in enjoyment of science on transfer: cross-sectional sample.



When error bars are examined (an indication of the confidence intervals), it can be seen that the error bars for the cross-sectional data are much larger than for the longitudinal data, particularly for the year 7 data, suggesting lower levels of reliability (Figures 9.2-9.7). Furthermore, the degree of overlap between the longitudinal and cross-sectional error bars means that the two sets of results comparing gender differences (Figures 9.6 & 9.7) cannot be regarded as significantly different. However, in view of the size of the cross-sectional error bars, it is felt that the value of the cross-sectional data is questionable. Since longitudinal data relies on responses from the same people on two different occasions, it seems unlikely that this cross-sectional data using unmatched samples is be more reliable than the longitudinal data.

All the data in the present study was obtained from large samples of children, drawn from the same primary and secondary schools. Furthermore, the data was obtained by the same methods and using the same instruments, and so it

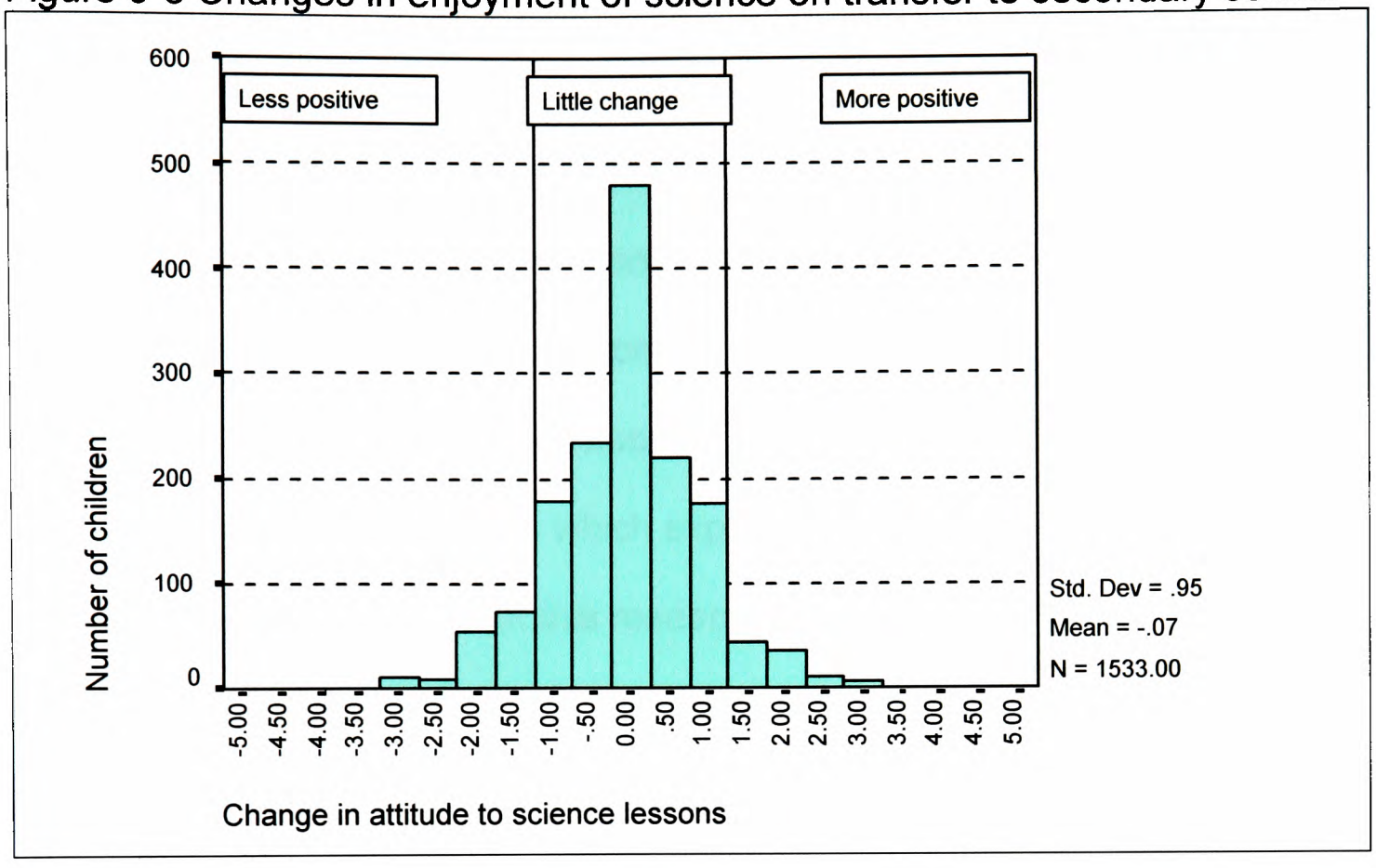
might be expected to yield similar results. But the size of the errors in the cross-sectional results indicates that this data is considerably less reliable than the longitudinal data. Consequently, it is suggested that cross-sectional analysis in general needs to be considered critically in the context of the sample size and the nature of the sampling. Unless the samples are sufficiently large and properly randomised, or matched, it seems probable that the results obtained may not be reliable, and that longitudinal data should be used in preference.

