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A QUESTIONNAIRE SURVEY OF THE TEACHING OF COMPUTER STUDIES, PUPILS ATTITUDES TOWARD COMPUTERS AND PERCEPTIONS OF THE LEARNING ENVIRONMENT

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Summary

Chapters 1 to 4 summarise previous studies of pupils' use of computers in school and at home, attitudes of pupils toward computers, and correlates of affective learning. Results from previous research were used to guide the selection of the objectives of the study and its methodology set out in Chapter 5. The development of the 206-item Checklist and other scales included in the teacher instrument is described in Chapter 6 and the selection of scales for the pupil questionnaire in Chapter 7.

Checklist responses from 253 teachers were used to identify 19 teaching Activities and subsequently five Styles of Teaching. The characteristics of the Styles were described in terms of the level of teachers' use of types of resources and their classroom interactions with pupils and were found to be associated with specific teacher variables. Pupil questionnaires were completed by 2200 pupils in 102 classes. Boys, pupils with experience of using a computer at home or at school, and those choosing science-based courses were shown to have more favourable attitudes toward computers. Multiple regression analysis was used to identify relationships between teacher and pupil characteristics, teachers' Activities, perceptions of the classroom environment and attitudes toward computers. A separate analysis was used to seek possible relationships between Teaching Style and the 21 attitude and classroom environment scales. A sample of 61 teachers provided information on their Computer Studies lessons. It was found that most lessons belonged to one of a few patterns and used a narrow range of resources. The relationships between lesson format, resource use, teacher characteristics and pupil ability were studied.

The findings of the study are interpreted in terms of the pressures of external examinations. Some implications of the findings for the teaching of Information Technology or similar courses are given with a suggestion for follow-up study.

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The cooperation of the teachers and pupils who completed questionnaires and made useful suggestions is recognised. The research would have been impossible without their help.

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Publications

Accounts of parts of the research described in this thesis have appeared in the publications listed below. No offprints or direct quotations from the published materials are included in the thesis.

Computer Education Activities and Pupils' Attitudes to Computers. ESRC End of Award Report C00232254, 1986.

Computer Education Activities and Pupils' Attitudes to Computers. Occasional paper ITE/18/87, ESRC-ITE, 1987.

Is using a computer at home more valuable than using a computer at school? **Computer Education 56,** 13-14, 1986.

Teaching Computer Studies: teachers' attitudes and their effects on pupils. **Computer Education, 57,** 18-19, 1987.

The Identification of Teacher-style in Computer Studies: an analysis of teachers' activities. **Educational Studies, 13,** 203-212, 1987.

Teaching Computer Studies: an investigation based on teachers' lesson diaries. **Journal of Computer Assisted Learning,** in press.

A study of the relationship between Teachers' Activities in Computer Education lessons and Pupils' Attitudes toward Computers. Paper accepted for **International Conference on Pupils' Attitudes Toward Technology,** University of Eindhoven, April 1988.

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Contents

CHAPTER 1

INTRODUCTION, AIMS AND SCOPE OF THE STUDY

Introduction

The 1981 launch of the microcomputer into all schools in Britain was accompanied by a flood of expressed hopes for the vocational significance of the new initiative. Kenneth Baker, then the new Minister for Information Technology said "I want youngsters, boys and girls leaving school at sixteen, to be actually able to operate a computer." (Baker, 1981).

The DTI Micros in Schools scheme enabled every primary and secondary school in the country to purchase a British made computer at half list-price. Within three years virtually every school in the country had at least one microcomputer, by 1987 some secondary schools had as many as sixty (Wellington, 1987).

Prior to the DTI scheme Computer Studies was a fringe subject with examination entry figures at a similar level to Spanish, Geology and Music. By 1984, entries had tripled to raise Computer Studies to 12th place in the league table of examination entries.

Year	Girls	Boys	Total
1976	892	2296	3188
1977	1701	4593	6294
1978	2198	5674	7872
1979	3024	7483	10507
1980	6692	10036	16728
1981	8952	15000	23952
1982	10346	22918	33264
1983	13322	30527	43849
1984	16570	39055	55625
1985	18538	43947	62485

Table 1.1 O-level entries by gender and total 1976-85 (Source DES statistics)

Computer Studies is a two-year specialist course dealing with the operation and applications of computers, especially microcomputers, taught for examination at age 16+. At the time the survey was started the course led to an examination for an O-level, CSE or 16+ qualification. Some schools had a policy of restricting the choice of Computer Studies to the most able pupils.

The Computer Studies O-level syllabus of most Examination Boards required pupils to take a written examination and to prepare a substantial project accounting for 20% - 40% of the total assessment. Although the Examination Boards had reduced the programming content of their syllabuses, most teachers still required pupils to become proficient in writing programs in BASIC. The majority of pupil projects were based on programming. Many syllabuses included a study of computer hardware and software, the commercial and industrial applications of computers and the social effects of computer use.

The problem

Previous research by the author (Moore, 1984) had shown that over a 12-month period attitudes to computers declined in a sample of pupils age about 15 years. The attitude decline was absent or much reduced if pupils made above average use of a home computer. Pupils taking Computer Studies seemed to share the same pattern of attitude decline as other subject groups. The previous research seemed to show that results of pupils' experiences in Computer Studies are not always as beneficial to their attitudes as teachers might wish. The reason for this could not be ascertained from the previous data but appeared to be linked to the environment in which the computer was used.

The present study was designed to seek further information about lessons in Computer Studies and the effects of these on pupils' attitudes. The intention was to seek relationships between pupils' attitudes, the classroom environment and the nature of computer use and the activities of teachers and pupils in Computer Studies lessons.

Aims of the study

Because of the uniformity of examination syllabuses and the need for the production of assessed project work, it is likely that the amounts of time spent in computer use by examination pupils in different schools varies by much less than the 15:1 ratio found in a Hertfordshire survey of non-examination pupils (Mohamedali et al, 1987). The new research focused on the nature and range of computer use in Computer Studies lessons. It was hypothesised that lesson activities would be determined by characteristics of the teacher, characteristics of the pupils and the physical resources available and that their effects on pupils' attitudes could be mediated by other computer experiences at home, by the use of CAL at school and by pupils' perceptions of the classroom environment.

The primary aim of the survey was to provide information about pupils' attitudes toward computers and toward a job or career requiring computer use and to discover what styles of teaching or computer related experiences fostered positive opinions about computers and their use.

The second aim was to provide information about pupils' perceptions of the Computer Studies classroom environment and how these were related to teachers' and pupils' activities.

The third aim was to provide data on the teaching of Computer Studies. Part of this study collected data on the context of Computer Studies teaching, i.e.the length of lessons, the type of room available, the size of the class and the ability of the pupils. Data was also collected on the resources used by teacher and pupils and the use of different teaching and learning activities including homework.

The variables measured

The study was based on written questionnaires completed by teachers of Computer Studies and classes of their pupils.

Teacher personal variables

Data was collected on the teacher personal variables of gender, total teaching experience, Computer Studies teaching experience, academic qualification in computing, educational (teacher training) qualification in Computer Studies, industrial experience with computers, other teaching subject, type and age-range of school.

Pupil personal variables

The pupil personal variables used in the study were gender, school subjects currently being studied, frequency and type of experience of using a home-computer, school experience of computer assisted learning by subjects and interest in Computer Studies at time of choosing the subject and at the time of the survey.

Teacher teaching variables

Teaching style was measured by means of 19 composite variables derived from a checklist of 206 teaching and teaching-related behaviours. Teachers also used a 29 scale semantic differential instrument to report their perceptions of The Job of a Computer Studies Teacher.

Pupil affective variables

Pupils completed four affective domain instruments:
1. Attitudes toward computers (Eight scales)
2. Perceptions of the classroom environment (Ten scales)
3. Perceptions of A Job using a Computer (29 semantic differential scales)
4. Computer anxiety (One scale).

Lesson variables

The following variables were studied to show the context, structure and use of resources of Computer Studies lessons.

1. Contextual variables of lesson duration, room-type, and the number and ability of pupils
2. Style of the lesson chosen from a list supplied
3. Resources used by teacher
4. Resources used by pupils
5 Type of homework set
6, The Lesson activities in the first, middle and final third of the lesson

The scope of the study

The study was restricted to the affective domain and assessed pupils' attitudes and feelings only. No measurements were made of students' cognitive learning or abilities in Computer Studies or other subjects. Thus it is not possible to comment on or draw inferences about teacher effectiveness in the cognitive domain. All pupil data was collected anonymously and the unit of analysis for the teacher-pupil activity-attitude studies was the class. No investigation was made of the differential effects of teaching behaviours on pupils of different backgrounds, attitudes or perceptions. The study made no attempt to probe teacher background variables of training, knowledge of computing and educational aims.

Limitations

The nature of the samples places one of the most severe restrictions on the generalisation of the findings of the study. The sample of Computer Studies teachers comprised those who responded to a countrywide postal survey. Although the sample was sufficiently large for sound statistical analysis, there must be some reservation in applying results of a self-selected sample to the whole population of Computer Studies teachers.

The pupils sampled in the survey were complete classes of some of the teachers completing the teacher-questionnaire. Although the teachers of these classes appeared to be a representative sample of the responding teachers, it is necessary to be cautious in interpreting pupil results as being applicable to all classes.

Although the study included assessments of the reliabilities and validities of the scales used, there is an underlying assumption that written response instruments are applicable to the measurement of behaviours, attitudes and perceptions. As with all studies based on the use of self-report instruments, the research relied on the willingness of teachers and pupils to give full and honest answers to the questionnaire items.

Background to the study

In a project of this nature which attempts to provide an overview of a relatively unresearched field, it is necessary to locate the methods and findings in the context of current practices and previous studies. The validity of a study has to be established through demonstration of consistent relationships between its findings and these backgrounds. This section gives summaries of recent studies of the frequency of Computer Studies teaching in schools, the use of computer assisted learning and pupils' use of a home-computer.

Computer Studies in Secondary schools

The frequency and type of computer-based courses offered in secondary schools has been investigated by Wellington (1987). The part of his survey reported here was conducted through The Times Network Service (TTNS). A letter and questionnaire were sent electronically to all 1010 LEA secondary schools registered as TTNS users (this number is 27% of the 3745 maintained secondary schools in Great Britain) and to a further 66 private schools. Complete replies were received from about 90 schools, 25 of these were TVEI schools.

The average number of computers per school was 23 with a range from 4 to 63. In schools that had received TVEI funding, the average number of pupils per computer was 26, in non-TVEI schools it was 47. Two-thirds of the computers were in specialist rooms, presumably for use in the teaching of Computer Studies or similar courses. Examination courses based on computer use were offered in 91% of the schools, 78% of these courses were for O-level or CSE examinations. Computer Awareness courses were given in 72% of the schools, half these courses were for Year 1 pupils. Open comments from schools indicated two trends. First, the desire to move away from examination courses in computing toward the more widespread use of computers for computer assisted learning (CAL) across the curriculum. Second, the trend to teach Information Technology (IT) and basic courses in Information Technology awareness rather than Computer Studies and computer awareness.

TTNS is a database system for education that also offers messaging facilities (electronic mail). The school pays an annual subscription to use the service and local rate telephone call charges throughout the time the school system is on-line to the network. TTNS has been criticised as being more difficult and more expensive to use than PRESTEL (Anonymous, 1987). It is apparent that TTNS users probably represent schools with above average commitment to the provision and use of computer resources. For this reason, the data obtained by Wellington probably represent the maximum levels of computer involvement in schools at that time.

Some serious questions about the educational value of Computer Studies have been raised (see for example the Times Educational Supplement Extra of November 4th, 1984). It has been pointed out that much of the CS syllabus is neither educationally worthwhile nor vocationally relevant. Computer Studies is not favoured by Universities for entry to degree courses in Computer Science, at least equal preference continues to be given to traditional 'O' and 'A' level subjects. The Alvey Report (1982) went further suggesting that school (computer) education of the wrong kind might actually do harm and, by implication, prejudice a student's chances of doing well in higher education.

> "...it is no good just providing schools with microcomputers. This will merely produce a generation of poor BASIC programmers. Universities in fact are having to give remedial education to entrants with 'A' level computer science" Alvey Report p.62.

Perhaps a still more serious indictment of Computer Studies is that it has hindered the spread of computer use across the curriculum.

Computer Assisted Learning across the curriculum

One of the major aims of The Microelectronics in Education Project (MEP) which ran from 1980 to 1986 was to encourage the use of computers as aids to teaching and learning across the school curriculum. Two studies in 1986 indicated that despite MEP encouragement and additional funding from DES and DTI, school use of computers was not widespread and was rarely integrated into good classroom practice (Jackson et al, 1986, Ellam & Wellington, 1986).

In the Wellington (1987) survey, only two-thirds of secondary schools reported the use of computer assisted learning outside computer-based courses. The data (Table 1.2) show that science, mathematics and technology were the most common subjects for the use of CAL. The extent of CAL in a school is significant because it is often the only access at school to computers provided for young pupils and older pupils who are not taking a specialist course in computing.

It was found that one effect of networking the computers in a school was to decrease their use for across the curriculum CAL. In non-networked schools, 27% reported use of CAL in four or more subjects, in networked schools only 21% used CAL in four or more subjects. The mean number of CAL subjects per school were 1.8 for networked, and 2.1 for non-networked schools. These figures have to be seen in light of the mean numbers of computers per school. For non-networked schools it was 17.6, in networked schools it was 26.7. It seems that networked schools generally made less use of computers for CAL despite a higher level of resource provision.

Subject	Year					
	1	2	3	4	5	Total
Sciences	6	0	16	6	3	31
Mathematics	9	2	2	4	1	18
Special Education	17	1	0	1	0	19
CDT	6	1	5	4	0	16
Modern Languages	5	2	4	2	1	14
English	5	2	1	3	0	11
Bus/Com Studies	2	0	4	5	0	11
History/Geography	4	4	3	2	0	13
Home Economics	2	0	1	1	0	4
Others	6	0	0	2	1	9
Totals (92 schools)	62	12	36	30	6	151

Table 1.2 Computer Assisted Learning across the Curriculum. (Data from Wellington, 1987)

These data constitute clear evidence that networking restricts the growth of CAL - an opinion often expressed without statistical evidence (see for example **The Micro-user**, October 1986, p31-32).

The low-level of computer access at school available to most pupils found in the Wellington 1987 survey was in agreement with the results of other studies. In the MPhil study 65% of pupils in the fourth year of secondary education reported they had never used nor seen the teacher use CAL in any subject. A secondary school study by Fife-Schaw et al (1986) found only 20% of pupils age 13-18 years reporting use of a computer at school within the previous four weeks. At all ages girls reported less frequent use of the school computer than boys. This suggests that either much computer use was within science and technology subjects that are less popular with girls, or that some school use was obtained through computer clubs and out of lesson activities. A questionnaire study of pupils aged 12-13 years in five Hertfordshire secondary schools (Mohamedali et al, 1987) found that on average only 29% of them had used a school computer. The values in different schools varied from 5 to 75%. Here pupils reported computer use had been chiefly in groups during lesson-time, this is the common practice in primary schools (Jackson et al, 1986).

The locating of a school's computer resources in a "computer room" under the charge of a single teacher, often from mathematics or science, isolates them from the majority of both staff and pupils. This prevents both the "physical diffusion" of computers into other parts of the school and their "mental diffusion" into the curriculum and everyday practice of other teachers. A further obstacle to the more widespread use of computers across the curriculum may be the lack of teacher-training and technical support. Taking on the tasks of technician, in-service training organiser and software consultant in addition to normal duties may not be to the liking of all Computer Studies teachers. Ellam and Wellington (1986) suggest that the "human factor" in introducing educational computing has been ignored with over-concentration on providing software and hardware.

Access to and use of home computers

Microcomputers have become a common part of the home lives of children and adolescents. In 1984 Crisp estimated that one in ten homes had a microcomputer and that the number was rising. Subsequently a million more homes acquired a microcomputer so that by 1986 it could be claimed (TES 'Home Truths', 7.3.86) that one-third of all households with children had a home computer. This was welcomed as "a major step towards the universal computer competence required by the coming information society." The MPhil study conducted in 1983 found that 52% of the sample of 15 year olds had used a home computer "Often" or more frequently. A pronounced gender difference was observed, 66% of boys compared with 40% of girls being placed in the high-use category. Fife-Schaw et al (1985) found that 62% of boys and 39% of girls had used a computer at home.

Mohamedali et al (1987) found that 56% of boys and 44% of girls in their sample had a microcomputer at home, in agreement with results quoted above. In their sample, 93% of pupils with home access used their computer for playing games. The data (Table 1.3) show that boys report spending significantly longer periods in this activity. For the use of educational software, although more girls than boys report this type of use five times as many boys claimed to use educational software for four or more hours per week. Although 80% of boys with a home-computer claimed to use it for programming compared with 55% of girls, the difference in the time spent on the activity was not significant. The earlier survey by Fife-Schaw et al (1986) had found broadly the same pattern of home-use and gender differences.

Type of Use	Duration /hour week^{-1}	Percentage Total	Female	Male
Playing Games	0 - 3	39	66	18
	3 - 6	18	14	21
	6 - 9	12	11	13
	9+	31	8	48
Educational Software	0 - 2	75	84	59
	2 - 4	12	11	14
	4+	13	5	27
Programming	0 - 2	64	73	60
	2 - 4	20	17	21
	4+	16	10	19

Table 1.3 The percentage of children who reported different uses and durations of use of a home computer (From Mohamedali et al, 1987)

The gender factor enters into many facets of computer use and attitudes (Turkle, 1984). Its effects are clearly evident in the data for pupils' home use of a microcomputer. Kelly (1981) has suggested that girls are disadvantaged in computers whilst both Hoyles(1985) and Harvey & Wilson (1985) suggest that parents are more likely to buy a home computer for a son than for a daughter. Glyn-Jones (1986) found computer ownership was associated with the presence of young children in the household and with boys. In her sample of 137 computer owning households there were 152 boys to 93 girls; of the 114 households reporting the gender of the children, 60 were mixed, 39 were boys only and 15 were girls only.

The survey of Mohamedali et al (1987) showed that children who had access to a home computer had significantly higher programming ability than those who did not. High ability pupils in comparison to those of medium and low ability were significantly more likely to use educational software and to use a home machine for programming. The amount of time spent playing games did not vary with programming ability but good programmers were more likely to rate themselves as good at computer games.

Overview

The study is described in eleven further chapters.

Chapters 2, 3 and 4 survey the literature relevant to the study. Chapter 2 surveys and summarises studies of pupils' attitudes toward computers. The results of the survey are used to identify scales suitable for assessing the attitudes of pupils studying Computer Studies. Chapter 3 identifies some kinds of teachers' behaviours and the classroom environment as important endogenous variables of the learning context. Chapter 4 outlines the meaning of Classroom Environment and its measurement. The accounts of instrument development and research summarised in this chapter were used to guide the choice of classroom environment scales for use in the main study.

Chapter 5 states and explains the objectives and methodology of the study. The main instruments used by teachers are decribed fully in Chapter 6. Chapter 7 explains how the pupil questionnaire was constructed almost entirely from existing scales and justifies the choices made.

Results of the empirical study are presented and described in Chapters 8 to 11 inclusive. Chapter 8 gives summary statistics of the teacher sample and describes the derivation of 19 teaching activities and the studies of the reliability and validity of these measures. Chapter 9 gives the basic descriptive statistics of the pupil sample, statistics summarising pupils' attitudes toward computers and statistics of their perceptions of the classroom environment. Results of the Anxiety and Attitudes to a Computer-Job scales are also given in this chapter.

Chapter 10. describes how the data were analysed to seek relationships between teacher and pupil background variables, teachers' classroom activities and pupils' attitudes and perceptions.

Chapter 11 describes how the context, structure, content and some other features of Computer Studies teaching were derived from accounts of nearly 700 lessons.

Chapter 12 attempts to link findings from the attitude survey, the teachers' and pupils' questionnaires and the Lesson parts of the study. Some implications of the findings for the teaching of Computer Studies or similar courses and for the training of teachers for these courses are pointed out and suggestions for action research are given.

CHAPTER 2

A SURVEY OF RESEARCH ON ATTITUDES TOWARD COMPUTERS

"It is almost universally acknowledged that educational objectives in the affective domain - those dealing with attitudes, interests and value - are of great importance " (Choppin & Frankel, 1976, p.57).

One reason for wishing pupils to acquire favourable attitudes to computers and microelectronics is to obtain wider acceptance of new technology in society, at work, and in the home. Thus although attitude studies have so far played an insignificant part in computer education research, there is some evidence that curriculum developers are interested in setting up and assessing attitude goals for computer education. This interest is evidenced by the increased number of computer attitude studies reported since microcomputers were first introduced to schools in the early 1980s. Often these studies have developed new attitude instruments; some of these instruments and the results obtained with them are reviewed in this chapter.

The measurement of attitudes

Several works describing the techniques of attitude scale construction are available; (Edwards, 1957; Oppenheim, 1966; Thomas, 1978; Youngman, 1979a). The steps of identification of constructs to be assessed, choice of instrument type, item preparation and testing followed by the determination of instrument reliability and validity with selected populations are well known and need not be repeated here.

Likert scales are widely used to measure attitudes to science, to mathematics and to other school subjects. Psychometric methods to establish the reliability and validity of scales are now well established and should be used to supply data to accompany all reports. Munby (1980) in an examination of fifty attitude instruments found only eight that could be described as psychometrically sound. Schibeci (1984) calls on journal editors to urge their reviewers to be more critical in their reading of attitude studies. He says they should summarily reject those not including data about the reliability and validity of the attitude instrument.

The reliability of an instrument or scale is a measure of our confidence that it would yield the same results if by some means it could be used to make the same measurements on the same population on another occasion. Techniques for measuring reliability fall into two groups; those that yield a measure of self or internal consistency and others that predict consistency of behaviour from one administration to another. Reported reliability values for science attitude instruments range from about 0.6 to above 0.95 (Munby, 1980, Table 6). The value of the reliability required depends on the intended use; for work with groups a value as low as 0.7 may be acceptable. For work with individuals a value of 0.9 or above is desirable. The reliability of a scale is bound up with its sensitivity, that is its ability to discriminate between respondents or groups of respondents. Discrimination is enhanced if respondents' scores are spread as widely as possible across the possible range of scores. If most of the items in a scale are scored "high" or "low" then the majority of scores will be high (or low) and the scale will be insensitive.

The spectrum of attitude objects is very wide and requires researchers to specify precisely which attitude object(s) is(are) being assessed in any particular study. The use of a scale implies an act of measurement on some attribute of the object to which the scale may usefully be applied. Gardner (1975a) gives examples of instruments that have no perceivable underlying construct and of others in which psychologically distinct variables were simply summed to give a single score. Since the purpose of an attitude scale is to give a measure of a respondent's position on a defined scale relating to a single attitude object, it follows that none of the scales cited by Gardner can yield an interpretable value. Nagy (1978) has noted that the global construct "positive attitude" has limited usefulness.

Gardner (1975a) argues that when a suitable instrument already exists, this should be used in preference to developing another instrument. Gardner's strictures do not appear to have an immediate effect. Munby

(1980) in his review of 50 attitude instruments found that 32 had been used once only and a further 3 had never been used - not even by the instrument developer!

At the trial stage of questionnaire development, responses from a sample representing the target group may be used to confirm the validity of the instrument. Some researchers subject the responses to factor analysis in order to derive scales from the total pool of items within the questionnaire. These scales then form the basis of the resulting instrument even though they may not accord with the researcher's initial theoretical constructs; examples of this practice will be given in the following section. Although the use of empirical analysis can lead to the identification of reliable scales, it cannot give meaning or validity to the scales. It should not be claimed that a scale established by empirical analysis is for this reason any more or less valid than one established by theoretical argument.

Brown & Davis (1979) specifically rejected the use of factor analysis for the identification of instrument scales. They argued that because empirical analysis was unlikely to give uniform scales each relating to a single identifiable construct, it was preferable to rely on the researcher's a priori constructs and allocation of items.

Studies of attitudes toward computers

Surveys carried out before 1982 (Ahl,1976; Lee, 1970; Lichtman,1979; Mathews & Wolf, 1979; Smeltzer, 1981) pre-dated the boom in sales of micro-computers to schools and homes. Because the early questionnaires and surveys were set in the context of the remote large "mainframe" computer, neither the instruments nor the results obtained with them are directly relevant to the present study.

Two more recent surveys of computer attitudes, one by Morrison (1983) the other by Bannon et al (1985) were also concerned with large computers. Morrison's survey was of students at a single university in Australia. He used an attitude questionnaire developed thirteen years previously (Lee, 1970). According to Lee this instrument contained two empirically established scales, "Beneficial tool of man" (positive), and "Awesome thinking machine" (negative). Morrison failed to replicate Lee's results. He found five, rather than two, factors; these did not include a strong positive factor. The lack of agreement between the two uses of the same questionnaire might be due to the changed social context of computer use or to other differences between the two samples; that of Lee was taken from the general adult population in North America.

The survey by Bannon et al (1985) used eleven items from the 1976 Ahl survey with six others devised by the research team. Nine of the items were described as cognitive, the remainder were said to be affective. The basis of the classification of items is not clear; the statement "Computers will improve education" was described as a cognitive item whilst the similar statement "Computers will displace teachers" was said to be an affective item. The questionnaire was answered by 1811 university students and 714 educators; their ages ranged from under 19 to over 30 years. Factor analysis identified two factors. The first factor was made up of seven "cognitive" items, all the items loading to this factor were positively worded. The second factor contained seven "affective" items, all these items were negatively worded. Bannon does not report the percentage of the score variance loading on the factors. The two groups of items were used as subscales. This appears to be an example of factor analysis being used to impose a statistical structure on an attitude instrument. No breakdown of scores by age, gender or occupation is given.

Wagman (1983) used the 100 item Cybernetics Attitude Scale to study the attitudes of undergraduates toward the use of computers in ten specific sectors of society. The results were said to show that the undergraduates were in favour of using computers for administering the justice system and for statistical purposes, they were critical of their use in counselling and medicine. T-tests showed significant gender differences on five of the subscales - society, values, cognition, education and criminal justice. For each of the scales, men held the more favourable attitudes toward computer use in that sector. Inter-scale correlations were quite high and for this reason Wagman warns that the extent of gender differences in attitudes may be much less than the raw correlation data suggest.

Griswold (1983) used a questionnaire of 20 Likert-type items to study computer awareness amongst undergraduate and post-graduate education students. The questionnaire items were judged to cover four categories: (i) concrete implications of the computer, (b) abstract implications, (c) computer abilities, (d) education applications (Griswold, 1985). A composite awareness score was calculated by summing responses to all 20 items. The alpha reliability of the composite scale was 0.75. The computer awareness scores were significantly correlated with three variables: age, arithmetic skill, and locus of control. Computer awareness was generally greater in older, arithmetically skilled, and internally-oriented individuals. Computer awareness was not significantly correlated with length of mathematics experience, nor with gender.

Griswold (1985) used the same 20-item questionnaire in a comparison of groups of university students of education (N = 207) and business (N = 210). On this occasion the same composite score was described as a measure of computer attitudes. For 18 of the 20 items, business students responded more favourably than education students, nine of the differences were statistically significant. Education students were less likely to have had previous experience of using a computer, had less favourable opinions about abstract implications, and were less likely to view the computer as a tool. In a multiple regression analysis, age was the best predictor followed by subject. Gender was not a significant predictor.

Several of the items included in the Griswold instrument appear to have a cognitive component within them. Thus statements such as

"Computers can teach reading (mathematics)"

can be answered without reference to the respondent's opinion of whether computers should be used to teach reading (mathematics). Such items appear more related to respondents' awareness of the uses of computers than to their opinions about these uses. It is not clear that they are appropriate to the measurement of computer attitudes as was claimed in the 1985 study.

Reece & Gable (1979) report properties of an instrument developed to monitor student attitudes towards microcomputers in schools. In its original form the instrument contained 10 affective, 10 behavioural and 10 cognitive items concerning microcomputers and their use. A total of 199 responses to the questionnaire were obtained from students aged 13+ and 14+ years. Factor analysis showed only one interpretable factor; this contained 10 items; five affective, four behavioural and one cognitive. Reece and Gable called this 10-item scale the General Attitude Toward Computers (GATC). The adoption of the single multi-domain factor as a measure of attitude appears to negate the authors' original theoretical concepts of attitude structure. Scale reliability was moderately high at 0.87, a benefit of the use of factor analysis for item selection. The paper of Reece & Gable reports only the statistical properties of their scale, it contains no information on students' attitudes.

The GATC scale was used by Enochs (1985) to assess the attitudes of (US) middle school students toward computers. All the students were involved with the instructional use of computers at school for the purpose of drill and practice. The overall general attitude towards computers was high with a mean of 39.03 on a range 10 - 50. No significant differences were found between male and female students or between seventh and eighth graders. A significantly higher mean score ($p<.001$) was obtained by the group of students with a home computer.

Enochs (1984) also studied the attitudes of pupils shortly after beginning a course of instruction in the use of computers. Students (26M, 23F) were in the fifth grade, 17 of them had a computer at home. The computing exercises lasted about two hours with students working in pairs at a machine. The exercises were designed to introduce students to some computer terminology, to familiarise them with computer hardware and operation, and to teach simple programming. T-tests were used to test for effects of the instruction and for differences between gender and home-ownership groups. A significant ($p = 0.03$) difference was found between pre and posttest scores on the GATC instrument. No significant gender or home-ownership differences were found.

The results are interesting but inconclusive. Closer examination of Enoch's data shows mean scores in excess of 40 on a scale 10 to 50 were obtained by all groups in both pre- and posttests. This suggests the GATC scale may have lacked sufficient discrimination for use in this application. Conclusions were also limited by sample sizes. The differences between pretest mean scores obtained by the groups of boys and girls, and the differences between the pretest scores of groups of computer owners and non-owners were both greater than the pretest to posttest differences for the whole sample. Because of sample size effects, the last difference was said to be statistically significant and the former two not.