9.2 THE VALUE OF THE DATA AND ITS CONSEQUENT ANALYSES

The above discussion focused on the *differences* between the primary and secondary data, and using this approach it was possible to demonstrate that both types of data produced similar trends. However, that is the limit of its usefulness. Cross-sectional approaches can only reveal either a general improvement or a general decline in attitudes, and thus the conclusion may be reached that overall the transfer from primary to secondary school has a negative impact on children's attitudes. However, as will be illustrated below, the longitudinal approach leads to a different interpretation, wherein positive and negative influences may be seen. The longitudinal data may be represented as change data for each individual child, for example in Figure 9.8 changes in the enjoyment of science are shown. These changes were obtained by subtracting the individual enjoyment of science scores at secondary school from those obtained at primary level, as indicated below:

Enjoyment of science in Y7	-	Enjoyment of science in Y6	=	Change in enjoyment of science

Figure 9-8 Changes in enjoyment of science on transfer to secondary school



It is clear from Figure 9.8 that the suggestion of a general decline in enjoyment of science, on transfer to secondary school, is rather simplistic. Although some children do become less enthusiastic about science, others become more so. However, for the majority there is little change in attitude. It is here that the greater power of longitudinal data becomes evident. Groups of children, who change in particular ways, may be identified and studied further if a longitudinal approach is used but not if cross-sectional data is gathered.

As discussed in Chapter 3, a problem of correlation studies is that two variables may be apparently significantly related as a result of the effect of other variables. Accordingly, methods of control are generally included: partial correlation coefficients or regression analyses are often used for this purpose.

In the present study, the *whole* sample was analysed at primary level (P1 + P2) and again at secondary level (S1+ S2), using a regression model, which included variables relating to the *current* year (see Chapter 5). These analyses

produced a large number of potential relationships. However, when the whole sample was analysed, it was not possible to control for previous events, and so it is possible that some of these relationships were not actually important at all. This is a particular difficulty with cross-sectional data sets since it is not possible to control for the previous events and conditions of the respondents. However, in longitudinal studies, earlier events may be included in the analysis. In the present study, this was done by building a model, which explicitly included previous experiences and attitudes. Two examples from this research, using the longitudinal model, are given here to show the effect of this type of analysis.

In individual primary and secondary level analyses, teacher variables, such as qualifications and previous work experience are shown as being significantly related to children's attitude to science. However, the analyses of the change data indicate that only the teachers' general *view of science* is important. Views about the nature of science may arise from some formal training, or earlier work experience, but could also be the outcome of many other experiences. So, here the analysis of the longitudinal data suggests that, although INSET and formal science qualifications have a part to play in shaping teachers' views of science, these factors alone are not the important issue. Ultimately it is the teacher's personal view of science that is important. Liaison activities appear as significant factors in the secondary level analyses, but in the analyses of the change data, these variables are not significant. Instead, they are subsumed into the change in attitude to school, indicating that liaison activities affect the general feeling about school rather than attitudes to specific subjects. This is important, in that it suggests that liaison activities are only influencing pastoral issues and not furthering curriculum or subject pedagogy.