Richards et al (1986) claimed that few psychometrically sound instruments were available for use in the area of attitudes toward computers. To develop the Computer Attitude Scale they rewrote 27 items from a science attitude scale. The items covered four general attitude dimensions of Liking; Necessity of studying computers for career success; Self-confidence in using computers; and Belief that computers are a Male domain. These items were used with 192F and 178M students in seventh grade classes. Factor analysis identified three scales made up of 23 items; Liking (12 items, alpha = 0.88), Male domain (5 items, alpha = 0.84), Career-necessity (6 items, alpha = 0.72). No gender difference was found on the Liking scale. Males scored higher on the Male domain and Career-necessity scales. In a similar study with eleventh grade students, males and females did not differ on the Liking and Necessity scales. On the Male domain scale, males scored significantly higher than females.

The study also included an investigation of possible age and ability relationships with computer attitudes. In the Junior school study, a reading test was used as a measure of general ability. Reading ability was not correlated with scores on the Liking scale. Students with higher reading scores were less likely to see the computer as being "for men". The correlation between reading ability and Career-necessity showed that better-reading students were more aware of the career potential of computers. The scores of junior high school and senior high school students were compared on the three scales of Liking, Career-necessity and Male domain. The scores of the two groups did not differ on the Career-necessity scale. Although both groups were favourable to computers, the junior pupils had a significantly higher score on the Liking scale. On the Male domain scale senior pupils were less likely to see the computer as male-dominated. In this sense the older pupils had the more favourable attitude.

A study of sex-correlated differences in attitudes toward computers was made by Dambrot et al (1985). Subjects were 342F and 198M first-year psychology under-graduates at a North American university. Subjects answered the Computer Attitude Scale (CATT), the Fennema-Sherman Maths Anxiety Scale (1976), and the Computer Aptitude Scale of Konvalina et al (1983). The CATT was a 20-item instrument specially developed for the study because other existing measures of computer attitude were (it was said) designed for elementary or middle school pupils or teachers. The rationale used for item selection is not stated.

Results showed more males had completed a computer course and knew a computer language. Males had higher computer aptitude scores and more favourable computer attitudes. Significant gender differences were found in responses to 11 of the 20 CATT items. Generally females felt more threatened and intimidated by computers, and thought them less useful. Total scores on the CATT were significantly lower ($p<0.001$) for women. The correlation between computer aptitude and computer attitude was stronger for men than for women, $r = 0.27$ vs $r = 0.17$. In a multiple regression analysis, only maths anxiety predicted computer attitude for women, while for men, computer aptitude and maths anxiety were significant predictors of computer attitude. The variables of mathematics experience and general college achievement were not significant predictors of computer attitude. The proportion of the attitude score variance predicted by the significant variables was quite small, 0.05 for women and 0.09 for men.

Loyd and Gressard (1984a) developed an instrument to evaluate attitude changes and identify potential problems connected with the introduction of computer-based teaching programmes in US schools. The instrument contained 30 items, 10 each from the attitude domains of Anxiety about (fear of) computers, Enjoyment of using computers, and Confidence in using computers. All the items included either "I" or "me" and tapped attitudes rather than knowledge, no prior experience of using a computer was assumed in the framing of the items. Subjects were 104F and 51M aged 13 to 18 years in a computer-based education programme. Factor analysis of the responses confirmed the three factors accounting for 55% of the variance. The high inter-scale correlations and the loading of items from two scales on the same factor showed the scales shared a considerable proportion of common variance.

The instrument was used by Loyd and Gressard (1984b) in a study of 354 students aged 13 to 20+ years. Attitudes were positive, for each of the three scales they averaged about 30 on a range 10 - 40. Results were analysed for the effects of computer experience (categorised at three levels; less than 1 week, up to 6 months, over 6 months), gender, and age on the scales of Anxiety, Confidence and Enjoyment. No gender effect was found for any scale. An age effect was found only for the Enjoyment scale; younger students generally expressing greater enjoyment. Computer Experience was a significant variable for all three scales; greater experience was associated with more positive attitudes.

Williams et al (1983) were concerned that previous evidence of young pupils' attitudes toward the use of computers had been based on studies in which CAI was used to impart cognitive skills. They suggested little was known at that time about young children's attitudes toward the small home computers which in the future were likely to be their first and most frequent encounter with computing. The study used a semantic differential attitude instrument based on 24 bi-polar scales. The adjective-pairs were obtained from recordings of interviews held with other children prior to the main study. The study sample were 106 attendees at one-day summer computer-camps held in an upper-middle class area of Los Angeles. The age range of the sample was from 6 to 18 years although most were age 10-14 years; 71% of the sample were male. The questionnaire was answered about halfway through the single 6-hour session. Analysis of responses was restricted to students without previous experience of using a computer.

Factor analysis showed four interpretable factors; General evaluation (e.g. good-bad), Quality (new-old), Ease of use (easy-hard), and Expense (cheap-expensive, little-big). On scales with an evaluative connotation, the children generally indicated generally favourable attitudes. It is interesting that they rated the microcomputers neither as small nor inexpensive - a clear sign they lacked knowledge of mainframe computers. The factors of General evaluation and Expense were unrelated to gender and age. On the Ease of use and Qulaity scales , females and younger children tended to give less favourable ratings The features of voluntary paid attendance at the camp and not having a home-computer may restrict the generality of the findings.

A 20-scale version of the instrument of Williams et al has been used with primary and secondary school pupils in the UK (Harvey & Wilson, 1985). The pupils age 10-12 years were asked if they owned a microcomputer, if they would like to spend more time on the computer at school, and what they most liked doing on the microcomputer. They also wrote an essay "What I think about microcomputers". Pupils' attitudes were generally favourable. Only four of the twenty scales showed significant differences between primary and secondary pupils. Primary pupils thought the microcomputers more friendly, more understandable, newer, and bigger. Three items produced significant gender differences; boys thought microcomputers more fun and smarter whilst the girls thought them relatively more expensive. Although there were few gender differences in attitudes, twice as many boys as girls owned a micro. Harvey and Wilson speculate that it may be because the girls were too young to have been affected by parental socialisation.

Eleven scales showed a significant difference between owners and non-owners. In general owners had more favourable attitudes. The essays and free-response questions both contained a predominance of supportive material. Computers were regarded as "fun" with 72% of children giving "playing games" as their most enjoyable computer experience.

In the study of Mohamedali et al (1987) children were asked about their conceptions of computers and how they felt about using them. Pupils were classed as "experienced" if they had used the school computer or had used a computer at home or had used a friend's computer. Pupils were classed as "lacking experience" if they had done none of these.

Significantly more children with experience believed they were "part of the computer age" ($p<0.001$)and that computers could improve education ($p< 0.01$)than children who lacked experience. The group with experience were also more willing to use computers to relieve routine work ($p<0.01$). Males and females were also compared on the same variables. Fifty-six percent of males thought they were "part of the computer age" compared with 42% of females ($p<0.02$), males were also more willing to use computers to relieve routine work ($p<0.01$). No gender difference was found in responses to the question "Do you believe computers can improve education?".

Effects of computer assisted instruction

Generally, studies of students' attitudes in environments where computer-assisted instruction was used to teach cognitive skills are not included in this review of attitudes toward computers because in most cases the focus of the studies has been on the cognitive and affective outcomes related to the **subject** and the **method of delivery** rather than to the computer per se. A review of investigations of attitudes towards the use of computers for teaching and computer assisted instruction reported between 1976 and 1982 has been given by Lawton & Gerschner (1982). They found few studies of children's attitudes toward computers. In conclusion they state "overall the data appear mixed. It is noted that some students liked computers, that some students apparently learnt from computers, that other students apparently did not learn from computers" (page 51).

Clarke (1985) measured children's general ability and their attitudes toward mathematics before and after a one-year programme of using LOGO turtle-graphics for 40 minutes per week. The LOGO experiences included the development of problem-solving skills, playing games, and free-exploration sessions in which the children could create their own patterns and pictures. The sample consisted of 43 girls in years 1, 3 and 5 of an Australian girls' school. The data showed a significant increase in students' general ability and in the mathematics component of a standardised attitudes toward school questionnaire. Within the limits of the small sample size, the results support the belief that LOGO experience can enhance general ability and stimulate interest in associated subject matter. Although the work of Clarke deals with attitudes toward mathematics (and not computers), it merits description because it is one of the few studies in which students have used the computer other than in a programmed-learning context. Her work suggests that free-activity experience with a computer may have a favourable effect on attitudes.

An attitude study by Anderson et al (1981) was based on pupils' reactions to a unit of science material presented as an interactive simulation via a microcomputer. The lesson unit took pupils from 10 to 30 minutes to complete with a mean time of 20 minutes. The sample of 340 pupils age 15 to 17 years from a single US high school contained an equal number of male and female students, approximately equal percentages of each gender group had previous non-CAI exposure to computers. Two additional treatments were introduced into the experimental groups. One-third of the sample used a program with enriched graphics; these consisted of animated diagrams and the use of coloured lines on graphs. Another third of the groups experienced a simulated computer malfunction. Remaining students used the program without enhancement or malfunction. All students were given pre- and posttests of computer knowledge and three dimensions of attitudes toward computers; enjoyment, anxiety, and self-efficacy.

The three attitude scales showed positive changes immediately following the CAI experience; most of these gains disappeared over the next six months. The two treatments, enhanced graphics and malfunction, had no effect on computer knowledge or attitudes except for an interaction between malfunction and computer self-efficacy. Although all CAI groups showed an immediate gain in this variable, the gain was significantly greater in pupils not experiencing the malfunction. At the end of a six-month period, the CAI and control groups showed no difference on the enjoyment dimension. The CAI groups showed less anxiety and greater efficacy. The lower self-efficacy of the malfunction sub-group was still detectable at the end of the six month period.

The experiment indicates that pupils' attitudes toward computers may be affected by hands-on experience of using computers even though the CAI materials have no overt computer-related objectives. It appears that as little as 20 minutes use of interactive CAI materials may be sufficient to produce effects that are both significant and endure over some months.

Computer attitudes survey in Sweden

In 1982 a revised national curriculum was introduced into the Swedish 9-year comprehensive school, this was accompanied by a three year programme to introduce the concepts of "datalara" to all secondary pupils age 13-16..

It was planned that each pupil should have 75-80 hours of computing as an integrated part of the teaching of mathematics, natural sciences and social sciences. Three features of the Swedish programme are of significance: first, the study of datalara is compulsory for all students; second, the subject has been introduced as a practical study via use of the hardware; and third the concepts of "datalara" include much of what in the UK would be termed "Information Technology", ie it is a study **about** the computer as well as a study **of** the computer.

The implementation of the first year of the three-year programme has been studied (Nissen & Riis, 1985). Results showed that in practice the programme was modest in content and in scope. Questionnaire responses indicated that in the year since the start of the programme, about 70% of the pupils had received some computer science lessons, 90% of these pupils indicated the lessons had included practical work with the computer. Only a small minority of the lessons had been integrated with a subject other than mathematics.

Responses to attitude statements such as:

1. What is your opinion about computer science at school?
2. In our society we seem to become increasingly dependent on computer-technology. What is your opinion of this?
3. In an international comparison our country is highly technologically developed. What is your opinion of this?

showed significant gender differences, males showed the more favourable attitudes. The question "How much have you been using computers outside school?" also showed a considerable gender difference. To this question 42% of boys replied "Very much" or "Somewhat" compared with 8% of girls. The results are interesting because they show a year-long programme of compulsory computer education for all does not succeed in eliminating gender differences in attitudes and choice of activities.

The Computers and Robots Attitude Questionnaire

A study by the present author (Moore, 1984, 1985a) developed and validated a multi-dimensional attitude instrument, the Computers and Robots Attitude Questionnaire (CARAQ). Discussions with pupils were used to determine the range and dimensions of the questionnaire. Following preliminary trials, a pool of 110 items representing eight attitude dimensions was tested with a sample of 900 pupils age 13 to 15 years. Item-analysis, cluster analysis and factor analysis were used for item selection, to confirm the concept validity of the pre-chosen scales and the placing of items and to measure scale homogeneity. In its 1984 form the CARAQ instrument contained 64 items representing seven of the original attitude dimensions. The scale names and definitions are given in Table 2.1.

Scale Name	Scale Description	Sample Item
EMPLOY	The perceived need for the country to use robots and computers in commercial and industrial applications	We need to use more robots in our factories
THREAT	The dangers to individuals and society inherent in the use of computers	A faulty computer could start a world war
FUTURE	The extent to which computers will be part of our lives in future years	In the future nearly everyone will have something to do with computers
SOCIAL	The benefits and "social-cost" of using computers and robots	Computers have done more harm than good in the world
CAREER	The extent to which pupils perceive a career using computers to be worthwhile and satisfying	I should like to work for a firm that uses computers
LEISURE	The extent to which pupils use or are willing to use leisure time to make contact with information about computers	TV programmes about robots and computers bore me
SCHOOL	The extent to which pupils wish to use and learn about computers at school	School should use computers to help pupils learn more easily

Table 2.1 The Computers and Robots Attitude Questionnaire (CARAQ)

In a validation study (Moore, 1985b), 911 pupils from eight all-ability comprehensive schools completed the CARAQ instrument at age 14+

years and again 12 months later. Additional questions collected data on pupils' experiences of computer-assisted learning and their home-use of a microcomputer. Statistical data on the pretest and posttest uses of the CARAQ scales given in Table 2.2 show they have acceptable internal consistency and test-retest reliability.

Scale Name	N of items	Scale-Range Min.	Scale-Range Max.	Mean (*)	SD (*)	Alpha rel. (*)	Test-retest corr.
EMPLOY	11	11	55	36.63	9.50	0.867	0.816
THREAT	10	10	50	30.96	8.25	0.811	0.776
FUTURE	9	9	45	26.43	6.56	0.750	0.789
SOCIAL	11	11	55	35.29	8.25	0.813	0.795
CAREER	7	7	35	23.20	7.10	0.878	0.890
LEISURE	7	7	35	23.40	7.63	0.902	0.854
SCHOOL	9	9	45	23.83	7.85	0.855	0.844

Based on responses of 911 students (*) Posttest values

Table 2.2: Summary statistics of Computers and Robots Attitude Questionnaire scales.

For the purpose of the analysis, pupils were classed into course-groups according to the combination of subjects forming their fourth year programme. The <u>CS-group</u> contained all pupils taking Computer Studies as one of their subjects. The <u>ST-group</u> contained pupils taking <u>two</u> physical science or technology subjects, whilst the <u>NOST-group</u> was formed of pupils taking no more than one science or technology subject. Pupils in the CS-group had more favourable pre-course attitudes than pupils in the ST group, this group had more favourable attitudes than the NOST group.

There was a significant gender effect for the complete pre-test sample of 628 boys and 646 girls on every one of the seven attitude scales. In contrast, a consistent gender difference within course groups was found only for the scale <u>Leisure</u>.

The study also investigated attitudes as a function of ability. For boys, the mean correlation between Piagetian developmental stage and the seven attitude scales was 0.15 ($p<0.05$); for girls the correlation was smaller and not significant.

In another analysis, pupils were divided into two groups according to their reported use of a home microcomputer. Pupils reporting they had used a microcomputer at home "Quite often", "Many times", or "Very many times" were placed in the High- use group, others reporting they had used a micro at home "Never" or "A few times" were placed in the Low-use group. The post-test means of pupils in the High-use group were significantly more favourable than pupils in the Low-use group. This result held for all scales for the complete sample, for pupils taking Computer Studies and also for pupils not taking Computer Studies.

Part of the study was concerned with the change in pupils' attitudes over the 12-month period from pre- to posttest. The pattern of change within each course group was very similar for boys and girls. In all course-groups, pupils who had not made significant use of a microcomputer at home or at school showed a decline in attitudes that was absent or much reduced amongst pupils reporting High-use of a home microcomputer. Further analysis showed that in the group of pupils who did not use a computer at home, Computer Studies lessons did not prevent the decline in computer attitudes. From these data it appears that in the groups of pupils with the most favourable computer attitudes, a 12-month period of Computer Studies lessons had a smaller attitudinal effect than their home-use of a microcomputer. For both the whole sample and the subsample of those not taking Computer Studies, the general decline in attitudes toward computers during the 12-month period was eliminated or significantly reduced when pupils reported a high level of computer assisted learning (CAL) experience at school.

Some generalisations from the survey

Generalisation from results of the studies described is restricted by the varied and frequently non-random selection of experimental subjects as illustrated by the study by Dambrot et al (1985). In some studies apparently based on more nearly random selection of subjects, the description of the sample may not be complete. For example, in the study of Harvey & Wilson little information is given about the ability range of the classes; the social or ethnic backgrounds of the schools and the pupils, and of any previous microcomputer experiences pupils may have had at school.

Results from the studies reviewed repeatedly show the importance of the study subjects, degree course or interest background of the sample. Griswold (1985) found course of study (education or business) was a significant predictor of attitudes for his university sample. At school level, a study using the CARAQ instrument showed highly significant pre and posttest differences between three course groups.

In both these studies, when subject (course) group was controlled, no significant gender-attitude relation was found. Raw correlations between gender and attitudes appear to reflect both group composition, as in the two studies cited, and more complex relationships between variables. Even when course group is not strictly controlled or isolated, as in studies by Wagman, Enochs, Harvey & Wilson, and Richards et al, there is general agreement that gender differences are either non-significant or restricted to one or two from several instrument subscales.

Griswold (1985) and Dambrot et al (1985) found that ability was not significantly correlated with students' attitudes toward computers. The finding of the CARAQ study of a barely significant correlation between ability and attitudes is consistent with the findings of Richards et al which showed some significant and some non-significant correlations between attitudes and reading skills. It is perhaps worth stressing that these four studies came to very similar conclusions about the lack of a marked ability-attitude relationship although they worked with four different measures of ability and four different attitude instruments.

A number of studies investigated the relationship between age and attitudes. Harvey & Wilson found a just significant fall in attitudes between a sample of primary school pupils age 10+ and a sample of secondary school pupils who were one year older. Because pupils suffer many changes in moving from primary to secondary education, it is impossible to conclude that the small attitude changes found are simply an age-effect. Enochs found no attitude differences between students in seventh and eighth grades. Studies over wider age spans have also shown small or inconclusive effects. Loyd & Gressard found a significant age correlation with only one of the three scales in their attitude instrument. Similar results were reported by Richards et al from their comparison of seventh and eleventh grade students. The CARAQ study produced data showing that, in the absence of additional computer experience, secondary school pupils suffered an attitude loss over a 12-month period. Some part of this loss may have been a manifestation of the general attitude decline commonly observed amongst pupils of this age. On the total evidence available, the relationship between attitudes toward computers and age appears to be complex and to change direction between school-age and adult populations. More sophisticated studies will be needed to separate possible changes in pupils' attitudes to computers from more general changes in attitudes to school and society.

In contrast to gender and age/ability, computer experience, including home experience, is shown to be a significant variable in most studies. Previous computer experience was shown to be a significant predictor of students' attitudes in an analysis based on three categories of length of experience (Loyd & Gressard, 1984b). Owning a home-computer was positively correlated with attitudes to computers in all studies investigating this variable. The CARAQ-based study showed a relative improvement in attitudes amongst pupils reporting a high level of use of a home-computer. The survey of Mohamedali et al (1987) showed that pupils with experience of computers, at home or school, had more favourable attitudes than those without experience.

Although there has been no planned study of the effects of different types of computer education programme, it is likely that, as in science, these have different attitudinal outcomes. Passive use of CAI materials was found to have no attitudinal effect (Griswold, 1984). This is not a surprising result as in much CAI the computer is used only as a sophisticated page-turner and test-machine. From the student's view, this material and type of application fail to utilise or reveal the potentials of the computer. Quite different results for the effects of computer based learning are obtained when students are actively involved in using the machine as a tool. The work of Anderson (1981), Clarke (1985), Enochs (1984), and Moore (1984) all indicate that practical activities have positive effects on attitudes.

It can be concluded that computer assisted learning in which the focus is on the subject and away from the computer has insignificant effects on computer attitudes. On the other hand, practical use of the computer in schools for LOGO or interactive-CAL materials can have positive effects on pupils' attitudes toward computers.

Discussion

The global construct "attitudes to computers" measured by some questionnaires is less useful than information about attitudes related to specific constructs such as leisure, career and anxiety. Researchers should specify precisely which attitude objects are being assessed in a specific scale or instrument. It may be preferable to specify scale constructs *a priori* rather than to rely on factor analysis to group items according to their statistical properties.

The review has shown that the four variables most often studied as correlates of computer attitudes have been age, gender, ability, and home-ownership. The marked effect of computer ownership on pupils' attitudes and the lack of an equal effect that can be attributed to Computer Studies lessons suggest that school influences on attitudes are small but give no clue as to why this is so. The four variables are not directly under the control of the teacher, this means that results from the studies are of little help to teachers seeking to improve the attitudinal outcomes of their classes.

Summary

Attention has been drawn to the need for attitude scales to be reliable and to have the power to discriminate between different groups. Each scale of an instrument should yield a score giving the respondent's position with respect to a single attitude object.

A review has been given of some studies of attitudes toward computers with particular attention to studies carried out after about 1982, the time when micro-computers became more common in schools and homes. The studies described in the text are summarised in Table 2.3. A blank in the table indicates no investigation was reported.

Despite differences in the format of the instruments and the attitude-dimensions reviewed, the results obtained a degree of consistency which is remarkable when the age-span and origins of the different samples are also considered. Although the main concern of this thesis will be the attitudes held by secondary school pupils, the general similarity of results across all studies suggests it is worthwhile to consider also measurements made on both younger and older groups.

The discussion has pointed out that based on the findings of the Swedish and CARAQ studies, it appears that Computer Studies lessons have less effect on pupils' attitudes toward computers than some other variables included in the reviewed studies. This finding points to the need for further study of the teaching of Computer Studies and the accompanying classroom environment.

Table 2.3 Summary table of recent research studies in Attitudes toward Computers

Name Date	Sample Age	Scales	Variables studied Age	Gender	Other	Comments
Bannon 1985	School pupils University students Teachers. 19-30+	1 Cognitive 1 Affective (By Fact anal)				Mainframe orientation No variables effects reported
Wagman 1983	University students age not given	10 social applications		M+ on 5 scales		High interscale corr weakens obs. gender effect
Griswold 1983	Under- & post-grads, age n/g	Composite score on 20 items	+		Arith (+) Locus of control(-)	Scale called computer awareness
Griswold 1985	Univ., Education & Business students age not given	Composite score on 20 items	+	NS*	Study Course(sig) Maths level (NS)	Compared Business/Education Students. Scale called Computer Attitudes
Griswold 1984	Elementary school			NS	CAI (NS)	Effects of CAI experience on attitudes to maths and school
Clarke 1985	Elementary school 11-14 (Girls only)				Maths ability and attitudes to school (both +)	Effects of LOGO exploratory experiences on ability and attitudes
Reece & Gable 1979	Secondary School 13-14 years	GATC scale				Describes use of factor analysis for scale construction
Enochs 1985	Middle School 13-14 years	GATC scale	NS	NS	Home-Owners (sig +)	Showed sig effects of home-ownership

.......continued/

Table 2.3 continued

Enochs 1984	Middle School 12-13 years	GATC scale		NS	Home-Owners (not sig)	Effects of "hands-on" experience. Small samples
Richards et al 1986	Secondary Sch.	3 scales			Reading ability (Mixed results see text)	New instrument based on science attitude questionnaire
		Liking	-	NS		
	13-14 years	Career Necessity	NS	M+		
	17-18 years	Male Domain	+	M+		
Dambrot et al 1985	Univ. freshers (Psychology)	CATT		NS	Maths Anxiety (M -, F -) Maths apt (NS) Gen achev. (NS)	Found gender diffs in aptitude and comp. experience
Loyd & Gressard 1984	High Schools and College 13 - 21	Anxiety	NS	NS	Computer Experience Positive effect on all scales	
		Liking	+	NS		
		Confidence	NS	NS		
Williams et al 1983	Camp attendees in holidays	SD of 24 items (4 scales)	2 scales sig 2 scales not sig			Study restricted to those without home-computer
Harvey & Wilson 1985	Elementary and Secy 10 -12 years	As Williams (20 items only)	Primary + on 4 items	3 items sig	Home-use sig on 11/20 items	Attitudes of primary and first year secondary pupils
Swedish Survey 1984	Lower Secondary 13 - 14 years	Survey items		M+		Survey after one-year of Information Technology for all
Moore 1984	Secondary 14 - 15 years	CARAQ 7 scales		NS*	Home-use (+) CAL (+) Ability (NS) Subject group (sig)	One year follow-up study linked to Computer Studies and Science study choices

(*) After allowance for course/subject groupings

CHAPTER 3

SOME CORRELATES OF LEARNING

This chapter describes some research studies on factors affecting student learning. Results of the studies will be used to select factors that may be relevant to the teaching and learning of Computer Studies.

The salient facets of a model of student learning

According to Walberg (1981, 1982, 1984) nine factors have produced significant causal influences on academic learning in a wide range of studies. The factors may be classified as student aptitude variables, instructional variables, and social-psychological environment variables.

Student aptitude variables

1. Ability, as measured by standard IQ or achievement tests

2. Development, chronological age or maturation

3. Motivation, as indicated by self-concept or personality tests or the student's willingness to work on learning tasks

Instructional variables

4. Quantity of instruction (time on task)

5. Quality of instruction including aspects of curriculum and instructional techniques

Psychological-environment variables

6. Home environment

7. Classroom or school environment

8. Peer group environment outside school

9. Media environment (especially television)

The first five variables are only partly alterable by teachers. The four remaining factors are psycho-sociological learning-environment variables. The learning environment variables affect learning directly and indirectly by raising motivation and responsiveness. Their inclusion is a recognition that learning is influenced by stimulation from parents and others at home, the classsroom environment, and by out-of-school contacts with peers and diverse social forces.

The relative importance of factors in the model

Although the large number of variables involved in learning has effectively prevented direct research on the relative effects of the components of models of teaching, the technique of meta-analysis (Glass 1977; Glass et al, 1981) can be used to combine results from many studies and thus obtain an overall value of the relationships between variables. The major advantage of meta-analysis is that because it combines data from a large number of people, conditions, curricula, classrooms, and so on, the conclusions are more generalisable.

Fraser (1987) has brought together the results of 134 meta-analyses each of which related some facet of learning to either cognitive or affective learning outcomes. The findings of the meta-analysis synthesis are consistent with Walberg's nine-factor model of educational productivity. He found that thirteen variables which had a correlation of 0.20 or greater with academic achievement could all be classified under the headings of the learner, the instructor, the environment and the use of learning strategies. Some of the factors found to have low or negligible relationships with achievement included pupils' affective characteristics, gender differences, teacher enthusiasm, and individualisation. Learning environment variables and most instructional variables were shown to have less impact on affective outcomes than on cognitive ones. The mean correlation between affective outcomes and the range of instructional factors was 0.11 compared with 0.14 for the correlation between achievement outcomes and the same factors.

Further support for the Walberg nine-factor model was obtained from a survey of 17-year old students carried out in the US by the National Science Foundation in 1981-82. Results showed many significant correlations between a wide range of educational productivity factors and cognitive and affective learning outcomes in science. Amount of science previously studied was a significant predictor of cognitive achievement but not of attitude. Homework, classroom environment and home environment were found to be highly significant ($p<0.01$) predictors of both achievement and attitudes.

RESULTS FOR SPECIFIC EFFECTS

The significance of science studies

In this section, results from previous studies of relationships between learning variables and outcomes are reviewed. The purpose of the review is to identify promising lines of enquiry for research in computer education.

Because few studies have been made of affective outcomes in computer education, it is necessary to look to other subjects for clues for likely relationships between variables and outcomes. It is thought studies of the outcomes of science teaching are most likely to offer clues about the most effective techniques of computer education as there have been more studies of the determinants of attitudes in science than in any other subject. Also there are a number of similarities between the teaching of science and the teaching of computer studies in secondary schools. These include:

1. Both are taught by specialist staff
2. Both subjects have specialist rooms and equipment that is seen as "belonging" to that room
3. Both subjects have links with mathematics
4. Teachers in both subjects can make reference to phenomena, events and objects in everyday life to illustrate principles and applications
5. During lessons pupils engage in practical exercises individually, in pairs or in small groups.

The NSF Survey showed that although the strength of the effects is different, affective and cognitive outcomes show a broadly similar pattern of relationships with a wide range of learning variables. It was decided to use the results of studies of both affective and cognitive learning outcome effects in science to act as **indicators** to promising investigations into the attitude-related effects of computer education.

LEARNER VARIABLES

The effect of pupil ability and achievement on attitudes

There is substantial evidence that pupil ability affects learning performance. Bloom (1976) reported a correlation of 0.77 between performance on course entry and cognitive achievement one year later. Achievement has been found to have a correlation of 0.51 with IQ (Hattie & Hansford, 1982), and 0.42 with Piagetian stage (Jordon & Brownlee, 1981).

Intuitively it would seem that students with the ability to do science would show a stronger liking for science, in which case the data on attitudes and ability would show a significant positive correlation. This expected relationship was not found in a meta-analysis carried out by Steinkamp & Maehr (1983). In this study the correlations between ability and attitudes of 0.07 for boys (n = 268) and 0.02 for girls (n = 225) did not reach the 0.05 level of significance. The researchers point out that the failure to find the expected relationship cannot be attributed to inadequate attitude instruments, overall these had reliabilities close to those of the cognitive instruments.

A meta-analysis of relationships between student characteristics and student cognitive and affective outcomes was conducted by Fleming & Malone (1983). Measures of general ability showed moderately strong positive relationships with achievement (correlations in the range 0.25 to 0.59, mean 0.43) but a much weaker relationship to attitudes (range 0.08 to 0.21, mean 0.15). Hough & Piper (1982) investigated the relationship between elementary school pupils' attitudes to science and their science achievement. A correlation of 0.45 was found for 583 elementary pupils in 30 classes. A much less strong relationship was found by Willson (1983) in a meta-analysis of 34 studies. For students at secondary level the mean correlation between achievement and attitudes was approximately 0.12.