9.3 SUMMARY

It is generally recognised that cross-sectional data is cheaper and quicker to acquire than longitudinal data (for example, see Cohen and Manion, 1994). However, cost and speed must surely take second place to reliability and usefulness. The comparison of the two data sets in this study suggests that unless cross-sectional samples are very carefully chosen so as to be closely comparable, and are also large, then the results are likely to be unreliable. Secondly, the value of cross-sectional data is limited, showing only very general trends, and furthermore it is not possible to follow changes for individual groups. Thus, although cross-sectional comparisons may be used to indicate general trends for large random samples of the population, they do not appear to be appropriate when dealing with small non-random samples. As Travers (1969) says:

'...cross-sectional studies are a highly unsatisfactory way of obtaining developmental data except for the crudest purposes'

APPENDIX 10 YEAR 8 QUESTIONNAIRE RESPONSES

Table 10-1: Year 8 responses to school items

No.	Item	Boys						Girls					
		N	SA %	A %	U %	D %	SD %	N	SA %	A %	U %	D %	SD %
6	I enjoy everything about school	1,086	0.70	8.68	11.42	22.20	7.58	969	1.02	7.90	14.39	21.97	4.14
7	I am bored most of the time at school	1,090	2.56	9.63	8.39	21.91	7.77	983	2.10	6.76	9.01	26.26	5.59
8	There are lots of school subjects I don't like	1,094	3.71	15.78	7.27	17.63	5.65	999	2.71	14.15	7.50	21.11	4.49
9	I get good marks for my work	1,038	4.92	26.05	15.32	2.90	0.81	943	2.82	29.76	13.15	3.39	0.89
10	I always work as hard as I can at school	1,081	9.65	20.24	12.00	8.00	0.39	986	11.92	20.63	8.94	7.37	0.86
11	I always behave badly at school	1,080	0.54	1.39	5.10	18.38	24.63	994	0.15	0.62	2.93	17.84	28.42
12	School is not very enjoyable	1,097	5.26	10.36	11.06	17.25	6.65	984	3.17	8.66	11.68	19.41	6.50