The results of these science related studies showing there is no more than a weak and possibly variable relationship between science attitudes and pupils' ability are in agreement with the findings of studies of ability and computer attitudes reported in the previous chapter. The conclusion that ability is probably not a strong determinant of pupils' attitudes toward computers suggests that this variable might be omitted from a survey of the attitudinal effects of Computer Studies teaching.

The effect of gender on attitudes

Previous research has generally indicated significant gender differences in both science achievement and attitude. In the Fleming & Malone (1983) study, there appeared to be a reversal of the ability-attitude relationships for boys and girls with age. In middle school, the science performance of males exceeded that of females of equal ability; whilst the females had the more positive attitudes. In high school, the reverse was the case.

Gender differences were also investigated in the study by Steinkamp & Maehr. Mean correlations between achievement and ability were statistically significant for both sexes and the difference was significant at $p = 0.001$. The result agrees with findings of Comber & Keeves (1973) who obtained higher science scores for males in 19 developed and developing countries. In contrast, although the NSF study on 17-year olds reported by Fraser (1987) indicated a significant gender effect when raw correlations were considered, gender differences in science attitudes disappeared when other factors were controlled.

As described in Chapter 2, several studies have investigated gender differences in attitudes to computers. In general populations, the gender difference has been significant with males having the more favourable attitude. When studies were restricted to one course group or pupils choosing a particular combination of subjects, gender effects on computer attitudes were generally non-significant. Thus the relationships of gender with attitudes toward science and attitudes toward computers appear to be closely similar.

The effect of pupil anxiety on achievement and attitudes

Mallow & Greenburg (1982) regarded science anxiety as "a phenomenon of national scope that is well known but little understood". They report its effects are most serious on women and disadvantaged (minority) groups.

They suggest science anxiety is increased (made worse) by unpleasant past experiences in science, over-concerned teachers, and social effects such as role-stereo-typing of both women and scientists.

The reduction of anxiety is important because of its influence on learning. Research studies worldwide have shown that anxiety can impede the attainment of cognitive and affective goals. Fraser & Fisher (1982b) found correlations of between -0.09 and -0.27 between science anxiety and attitudes in pupils age about 14-16 years. Hattie and Hansford (1982) report a correlation of -0.11 between anxiety and achievement based on a meta-analysis of personality influences on achievement in a range of school subjects.

Studies by Dambrot et al (1985) reported in Chapter 2 have shown the negative effect of anxiety on computer attitudes for both male and female undergraduate students.

INSTRUCTOR VARIABLES

A comprehensive study of the relationships between teacher characteristics and teaching (ie classroom) behaviours has been made by Druva & Anderson (1983). The independent teacher characteristics were gender, IQ, level of academic knowledge, age and personal variables. The study identified 26 dependent teacher-behaviour factors and 23 student factors including attitudes to science, attitude to course and attitude to teaching method. A composite variable of 20 separate factors was positively associated with teacher education courses, grade as a student teacher and length of teaching experience. Correlations of the composite teacher variable with gender, age and science training were small, none reached a value of 0.20.

Students' attitudes to science showed a correlation of 0.26 with teacher-age and 0.18 with teacher science training. A correlation of -0.20 was found between students' attitudes and teacher-efficiency (order, conscientiousness, planning). The correlation between students' attitudes and teachers' attitudes was very small, 0.04 with a sd 0.16.

Sweitzer & Anderson (1983) carried out a meta-analysis of the effectiveness of science-teacher training programmes and short courses. In 153 studies teachers who received the training consistently outperformed the control group on various teacher-criteria measures. According to Joslin (1981), although inservice courses are effective in enhancing teachers' achievement, classroom skills, and attitudes they show smaller and mostly non-significant effects on student outcomes.

This result casts doubt on the assumption that science knowledge is highly related to teaching effectiveness. Although in the Druva & Anderson investigation science knowledge (measured as length of science study) had one of the highest correlations with both cognitive and affective student outcomes, the empirical value of 0.19 represents less than four percent of the student outcome score variance. In a review of the effects of new curriculum programmes (see next section), Shymansky et al (1983) found that overall student outcome performances were less positive in studies where teachers reported having received content-focused inservice training.

No equivalent study of the relationship between teacher characteristics and pupils' attitudes toward computers was found.

Lilley & Wilkinson (1983) studied the effect of teacher variables on their verbal behaviours in Further Education classrooms. They argued that since verbal interactions between teacher and pupil occur at an early stage in the teaching process, they should be more sensitive to teacher characteristics than are student learning outcomes. The study examined 27 teacher classroom variables and 15 teacher characteristics including gender, age, qualifications and a number of personality variables. Overall there was a lack of significant relationships. In particular it was found that whether a teacher chose a 'direct' or 'indirect' verbal approach in the classroom had little to do with teacher characteristics.

These studies suggest that few teacher personal characteristics have a significant effect on teaching behaviour and on student outcomes. The measurement of a wide range of teacher personal characteristics therefore need not be given high priority in a survey of Computer Studies teaching.

INSTRUCTIONAL VARIABLES

Under this heading are considered curriculum materials, methods of instruction, teaching methods and perceived classroom environment.

The effect of curriculum materials on attitudes

New science curricula are characterised by emphasis on processes rather than products, the use of a wide range of teaching resources, pupil-controlled practical activity and the inclusion of a consideration of applications and social effects of science in addition to normal theory.

Weinstein et al (1982) analysed 33 curriculum schemes from Great Britain, the US and Israel. In 151 separate comparisons results favoured the new curricula. Shymansky et al (1983) made a meta-analysis of 105 studies that had compared the effectiveness of the National Science Foundation curricula with traditional curricula. In every instance, the NSF curricula were favoured on attitude outcomes. In a meta-analysis of research on three major activity-based elementary (US) science programmes, Bredderman (1983) found they favoured both science process skills and affective outcomes. Because the effects were largely independent of the nature or design of the study and the instruments used to measure outcomes, it seems reasonably certain that the new science curricula are associated with improvements in both cognitive and affective outcomes.

In studies of attitudes to computers, the findings of Clarke (1985) and Enochs (1985) that groups engaging in practical activities with computers showed more favourable attitudes have been mentioned previously.

The effects of methods of instruction and teaching method on attitudes

Willett et al (1983) tackled the question "What are the effects of different instructional systems used in science teaching?". An instructional system was defined as "a general plan for conducting a course over an extended period of time. It is general in that it encompasses many aspects of a course" (Page 406). From a meta-analysis of 130 studies in which an innovative or alternative instructional system was compared with traditional teaching, they showed that most instructional systems operate at or near to the level of traditional teaching.

Wise & Okey (1983) identified 12 categories of teaching method. They described teaching methods as

> "...narrower, less encompassing than instructional systems. Whereas the latter might plausibly guide a great many decisions about the organisation and conduct of teaching a science course, teaching methods refer to more limited aspects of a teaching plan (e.g. the method of testing, type of questionning, wait-time and the like). (Page 420).

The overall mean effect size of the various methods on achievement and attitudes was modest but Wise & Okey suggest that further research might identify combinations of teaching behaviours that would give larger effects.

McGarity & Butts (1984) investigated the relationship between teacher classroom management behaviour, student engagement, and student achievement in middle and high school science classes. Results showed that teacher management behaviour was related to student engagement ($r= 0.69$) and to student achievement ($r = 0.51$). These relationships were consistent across differing levels of ability. They conclude:

> "All aptitude levels achieved more when taught by teachers who exhibited competency in classroom management." (page 60)

The particular management behaviours studied included help for individual students, encouraging learner involvement and providing feedback.

The importance of time as an instructional variable is shown in results of a meta-analysis of the relationships between homework and achievement (Paschal et al, 1984). In this study, 85% of the relationships favoured homework ($p<0.0001$). Any homework was preferable to no homework, traditional types of homework showed larger effects than non-traditional types.

Results in this section suggest that any study of the effects of Computer Studies teaching should be concerned with classroom teaching methods and classroom management activities and not with more general teaching concerns such as course planning.

The effects of classroom environment perceptions on attitudes

Johnson et al (1981) showed that cooperative classroom structures were almost always more effective than competitive or individualised structures. Individual settings were least effective when compared to 'cooperative with intergroup competition' and 'interpersonal competitive' settings. Systems that provided close student supervision and support, goal orientation and a high level of teacher interaction were more effective. The negligible effect of individualisation is important because even in the typical non-individualised classroom, pupils spend a considerable part of their time working alone.

Classroom environment is the label used to describe the complex psycho-sociological climate of the classroom as perceived by students. Considerable research has taken place on the effect of classroom climate on the cognitive and affective outcomes of science education (see Fraser, 1986; Fraser & Walberg, 1981). Because many studies have shown that classroom environment variables account for an appreciable part of the attitude score variance, the measurement and application of these scales is discussed more fully in Chapter 4.

Discussion

The usefulness of the review lies in the application of the findings to computer education. If the results from science studies are applicable to computer education it would be expected that higher levels of affective outcomes might be obtained by appropriate choice of lesson activities and strategies showing particular concern to

(1) Increase the percentage of students' "time-on-task"
(2) Use specific teaching activities and combinations of these activities. (The most useful activities still remain to be identified)
(3) Increase the number of practical student activities
(4) Improve their classroom management skills
(5) Improve pupils' perceptions of the classroom climate.

Walberg's nine factors include some that are outside the control of the classroom teacher. Recognising the existence of two sorts of factors, Haladyna et al (1983) have proposed a model of attitude learning based on the dimensions of content and focus. Content refers to one of the three constructs of learner, teacher and learning environment. The focus of variables may be described as exogenous, lying outside the institution, or endogenous, within the institution. Endogenous variables are under the control of the school or teacher, exogenous variables by definition are not. For example, the teacher has no control over any of the learner variables such as gender, ability, maturation, and personality. Nor can the teacher determine the home, peer-group, and media environments of the learners. The influence of the teacher is restricted to the quantity and quality of the instruction he provides and certain influences on the classroom environment.

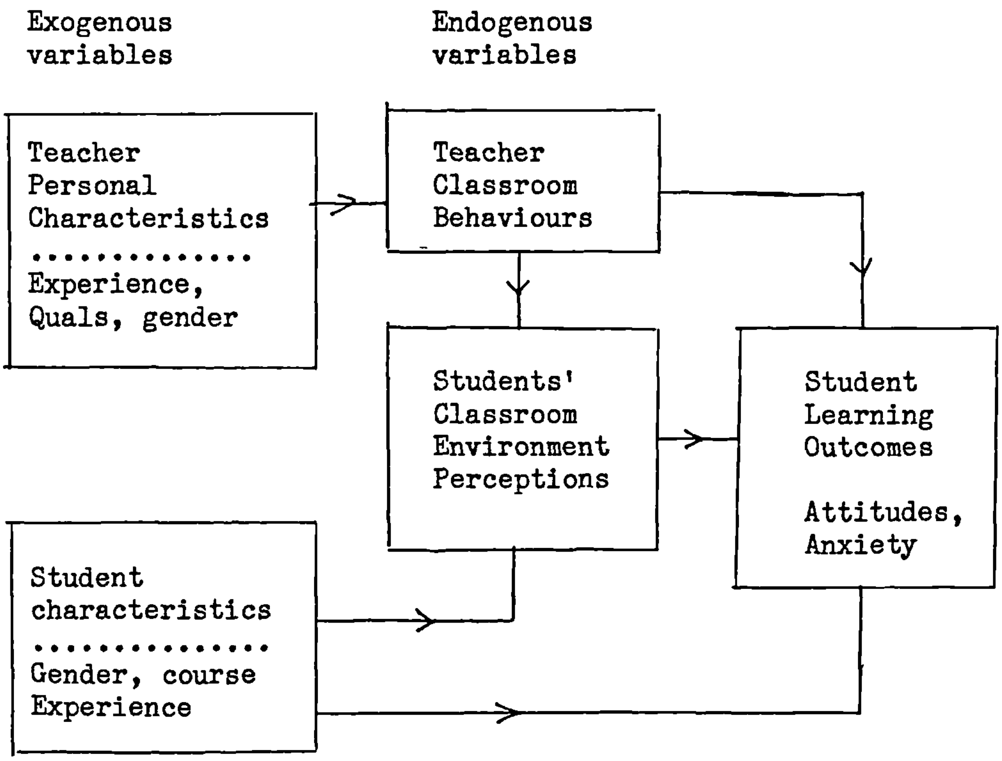


Figure 3.1 Model used to denote objectives of the study (Adapted from Haladyna & Shaughnessy (1982))

The studies described in this chapter lead to the expectation that of the endogenous variables, teachers' classroom activities and pupils' perceptions of the classroom environment are amongst the most important determinants of pupils' attitudes toward computers. It is, therefore, worthwhile to make these the principal subjects of a survey of computer education. In this study information will be obtained about teacher, pupil and learning environment variables that might determine learning outcomes in Computer Studies. The variables and interactions to be studied are shown in Figure 3.1. This is a form of the model of Haladyna & Shaughnessy (1982) modified to highlight the variables which, according to the studies reviewed in this chapter, are strongly associated with affective learning.

Summary

Attention has been drawn to Walberg's model which identifies nine factors which influence learning. These can be grouped into three categories; learner variables, instructor variables and instructional variables. Support for the model is obtained from results of meta-analysis and separate studies in which variables in the three categories were shown to have significant correlations with both cognitive and affective outcomes. A justified decision was made to look to science education studies for help with identifying factors likely to influence outcomes in computer education. Teacher variables concerned with instructional methods and pupils' perceptions of the classroom environment appeared to be the most significant.

CHAPTER 4.

THE MEASUREMENT AND EFFECTS OF PUPILS PERCEPTIONS OF THE CLASSROOM ENVIRONMENT

Introduction

The powerful effects of the learning environment on human behaviour have been shown in a wide variety of settings including the home, schools and colleges, the community, and social institutions (Walberg & Marjoribanks, 1976; Pace & Stern, 1958; Anderson, 1970; Marjoribanks, 1974; Moos, 1974). Research over more than a decade has shown that student perceptions of the classroom environment account for substantial amounts of variance in learning outcomes. This research has been replicated at different educational levels, in several countries and through use of a variety of classroom environment measuring instruments. Reviews of research relating classroom environment to learning outcomes have been given by Anderson & Walberg, 1974; Walberg, 1976; Fraser 1981a, b; Fraser & Walberg, 1981; Fraser, 1986. Fraser (1986) refers to "compelling evidence that the classroom environment is such a potent determinant of student outcomes that it should not be ignored by those wishing to improve the effectiveness of schools" (page 1).

Definition of classroom environment

According to Walberg classroom environment refers to students' and teachers' perceptions of all psychosocial aspects of the learning environment that influence learning. Classroom environment perceptions include interpersonal relationships amongst pupils, pupil-teacher relationships, the material provisions of the classroom and pupils' liking for the subject and method of teaching. Classroom environment perceptions characterise the learning environment as seen by the participants, this may be different from the impressions of the teacher and of an outside observer.

From a study of environments in a wide range of social institutions, Moos (1974, 1979) derived three categories, or dimensions, of environments that bear on behaviour. The three dimensions are:

Relationships: which identify the nature and intensity of personal relationships including person-person support within the environment

Personal development: the direction(s) along which personal growth and self-enhancement will tend to occur and the extent to which the environment provides for and encourages such development

System maintenance and system change: the extent to which the environment is perceived as orderly, has clear goals and expectations and is responsive to change.

Moos concluded all three dimensions must be assessed to provide a complete understanding of any environment (Moos, 1974). This principle has had an important influence on the development of instruments to measure classroom environment. In these dimensions the role of teachers in learning is implictly included through their effects on the classroom psychosocial environment.

The assessment of psychosocial classroom characteristics

Questionnaires to teachers and pupils are convenient for tapping psycho-social perceptions of the learning environment. When used in this way, the items are high inference measures requiring the respondent to evaluate the meaning of classroom behaviours. For example a response to the item "The teacher is friendly to students" on a scale from Strongly Agree to Strongly Disagree requires students to make judgements based on a synthesis of a range of past events. Measures of this kind contrast with the low inference measures found in observation schedules.

Proponents of the use of students' responses to high inference items advance a number of arguments to support their use in preference to low inference observation studies. The arguments may be summarised as follows:

1. paper and pencil tests are more economical than the use of trained observers,
2. students' perceptions are based on experiences over several lessons; an observer may see only one or at most a few lessons for a particular class or teacher,
3. questionnaires tap the perceptions of all members of the class in contrast to observation by (usually) a single observer

Students' perceptions are real to them and may be more important than "true" events as determined by an objective and non-involved observer. Mintzes (1982) points out "It is quite possible that outside observers do not share the assumptions of students whose learning outcomes are being monitored...students may have their own normative and idiosyncratic assumptions about teaching behaviours and these assumptions may be as important to learning as the behaviours themselves." (p.790). It is possibly for this reason that perceptual measures of classroom environments have been found to account for more learning outcome variance than classroom observation variables (Fiedler, 1975).

In common with other questionnaire-based studies, classroom environment research has the problem that teachers' and students' answers may be over generalised and biased towards views thought to be socially desirable. Despite this difficulty, the convenience and demonstrated validity of perceptual measures of classroom psychosocial environments have led to significant research in many countries. Several instruments are now available for these studies and some of them have been used in a sufficiently wide range of classrooms for their statistical properties to be known.

The following sections give an account of three of these instruments and investigational methods that might be applied to a survey of computer education classrooms.

Three classroom environment instruments

Instrument	Number of scales	Items per scale	Scoring
Learning Environment Inventory (LEI) (1)	15	7	SD, D, A, SA (1, 2, 3, 4)
Classroom Environment Scale (CES) (2)	9	10	True/False (1/0)
Individualised Classroom Environment Questionnaire (ICEQ) (3)	5	10	SD,D,NS,A,SA (1,2,3,4,5)

References: (1) Fraser, Anderson & Walberg, 1982
(2) Moos & Trickett, 1974
(3) Rentoul & Fraser 1978

Table 4.1: Overview of three classroom environment instruments

Table 4.1 gives an overview of three instruments that have been used in a range of secondary school level classroom environment research. They are the Learning Environment Inventory (LEI) (Fraser, Anderson & Walberg, 1982), the Classroom Environment Scale (CES) (Moos & Trickett, 1974) and the Individualised Classroom Environment Questionnaire (ICEQ) (Rentoul & Fraser, 1978).

Table 4.2 gives descriptions of the 29 separate scales contained in the LEI, CES and ICEQ instruments. The classification of the scales given in the table is that of Moos (1974, 1979). In agreement with Moos' requirement each instrument contains one or more scales classified with each of his three categories.

The sample items show the three instruments are concerned with different aspects of the classroom environment. Although even within each instrument, the scales are not wholly separate, some broad trends can be distinguished. The LEI instrument focuses principally on the actions of the class, the CES scales are divided between class and the teacher's control of the class, whilst the ICEQ items ask for perceptions of teaching and learning activities.

Development procedures for the three instruments have been described in the references given. An overview is available in Fraser (1986, pages 22- 30). Briefly, for all the instruments the stages of development were:

1. Identification of the salient dimensions which characterise the style of classroom of interest to the study. The dimensions chosen have to provide coverage of all aspects of interest whilst remaining conceptually distinct.

2. Items for the dimensions (scales) were written

3. Test items were pilot-tested with samples of students; responses were subjected to a range of item analyses to remove faulty items and so obtained enhanced reliability and discriminant validity

4. Statistics of scales comprising the retained items were either calculated from sample responses or determined using a fresh sample of respondents.

Scale (Moos' Category)		Sample item
Learning Environment Inventory (LEI) (1)		
Cohesiveness	(R)	All the students know each other very well
Friction	(R)	Certain students in the class are responsible for petty quarrels
Favouritism	(R)	Every member of the class enjoys the same privileges
Cliqueness	(R)	Certain students work only with their close friends
Satisfaction	(R)	There is considerable dissatisfaction with the work of the class
Apathy	(R)	Members of the class don't care what the class does
Speed	(PD)	Students do not have to hurry to finish their work
Difficulty	(PD)	Students in the class tend to find the work hard to do
Competitiveness	(PD)	Students seldom compete with each other
Diversity	(S)	The class has students with many different interests
Formality	(S)	The class is rather informal and few rules are imposed
Material Environment	(S)	The books and equipment needed by students are easily available in the classroom
Goal Direction	(S)	The class knows exactly what it has to get done
Disorganisation	(S)	The class is well organised and efficient
Democracy	(S)	Class decisions tend to be made by all the students
Classroom Environment Scale (CES) (2)		
Involvement	(R)	Most students in this class really pay attention to what the teacher is saying
Affiliation	(R)	There are groups of students who don't get along in the class
Teacher Support	(R)	The teacher is more like a friend than an authority
Task Orientation	(PD)	This class is more a social hour than a place to learn something
Competition	(PD)	Students try hard to get the best grade
Order & Organisation	(S)	Students fool around a lot in this class
Rule Clarity	(S)	In the first few weeks the teacher explained the rules about students could and could not do in this class
Teacher Control	(S)	Students don't always have to stick to the rules in this class
Innovation	(S)	New ideas are always being tried out here
Individualised Classroom Environment Questionnaire (ICEQ) (3)		
Personalisation	(R)	The teacher considers students' feelings
Participation	(R)	The teacher lectures without students asking or answering questions
Independence	(PD)	Students choose their partners for group work
Investigation	(PD)	Students find out the answer to questions and problems from the teacher rather than from investigations
Differentiation	(S)	Different students use different books, equipment and materials

Note: Moos' categories R = Relational, PD = Personal Development, S = System (see text). References (1), (2), (3), See Table 4.1 above

Table 4.2 Scale names, categories and sample items for three learning environment instruments.

The Learning Environment Inventory (LEI)

The LEI was originally developed for evaluation of the Harvard Project Physics programme (Walberg, 1968). Based on experiences with an earlier instrument known as the Classroom Climate Questionnaire, Anderson & Walberg (1974) were able to choose for the LEI "concepts previously identified as good predictors of learning" and others "considered relevant to social psychological theory and research... (and) concepts intuitively judged relevant " (p.3).

In the most recent version of the LEI (Fraser et al, 1982) the mean values of the alpha internal reliabilites of the scales obtained from a variety of subject areas were in the range 0.56 - 0.85 whilst the inter-scale correlation values were low, in the range 0.08 to 0.40, indicating they probably measure distinct environment dimensions.

The Classroom Environment Scale (CES)

In developing the CES, Trickett & Moos (1973) reviewed literature in educational and organisational psychology, read descriptions of classroom environments, conducted interviews with teachers and observed classes in contrasting schools. The dimensions chosen for the CES were consistent with the three basic categories described by Moos.

The final version of the CES contains nine scales with 10 items of True-False format in each. A version of the CES similar to that of Trickett & Moos is mentioned by Fraser & Fisher (1983a). Their instrument contains 87 items only because removal of 3 items resulted in a noticeable improvement in scale statistics. This illustrates the continuing development of classroom environment scales when each application of an instrument may also be used as an opportunity to reappraise the scale content and to redetermine scale reliabilities.

The values of the scale internal reliabilities and intercorrelationsof the CES instrument were similar to those of the LEI being in the range 0.67 to 0.86, and from 0.09 to 0.31 respectively.

The Individualised Classroom Environment Questionnaire (ICEQ)

The ICEQ was developed to measure the environment of classroom settings (predominantly science classroooms) commmonly described as "open", "individualised" or "enquiry-based" (Rentoul & Fraser, 1979). Development of the instrument was guided by the wish to produce an economical instrument of a few scales only. Dimensions for the ICEQ were chosen after a review of the literature on open classrooms and individualised curricula; the views of teachers and educators were also obtained. Ideas for items and scales were also obtained from existing instruments, Rentoul & Fraser list 17 scales that were consulted as relevant to the study. The final form of the instrument contains 50 items arranged in five equal scales. The wording of the items is said to be appropriate to secondary school students.

The mean alpha coefficient of the ICEQ scales is 0.70. The scale inter-correlations range from 0.16 to 0.36 with a mean of 0.27 showing the scales are statistically distinct though somewhat overlapping.

Other forms of the LEI,CES and ICEQ instruments

Tisher & Power (1975) reported that 14 year olds had difficulty with some items of the original LEI. Partly for this reason and partly for reasons of test economy, a simplified version of the LEI known as the My Class Inventory (MCI) was produced (Anderson, 1971b) and further developed for use with pupils age 8-12 years (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982). The MCI retains only five of the 15 LEI scales; in the short form of the instrument there are five items per scale; all the items have a YES/NO response format and a reduced level of reading difficulty.

Although the CES and ICEQ instruments have been used successfully in the forms described above, some applications require a more rapid assessment of classroom environment. For this purpose, Fraser and Fisher developed short forms of the CES and ICEQ instruments (Fraser 1982a, Fraser & Fisher, 1983). The short form of the CES contains only six (instead of nine) scales and each scale is reduced to 4 items. The short form of the ICEQ contains 25 items with 5 items for each of the five scales contained in the full instrument. Thus, in contrast to the modified LEI and CES instruments, the short form of the ICEQ does not reduce the range of classroom environment variables that are assessed.

Fraser & Fisher (1986) give statistical data on the short forms of the MCI, CES and ICEQ instruments using data collected from large and representative samples of classes in the USA and Australia. The data provide evidence of the reliability and validity of the short forms of each scale. The correlations between the long and short forms of the CES and ICEQ scales were quite high ranging from from 0.78 to 0.97. These values are interpreted as showing that in the two forms of the instruments, the scales measure the same constructs. The internal reliability of the shortened scales was lower in line with the reduction in the number of items.

Review of studies of the association between student outcomes and classroom environment

Early research on the social climate of learning concentrated on the relationships between perceived classroom environment and cognitive outcomes (e.g. Anderson, 1970, 1971a; Walberg, 1969). Lawrenz (1976a, 1976b) was one of the first to investigate a suggestion due to Bloom (1971) that students' perceptions of the classroom environment should also affect outcomes in the affective domain. In the study of Lawrenz (1976a), high school students of Physics, Chemistry and Biology completed a Science Attitude Inventory and the 10-scale LEI. Three separate analyses were used to find which LEI scales acted as predictors of attitude to science for students of biology, of chemistry and of physics.

Linear regression equations accounted for 29-39% of the attitude score variance. In biology classes Favouritism was the best predictor of attitude to science. In chemistry classes the scales of Friction, Difficulty and Diversity were predictors of attitude. In physics classes none of the LEI scales was a significant predictor of attitude to science. Lawrenz suggests this result may be a consequence of the greater maturity of physics students who had already spent two years studying first biology and then chemistry.

Fraser (1979) examined the relationships between four cognitive and three affective science outcomes and a version of the LEI modified to make it more relevant to seventh grade science classrooms in Melbourne, Australia. Multiple regression analysis showed that after controlling for pretest scores, socioeconomic status, general ability and gender, the classroom environment scales accounted for between 3% and 22% (mean 8%) of the mean score variance.

A comprehensive study of science classroom environments based on the CES was carried out by Fraser & Fisher (1983b). The sample consisted of 2175 students in 116 Grade 8 and Grade 9 science classes in Tasmania, Australia. Tests of three cognitive and six affective outcomes were given at both the beginning and end of the year, the CES instrument was used at mid-year. Results showed that, after correction for pretest scores, the the number of significant outcome-environment correlations was about four times that expected by chance. Multiple regression equation coefficients were used to suggest which environment variables were most strongly associated with particular learning outcomes. The results were:

Learning outcome	Favoured by:
Social implications of science	Order & organisation (+)
Enjoyment of science lessons	Order & organisation (+)
Normality of scientists	Teacher support (+), Innovation (-)
Attitude to Inquiry	Rule clarity (+)
Adoption of scientific attitudes	Affiliation (+), Innovation (-)
Leisure interest	Order & organisation (+), Innovation (+)
Generalisations	Teacher support (+), Task orientation (+), Innovation (-)

Note + (-) indicates that outcome scores are increased by greater (lesser) scores on the environment variable.

The same study explored relationships between the nine learning outcomes and the 5 ICEQ scales. The scales of Participation, Involvement and Investigation were positively associated with outcomes of Social implications, Attitude to scientists and Generalisations. The block of 5 ICEQ scale scores accounted for 7.1% of the posttest attitude score variance, the ICEQ scores were not significantly related to the achievement score variance. The communality and uniqueness of the CES and ICEQ scales were also calculated from the data. It was shown the two instruments measure different dimensions and that it may be worthwhile to use both in the same study of outcome-environment relationships.

The study of environment-outcome relationships has not been confined to use of the LEI, CES and ICEQ instruments. Gardner (1976) used eight classroom environment scales derived from a college level questionnaire to predict four attitude criteria. He found the number of significant correlations between an attitudinal outcome and an environment measure was five times that expected by chance. A meta-analysis of studies relating classroom environment to student outcomes in eight subjects and four countries has been made by Haertel, Walberg and Haertel (1981). Their results agree with earlier findings by Anderson & Walberg (1974) that student perceptions of the learning environment account for about 30% of the variance in learning outcomes beyond that accounted for by appropriate pre-test measures.

The results quoted in this section together with others in reviews and elsewhere support the view that the classroom environment has important effects on student learning. Although the relationships are correlational and therefore not proof of causality, they are sufficiently strong and widespread to suggest that assessments of students' perceptions of the classroom environment should be included in any comprehensive survey of Computer Studies teaching.

Review of determinants of classroom environment

In the studies sampled in this section classroom environment scores were used as dependent (criterion) measures. Fraser (1986) summarises work on classroom environments as criteria under three headings: curricula, differences between teachers and students, and other variables. The present discussion is limited to research studies concerned with the effects of variables wholly or partly under the control or selection of the teacher.