Table 10-2: Year 8 responses to science items

No.	Item	Boys						Girls					
		N	SA %	A %	U %	D %	SD %	N	SA %	A %	U %	D %	SD %
13	I look forward to science lessons	1,077	5.07	19.44	14.91	6.79	3.98	979	3.28	14.13	15.22	12.80	4.37
14	Science is more interesting when we use computers	892	10.13	16.23	10.13	9.94	2.72	832	4.97	16.51	10.88	15.20	3.28
15	The calculations we do in science are difficult	1,033	3.59	11.41	16.95	15.65	2.61	923	2.44	13.20	18.17	13.61	2.36
16	I don't like science lessons	1,092	2.71	4.65	8.21	20.45	14.48	981	2.79	7.67	9.76	20.06	9.22
17	Science has ruined the environment	944	3.42	4.23	13.68	16.56	13.05	833	1.98	3.69	16.38	16.47	10.53
18	There are too many facts to learn in science	1,067	5.58	15.95	9.74	14.77	3.93	982	3.53	17.12	11.78	14.69	2.91
19	Using a computer makes science so interesting I don't want to stop	901	5.50	9.00	11.56	14.60	9.29	820	3.03	4.55	11.85	20.85	9.76
20	There are too many new words to learn in science	1,083	5.32	17.93	9.63	13.94	3.76	978	3.76	18.87	11.04	13.23	2.51
21	I like doing experiments	1,110	36.63	11.65	1.07	0.15	0.84	1,005	26.05	19.35	1.90	1.37	0.99
22	When I use a computer in science I understand things better	837	8.78	14.61	15.22	8.48	2.55	769	3.27	10.42	19.31	12.87	4.49
23	I already know the science my teacher teaches us	1,056	1.12	4.73	13.31	22.69	8.10	949	0.96	3.29	8.74	27.59	9.46
24	Scientific discoveries do more harm than good	919	2.09	6.28	19.12	17.32	7.61	756	1.71	4.19	24.07	14.84	2.76
25	I'm not always sure how to write about experiments I have done	1,091	4.02	21.42	9.28	12.92	2.40	1,002	2.32	20.96	6.19	16.78	3.71
26	The ideas we learn about in science are too easy	1,067	1.26	3.39	8.83	28.71	7.73	981	0.63	2.68	9.70	31.47	5.60
27	Doing experiments is a waste of time	1,100	0.46	0.54	2.54	12.69	34.08	994	0.38	0.85	2.31	20.77	25.38
28	I like doing calculations in science	1,023	3.00	9.33	15.40	13.41	9.16	898	1.25	6.49	14.99	17.82	9.16
29	Science is difficult when it involves writing	1,084	4.23	8.38	12.22	19.50	6.11	981	1.64	5.79	8.69	24.82	8.61
30	I enjoy going to science lessons	1,074	8.81	17.62	14.79	5.35	3.78	972	5.74	15.89	14.16	8.34	5.51
31	There are too many new ideas to learn about in science	1,069	3.74	12.49	14.48	16.79	3.42	946	2.07	12.57	14.24	17.02	3.18
32	I don't understand the calculations we do in science	1,028	3.07	6.88	15.08	20.46	4.97	909	2.07	10.52	17.40	16.32	3.23
33	Science is our worst enemy	1,060	2.27	2.35	6.07	15.21	24.68	950	2.51	3.96	6.80	19.50	16.67
34	I already know most of the science we have done this year	1,078	1.35	6.34	11.66	23.63	7.45	967	0.87	6.82	8.41	24.50	8.96
35	Writing about why I did an experiment is difficult	1,064	4.06	14.01	11.39	16.32	4.46	963	2.71	10.67	11.54	19.59	5.25

Table 10-3: Year 8 responses to classroom activities items

No.	Item	Boys						Girls					
		N	Never %	Less than half lessons %	Half of lessons %	More than half lessons %	Every lesson %	N	Never %	Less than half lessons %	Half of lessons %	More than half lessons %	Every lesson %
36	We use text books	1,086	22.0	30.1	22.2	23.8	1.8	978	18.4	29.0	24.4	25.8	2.4
37	We use library books	1,006	.4	.4	2.3	28.9	68.0	902	.6	1.1	2.9	27.2	68.3
38	We copy the teacher's notes from the board or worksheet	1,094	25.8	30.2	23.3	19.2	1.6	997	26.7	27.7	24.1	19.3	2.3
39	We make up our own experiments and the teacher helps us to make a plan to do them	1,031	1.7	5.2	6.8	23.1	63.1	914	1.6	4.5	6.1	24.7	63.0
40	We choose the topics we want to study	1,068	.3	.7	1.7	4.5	92.9	976	.3	.4	1.1	5.4	92.7
41	We talk in a group about our ideas	1,039	9.2	15.5	22.4	30.3	22.5	950	8.0	15.2	23.7	36.6	16.5
42	We talk to the teacher about our ideas	1,054	16.1	19.6	22.3	26.6	15.4	936	13.8	17.7	24.8	25.3	18.4
43	We have tests on what we have learned	1,030	8.3	17.1	27.0	46.0	1.7	940	6.6	16.6	34.7	40.5	1.6
44	We work in small groups to do experiments	1,089	27.3	38.0	22.5	11.0	1.2	987	24.6	42.9	20.7	10.1	1.7
45	We work on our own to do experiments	1,056	1.3	3.2	5.9	24.7	64.9	959	.9	2.2	6.4	24.8	65.7
46	We watch the teacher do experiments	1,090	9.5	21.6	25.0	39.1	4.8	977	10.0	22.4	28.8	35.0	3.8
47	We use computers	1,067	1.2	2.5	5.8	27.8	62.6	962	.5	2.6	5.8	26.5	64.6