In an evaluation of science facilities in Australian schools, Ainley (1978) examined the relationship between the provision of science facilities and a specially devised classroom environment scale, Stimulation through variety. This variable included students' perceptions of provision for independent inquiry and of the range and variety of resources. The independent variables were science room occupancy, science room quality, apparatus provision, and technical support. From a study of 105 classrooms only one significant result was obtained, scores on the Stimulation through variety scale were greater in classrooms that had more apparatus.

Talmage and Hart (1977) used the short form of My Class Inventory (MCI) instrument in an evaluation study of a one-year in-service programme on investigative approaches to the teaching of mathematics. The experimental group consisted of 23 classes of pupils taught by teachers who had attended the programme, they were compared with a control group of 23 classes taught by non-programme teachers. It was shown that, after allowing for pretest scores, class level mean scores on only the cohesiveness scale were significantly higher in the group taught by programme-trained teachers.

Fraser (1986) reports a study of effects arising from teacher competency in USA elementary schools made by Ellett et al (1978). Teacher competency was measured by 20 indicators of planning, managing, instructing, etc. using data collected from observers, peer-group teachers, school administrators and students. Students' perceptions were measured using the MCI instrument. Twenty per cent of the correlations between classroom environment variables and teacher competency scores were statistically significant. More competent teachers had classrooms that were perceived by students as having less friction and a higher level of satisfaction. Lawrenz & Welch found in comparison with classes taught by male teachers, classes of female teachers were perceived as higher in diversity, goal direction and formality and lower in difficulty.

The studies described in this section show teachers may help to determine the classroom environment through their personal characteristics, training, or choice of resources. The studies by Ainley and by Talmage & Hart suggest that relationships in which classroom environment scores are criterion variables are, in general, weaker than the relationships found using the same variables as predictors.

The Choice of Classroom environment measures for studies in Computer Education

Several studies have shown that one or more scales of the MCI, LEI, CES and ICEQ instruments are correlated with cognitive or affective learning scores. Results such as those reported above may, however, not be applicable to all subjects and to all pupils. Fraser & Fisher (1982b) advise

> "some caution is needed before generalising from these results. Those specific classroom environment characteristics found conducive to the achievement of outcomes in science classes are not necessarily those likely to enhance the attainment of aims valued in classes studying other school subjects (e.g. English). Results found among a sample of Australian students at junior high school level are not necessarily generalisable to other cultures and grade levels." (p.515).

The need for caution expressesd in this paragraph is slightly reduced by the later report (Fraser, 1983) that the ICEQ scales gave statistically similar results when used with science and social science classes of pupils age 13-16 years.

In other words, although it is likely that use of a group of classroom environment measures will show significant relationships between learning and environment scores in most school subjects, the particular scales and strengths of the relationships could differ from study to study. Lawrenz (1976a) showed how different scales can be associated with superficially similar groups of students and environments.

The difficulty of applying the results of one study to the design of another stems from the lack of a basic educational or psychological theory of the relationships between classroom environment as measured by existing scales and learning. The lack of a basic theory leaves the choice of scales and of items for the scales to the subjective decisions of the researcher. Thus it is partly a matter of choice whether the study uses an established instrument or whether a new instrument is devised and developed. As Computer Studies is a relatively new entrant to the school curriculum there has not been time to build up a substantial body of research in the teaching of the subject. The lack of information about activities in

Computer Studies classrooms effectively prevented the development of new learning environment scales for this subject. Thus it seemed worthwhile to use one or more of the established scales to obtain pupils' perceptions of the classroom environment in a survey of Computer Studies teaching.

Because one aim of the research was to provide a description of Computer Studies teaching, the choice of scales was restricted to those focused on teaching, lessons and the behaviours of pupils and teachers which effectively ruled out the LEI scales because almost all of these have the class as the scale subject. The same criterion also cast doubt on the usefulness of the CES scales of Affiliation and Competition. It was also decided to favour the use of scales that had shown significant relationships with outcomes in science classes. To preserve validity it was decided to use the full (long) form of each selected scale.

Instrument and Scale name (£)	Raw correlation with Affective learning outcome		
	SocImp	LeisInt	EnjLsn
CES			
Involvement	0.22*	0.28**	0.42**
Affiliation	0.16	0.22*	0.20*
Teacher support	0.16	0.11	0.27**
Task orientation	0.25**	0.25**	0.17
Competition	0.20*	0.08	0.13
Order & organisation	0.30**	0.41**	0.45**
Rule clarity	0.24*	0.25**	0.25**
Teacher control	0.02	0.04	-0.02
Innovation	0.06	0.20*	-0.20*
ICEQ			
Personalisation	0.14	0.09	0.29**
Participation	0.30**	0.22**	0.32**
Independence	0.05	0.10	0.11
Investigation	0.09	0.20*	0.11
Differentiation	-0.15	-0.03	-0.02

Notes: (£) Long forms of all scales.
* sig at $p < 0.05$, ** sig at $p < 0.01$
Outcomes key: SociImp = Social implications, LeisInt = Leisure interest, EnjLsn = Enjoyment of lessons
Adapted from Fraser & Fisher (1982)

Table 4.3: Correlations of CES and ICEQ classroom environment scales with affective outcomes

Data from a study of science classrooms is shown in Table 4.3 (Fraser & Fisher, 1982a). The attitude scales of Social implications, Leisure interest and Enjoyment of Lessons have been selected for inclusion in the table because they are apparently similar to the CARAQ scales of SOCIAL, LEISURE and SCHOOL.

It was decided to use all five scales of the ICEQ. Although two scales lack significant correlations with science outcomes, their inclusion in the computer studies survey seemed justified. Intuitively, the scale INDEPENDENCE has face validity with a subject in which pupils with a home computer may be expected to do some work at home. The scale DIFFERENTIATION is included because it was recognised that the inclusion of the student project requires Computer Studies to have a higher level of differentiation than, say, science. Many CS teachers say they pay particular attention to the matching of students' projects to their capability.

From the CES instrument it was decided to select the scales INVOLVEMENT, TASK-ORIENTATION, ORDER & ORGANISATION, and INNOVATION. The first three scales have high correlations with affective outcomes in science and their selection is probably justified on these grounds. The fourth scale, INNOVATION, has fewer significant correlations with affective outcomes but seems appropriate in a subject that has a variety of new equipment. It might be expected that some teachers would use these resources to try out new teaching approaches, for demonstrations or other purposes. The four scales from the CES that were not used were less concerned with classroom events. Their omission was thought necessay to permit students to provide some personal information and to answer other scales in addition to the CE scales within a 35-minute period.

Chapter 7 will refer to the relationships found by Fraser et al (1983) between Science Anxiety and the ICEQ scales of PERSONALISATION and PARTICIPATION and the CES scales of INVOLVEMENT, ORDER & ORGANISATION, and INNOVATION. A later decision to include the assessment of pupils' level of Computer Anxiety in the study also argues for the inclusion of these scales in a classroom environment questionnaire for Computer Studies.

Summary

This chapter has described the LEI, CES and ICEQ instruments that have been widely used for the assessment of pupils' perceptions of the classroom environment. Previous research has shown pupils' perceptions are significantly related to affective learning outcomes; typically from 3 to 25% of the attitude score variance may be explained by classroom environment scores.

Criticisms of the proliferation of scales and lack of information about Computer Studies teaching led to a decision to employ scales from existing instruments. The use of existing scales would permit comparisons with previous studies and would also help the study to avoid the criticism that the researcher's personal choice of items might in some way pre-empt the findings of the survey. Properties of the CES and ICEQ scales and their association with outcomes in science attitude studies were used to guide the selection of scales for the assessment of Computer Studies classrooms.

CHAPTER 5

OBJECTIVES, METHODOLOGY, AND RELATED ISSUES

The objectives of the study

The objectives given below were contained within the research described in the following chapters.

1. To describe the characteristics of a sample of pupils engaged in Computer Studies.

2. To identify scales or instruments suitable for the measurement of attitudes toward computers held by Computer Studies pupils.

3. To seek relationships between pupil characteristics and attitudes to computers in the sample of Computer Studies pupils.

4. To describe the characteristics of a sample of Computer Studies teachers

5. To identify and measure variables that correspond to stable characteristics of teachers' behaviours in Computer Studies lessons.

6. To seek relationships between the behaviour variables of Computer Studies teachers and pupils' attitudes toward computers.

7. To identify scales or instruments to measure pupils' perceptions of the Computer Studies classsroom environment.

8. To seek relationships between pupil characteristics and perceptions of the Computer Studies classroom environment.

9. To seek relationships between the behaviour variables of Computer Studies teachers and pupils' perceptions of the Computer Studies classroom environment.

10. To seek relationships between pupils' perceptions of the Computer Studies classroom environment and their attitudes toward computers.

11. To determine the lesson styles, activities and resources used by teachers and 14-16 year old pupils in Computer Studies lessons.

12. To determine whether lesson styles and resource use in Computer Studies lessons are related to characteristics of the teacher, pupil and classroom environment.

The boundaries of the study

Modern syllabuses are crowded and leave teachers and pupils with little or no time to undertake additional classroom activities. Hence it was decided that the study should make minimum demands on the time of teachers and interrupt classrooms for no more than a single lesson period. This time was probably the maximum teachers would feel able to spare from the programme of pupils in the final stage of their two-year examination course.

Teachers were assured their replies and all the information obtained from them and their pupils would be treated in confidence. They were told no teacher or school would be named or otherwise identified in any report. For this reason teachers would be given the opportunity to respond anonymously if they wished. It was thought desirable that pupils too should give their responses anonymously.

Potentially there is a very large number of variables relevant to teaching and learning in Computer Studies. Some attempt was made to restrict their number or range. The pupil study was restricted to fifth year pupils studying Computer Studies as an examination subject (O-level, 16+ or CSE). It was hoped that the restriction to this group would reduce between school variability of course content, time allowance, access to resources, and the expertise of staff. The choice of a single year-group removed pupil-age as a variable. Fifth year pupils were chosen to ensure that all pupils in the sample had covered a substantial part of the content of their two-year course. In addition, obtaining data from pupils in the second year should have the effect of diminishing the importance of pre-course school experiences of computers.

The discussion of Chapter 3 has shown any correlations between teaching style, lesson activities and computer attitudes were likely to be rather weak. Large samples of teachers and pupils were therefore desirable. This requirement ruled out an approach based on direct observation of a small number of classrooms and interviews with teachers and pupils. Instead, a postal survey was chosen; this gave access to a larger pool of teachers and permitted a wider geographical spread of the sample.

The survey technique

Survey research is a means by which new knowledge about "what is" can be generated. New knowledge is needed in Computer Studies, a curriculum area in which we know little of the context in which students develop attitudes and interests and the role of teachers and classroom activities.

A significant decision in the design of a survey is the choice of the sample as generalisations from a survey are limited to the population that the sample represents. Consideration has to be given as to whether the sample should be a weighted cross-section of the whole population of teachers or simply encompass the full range of different styles of Computer Studies teaching. A weighted random sample of teachers drawn on a national basis is the ideal sampling model, but is rarely possible on grounds of limited knowledge, availability of resources and the cost of staffing. These limitations applied to the present study. It was decided to try to obtain a sample that included all types of Computer Studies teaching though not necessarily in proportion to their frequency in the total population. Accordingly a postal survey based on a random sample of schools from different types of Local Education Authority was used to sample the full range of computer education policies, levels of resource provision and teacher support.

The identification of significant measures of teacher behaviour

In attempt to find stable measures of teacher behaviour, Shaveleson & Dempsey-Atwood (1976) examined different studies that investigated the same teacher variables but differed in other respects. They concluded that an unreasonable number of raters and occasions are required to measure individual variables reliably. They discovered that stable measures having high correlations with student outcomes could be obtained by grouping variables relating to the same behaviour. Moderately stable measures of teachers' behaviours included presentation, feedback, and direct control.

One of the deficiencies of studies of teacher effectiveness has been over-reliance on dichotomies of teaching style whereby all teachers have been classified as either progressive or traditional, formal or informal, democratic or authoritarian. Therefore a naturalistic approach was sought that would identify intrinsic teaching operations as opposed to confirming expectations. The term 'intrinsic' emphasises that the identification of the activities rests with the teachers rather than with an external observer or category system. Cluster analysis was seen as an appropriate statistical procedure for the identification of groups of teaching activities subject to subsequent demonstration of the validity of the resultant classifications. Cluster analysis has been used in several studies since Barker Lunn's (1969) investigation of streaming in primary schools recognised the value of grouping people (teachers) rather than grouping variables (classroom events) (Bennett, 1976; Galton & Eggleston, 1979; Youngman, 1983).

Answers to the Bennett questionnaire were subjected to cluster analysis in order to group together teachers who had a similar profile of responses to all the questionnaire items. These groupings were denoted as types or teaching-styles. Analysis of responses from 468 fourth year primary teachers showed twelve teaching-styles. Each style was characterised by the use or non-use of a number of teaching behaviours.

Bennett and others had the benefit of a considerable body of literature from which they could extract characteristics and categories of primary school teaching. There is no matching body of literature on the teaching of Computer Studies. Discussion and criticism of subject content, examinations, and the curriculum role of Computer Studies are available but these do not cover descriptions of what teachers do nor suggestions of what they might do in the classroom. Thus there is no adequate basis for the *a priori* identification of teaching categories for a survey questionnaire. Any selection that was made would be very likely to reflect the bias of the researcher or the small group of persons he was able to consult.

The requirements of this study of teaching style were identified as:

1. Absence of a priori descriptions or classifications in favour of analysis of intrinsic data.

2. Descriptions of teaching style to be multidimensional, i.e. each descriptor should combine a number of separate teaching activities.

3. Validation of teaching style groups to be obtained through correlations with other data.

The use of cluster analysis permits requirements 1 and 2 to be satisfied. The results of cluster analysis should be treated as valid only when they show understandable correlations with other group characteristics.

The choice of pupil learning outcomes

Learning outcomes fall into the psychomotor, cognitive and affective domains. The psychomotor domain has little relevance to the present study. It is not part of the content of Computer Studies, an academic subject, that pupils should become, for example, proficient keyboard operators or be able to demonstrate motor skills in the handling of computer equipment.

It seemed unlikely that a cognitive test could be accommodated within the study as the devising and validation of an acceptable cognitive test for use with a wide population was judged to require time, skills and resources beyond those available. As many research studies have shown the achievement-attitude relationship to be rather weak, assessment was restricted to the affective domain.

The principle of anonymous responses was desirable in order to maintain the validity of the research at the highest possible level. Any other format could encourage pupils to give the answers they thought were wanted, or those thought acceptable to their teacher, rather than their own opinions. Adopting the principle of anonymous pupil responses had two important consequences for the design and methods of analysis of the study. Firstly, the design was limited to a posttest-only design. Secondly, it predicated the choice of the class as the unit of analysis.

The use of a pretest

Whilst the pretest is commonly used in educational research to ensure equivalence (or a measured lack of equivalence) between experimental and control groups, it is not actually necessary to experimental design provided that randomisation ensures lack of initial biases in the samples. It was already known that the study of pupil outcomes would have to be based on intact classes offered by teachers rather than chosen according to the needs of systematic sampling. Because intact classes were used true randomisation was not possible and the methodology became what Campbell and Stanley (1963) have termed "quasi-experimental".

Campbell & Stanley (1963) mention the possible effect of pretesting on posttest scores. Studies of this effect have been reviewed by Bracht & Glass (1968), Welch and Walberg (1970) and Willson and Putnam (1982). The Willson and Putnam study was a meta-analysis of 33 studies in which only part of the total sample had taken a pre-test. They conclude there is a significant general pretest effect which has most serious implications for interpretation of findings in nonrandomised studies. The effects of pretest sensitisation are different for cognitive and affective outcomes. Cognitive gains might be made due to familiarity with testing procedure. For affective outcomes there may be halo effects in which everyone feels better on the second testing.

Omitting the pretest would also remove a major source of sample attrition. In a previous study (Moore, 1984) based on a 12-month interval between initial and final testing, from an original sample of 1240 pupils only 911 were located at the posttest stage. The loss of over 30% of the sample occurred in eight local schools that could be visited by the researcher at convenient times. The prospective sample loss was likely to be much greater if (i) the pretest to posttest interval was increased to almost two years (the duration of the Computer Studies course), and (ii) the sample of schools were to be spread nationally.

In the absence of a pretest, the experimental design becomes similar to that of a Static-Group Comparison (Campbell & Stanley, 1963, p.8). It can be represented as

$$\begin{array}{cc} X_1 & 0 \\ \hline & 0 \end{array}$$

In this diagram, 0 represents an observation, the use of a pupil questionnaire or test, whilst X_1 is an experimental treatment. In the present study, cluster analysis was used to identify groups of teaching operations treated as Xs. The outcomes in groups whose teachers use X_1 (X_2, X_3, ...) will be compared with the outcomes of groups whose teachers do not use X_1 etc (or use each one to a much lesser extent).

The omission of both pretest and randomisation threatens the experimental design with a number of sources of invalidity. The most serious of these is a chance that a teacher's choice of lesson activities is in some way selectively linked to the initial state of the class. If, for example, teachers were to use activity X only with "good" classes then the finding of an association between X and student outcomes would be the result of teachers' choice of X and not of X itself. A further threat to validity lies in the possibility of different drop-out rates associated with the use and non-use of activity X.

The planned study is less reactive than the conventional static-group comparison. Because the activities themselves are identified during the analysis, no teacher or pupil can be termed "control" or "treatment" group at any stage of the field work.

In summary it can be seen that the omission of a pretest from the experimental design implied some loss of internal validity through failure to ensure the initial homogeneity of the sample. This may have been partially offset by the elimination of sensitisation effects that might have been caused by taking a pretest and by choosing a design of low reactivity. Since these effects act in opposite directions, it was anticipated that the omission of a pretest would cause no more than a small loss of experimental validity.

The aggregation of data and the choice of the unit of analysis

Lindquist (1940) recognised a problem that still arouses concern in the analysis of many educational and behavioural experiments; the question of whether to use individuals or classes (groups) as the statistical unit of analysis when the treatment is applied to classes.

Arguments for pupils or groups as the units of analysis have been made (Burstein & Linn, 1976; Cronbach, 1976). Hopkins (1982) states that the argument over the choice of class or individual as unit of analysis arises from a failure to distinguish between the experimental unit and the observational unit. The experimental unit is the entity allocated to a treatment independent of other units. In studies of teacher effects and classroom environment research generally the experimental unit is most often the class. The class works with a teacher independently of other classes and other teachers. The class (experimental unit) may contain several observational units (students). In a class-level analysis, the data from the individual observational units is aggregated and used as a single value, the class mean. It seems evident that when the class receives the treatment as a whole, the class must be used as the unit of analysis. However studies with fewer observational units have less power to detect differences. Hence in a class-level study it is preferable to have data from many classes of a few students rather than from a few classes each containing many students.

In practice quite different effect sizes are found from analyses conducted at the two different levels. The study of classroom perceptions and learning outcomes by Fraser and Fisher (1982a) illustrates the ranges of values obtained. When the individual was used as the unit of analysis, the mean correlation between the environment and outcome variables was 0.38, it was 0.50 when the class was used as the analysis unit. Finding significantly larger values for the class unit is consistent with results of a meta-analysis study by Haertel et al (1981).

It is now commonly understood that the use of different units of analysis involves testing conceptually distinct hypotheses (Cronbach, 1976; Burstein et al, 1978). For example, a question about the relationship between classroom environment perceptions and learning outcomes can be asked in three conceptually different forms.

1. Does the student who scores higher on classroom environment scales also score higher on outcome measures (class membership being disregarded)?

2. Do students who have different levels of classroom environment perception from their peers also show different learning outcomes?

3. Do students in classes with high performance on learning outcomes also have higher classroom perceptions?

The three analyses required to answer these questions are based respectively on the scores of individuals only, on the scores of individuals and class means, and on class means only.

The unavailability of data at one or more of the levels has motivated much of the literature on the unit of analysis problem. Lack of complete data prevents researchers from applying the methods and formulae of Burstein et al (1978) to obtain estimates of the full set of interaction terms. In the present study the decision to collect only one set of anonymous data from each student restricted the analysis to the class level. The questions that could be asked about teacher-student interactions were therefore restricted to those referring to whole class units as shown in Example 3 above. Although this restriction was undesirable, there was a further advantage in pursuing class-level analyses only. Since a class-level analysis is relatively insensitive to the number of students in each class, it was practicable to arrange that the two halves of each class answered different instruments. In this way each class could provide data on perceptions of the learning environment <u>and</u> on attitudes toward computers within a single-lesson.

Summary

In this chapter, an account has been given of the aims, methodology and experimental design of the survey.

It is hoped that the range of variables and interactions included in the study would be considered sufficiently broad and comprehensive to avoid criticisms of classroom studies expressed by Bennett (1976),

> "investigators have commonly observed a narrow range of the behaviour of a small and unrepresentative sample of teachers drawn from a population of unknown parameters, and have categorised them according to some global, ill-defined dichotomy, unrelated to any theoretical perspective" (page 32).

CHAPTER 6

THE MEASUREMENT OF TEACHER BEHAVIOUR: INSTRUMENT SELECTION AND DESIGN

Introduction

The principal instrument used to obtain data from teachers was a booklet "Activities in Computer Studies Teaching". It contained:

A brief statement of the purpose of the research study
Instructions for checklist completion
A Checklist of 206 teaching behaviours
Biographical data questionnaire
Explanation of the Rating Matrix
Rating Matrix of 17 teaching behaviours
Questionnaire on "The Job of a Computer Studies Teacher"
Invitation and space for comments/suggestions
A request for teachers to take part in the pupil questionnaire or teacher diary parts of the study.

A copy of the booklet is included in the end papers and in the Appendix.

This chapter describes the purpose and development of the questionnaires and scales included in the teacher instrument.

Three methods of studying teacher classroom behaviour were considered for the present study; (1) systematic classroom observation, (2) pupil-report questionnaires and rating scales, and (3) teacher self-report forms and diaries. Each method will be described briefly in order to indicate its likely potential as a means of obtaining objective information about the teaching of computer studies, and why the first two of these methodologies could not be applied in the present study.

A short review of teacher self-report instruments is given to explain how such instruments may be used to give valid descriptions of classroom events. The development of the Activities Checklist is explained in some detail because the checklist was the principal data-gathering instrument used with teachers and also because checklists have been relatively less used in classroom based research. The other questionnaires and scales used in the teacher booklet are also described.

Systematic observation

Systematic observation involves the use by the observer of a predetermined schedule to code events and behaviours as they occur in the classroom in preparation for later quantification and analysis. The 'objective' data so collected can be used to generate and test the hypothetico-deductive type of theory that is characteristic of the natural sciences. Studies based on systematic classroom observation have been extensively reviewed (Medley & Mitzel, 1963; Biddle, 1967; Rosenshine, 1971; Rosenshine & Furst 1973; Eggleston et al, 1975, Hamilton & Delamont, 1976; Power, 1977).

About 200 such classroom observation systems are now available (Simon & Boyer, 1968, 1974; Rosenshine & Furst, 1973; Galton, 1978). The major criticism of such instruments is based on the danger that preconceived and structured observation instruments may attend to only a small fraction of classsroom events (Hamilton & Delamont, 1976) although McIntyre & Macleod (1978) have defended systematic observation.

The use of observation schedules suffers from three kinds of difficulties; conceptual, analytical and practical.

Conceptual difficulties

The conceptual difficulties associated with observation schedules arise from the methods used to produce them. The categories comprising the schedules are derived in one of three ways; (1) from theory linked to previous research, (2) by modification of existing schedules, or (3) wholly empirically from observations in situations similar to those in which the instrument(s) will be used.

Slater & Thompson (1977) observed science lesson activities of pupils age 11-15 years by means of a pupil-behaviour schedule of 16 "learning-activities" selected by the researchers from the educational literature.

Eggleston et al (1976) developed the Science Teaching Observation Schedule (STOS) to study interactions in science classrooms. The schedule seems to have evolved empirically from observations of science lessons. The major rationale of STOS was that it should record intellectual transactions of pupils with teachers, other pupils and resources. It was also designed to distinguish between the types of questions asked in science lessons.

Schedules may be linked with a particular conception of the instructional process or the need to obtain a particular range of data. Since one purpose of the present study was to obtain an objective description of the teaching of Computer Studies it was necessary to avoid the reservations that might be associated with the use of an imposed classification in a subject with a wide range of possible activities and where few parameters have been identified.

Analytical problems

Most observation schedule systems employ one-zero sampling where any occurrence of a behaviour within the observation interval is recorded. Altmann (1974) and Dunkerton & Guy (1981) have pointed out that one-zero sampling imposes distortions on the observed frequencies of different behaviours that have different durations compared with the length of the observation period. One-zero sampling fails to give correct estimates of both the frequency of behaviours and the time spent on different behaviours unless the sampling interval is small compared with the time spent in the behaviour. The STOS, which uses a sampling interval of three minutes, has been critcised on these grounds (Dunkerton & Guy, 1981; Neill, 1983).

Eggleston & Galton's (1981) argument that one-zero sampling gives minimum frequencies for all behaviours is valid but unconvincing. Since one-zero sampling gives minimum frequencies, the tendency is for all teachers to show similar frequencies for common actions. This means that teachers will be most easily distinguished by their rare actions. It is probably not appropriate to distinguish between teachers on the basis of rare and possibly insignificant actions. Although this analytical pitfall might be avoided in a well-documented subject such as science teaching, it could be more difficult to distinguish between significant and non-significant activities in less-researched areas.

Resource difficulties

There are also practical difficulties associated with the use of observation methods. To obtain an adequate sample of classroom behaviours it is usually necessary to visit a considerable number of teachers and, because events within lessons are not independent, to visit each on more than one occasion. The training of observers and the visiting of classrooms is time-consuming and therefore expensive.

The role of observation schedules in the present study

For the three groups of reasons mentioned, it was decided to neither develop a new schedule nor adapt an existing schedule, so the study made no direct use of classroom observation.

Instruments utilising students' perceptions

Instead of using an outside observer to report on classroom processes, the students may be asked to report on occurrence of specific teaching activities or the use of tactics such as individualised instruction. Student self-report instruments hold the advantage over other observational techniques in their efficiency in gathering a large amount of data in a short time.

Steele, House and Kerins (1971) have shown that students' perceptions of teachers' behaviours agree significantly with judgments of experienced observers although both differ from those of the teachers' reports (Ehman, 1970; Steele, House & Kerins, 1971). Peck, Fox & Blattstein (1979) found that elementary school pupils' perceptions of teachers were reliable and stable across different classes. Waxman & Eash (1983) used a student-report instrument to capture data on eight classroom process variables. The study found that some teacher behaviours were significantly positively associated with student achievement. These results further substantiate the possibility of utilising students' perceptions of teachers as part of classroom research.

Despite the demonstrated stability and usefulness of students' perceptions of classroom events in previous research, this investigational technique was not used in the present study. One reason was that the categories on which students can report do not include teacher preparation and other out-of-the-classroom teaching activities. Further, the preparation of a student report schedule suffers from many of the conceptual problems described in connection with construction or selection of a teacher observation schedule. The deciding factor against use of this type of instrument was that of student load. Students taking part in the survey would be asked to provide a considerable amount of data relating to attitudes, perceptions of the classroom environment and some personal variables. It seemed unreasonable to ask the same students to also provide a detailed report on lesson activities.

Research on Teacher self-report instruments

In studies based-on self-report instruments teachers are interviewed or asked to complete a structured document or to write an account of their lesson immediately after its completion.

Hook & Rosenshine (1979) reviewed studies which compared teachers' estimates of their classroom behaviour with independent observations and concluded that "one is not advised to accept teacher reports of specific behaviours as particularly accurate" (page 10). Certainly from six studies which investigated the correspondence between teachers' and observers' reports of specific classroom activities, agreement was not good. In one study by Weiss (1973) it was shown that teachers tend to over-estimate their use of socially desirable teaching behaviours such as discovery learning and to under-estimate their use of less desirable behaviours.

In three further studies Hook & Rosenshine found evidence of greater correspondence between teachers' responses and observations when the investigation grouped both responses and observations into scales or dimensions. The finding that grouped activities are more reliable indicators of teaching behaviour had previously been reported by Shavelson & Dempsey-Attwood (1976).

Newfield (1980) has critically reviewed the work of Hook & Rosenshine and has offered fresh data supporting the value of teacher self-reports. He pointed out that they had chosen not to comment on evidence (quoted in their paper) of instances when teachers' and observers' rankings of behaviours were in close agreement. He concedes some of the studies reviewed casts doubt on the accuracy of teacher self-reports but not, he argues, to the extent of complete abandonment as Hook & Rosenshine suggest.

Newfield describes two studies of self-report instruments that used a large number of relatively specific items. In one of these 18 teachers used 68 specific items to describe teaching time behaviours relevant to a Reading/English project for Junior High School pupils. In the other study 31 teachers reported their lessons by means of 59 items written to represent specific activities of an elementary school programme of Movement Education. In both studies each teacher was seen for at least 30 minutes by an observer using the appropriate set of 68 or 59 items. At the end of the observed lesson the teacher was given the same list of items and asked to indicate which behaviours had occurred during the period. The teacher understood that the sole purpose of the exercise was to see if his report would agree with the observer's judgements. This was done to focus attention on the teachers' ability to describe their lesson presentation and to reduce the effects of social desirability of certain responses.

In the English programme, 47 of the 68 items showed significant correlations or teacher-observer agreements in excess of 80%. In the Movement Education study, 32 of the 59 items showed significant correlations or observer-teacher agreement in excess of 80%. These figures represent an almost ten-fold improvement over comparable data quoted by Hook & Rosenshine.

Newfield pointed out that although the level of teacher-observer agreement found in the two new empirical studies was encouraging, the magnitude of the correlations was still quite low. He suggests further item development might increase these values. He also stresses the unusual instructions given to the teachers who completed the self-report form. Although the study provides evidence that teachers have the ability to estimate their behaviours, it does not show they would be willing to do so if there was a possibility that the data might reflect unfavourably on their teaching. Thus the general issue of social desirability still needs to be considered when assessing the potential of teacher self-reports.

Summary of research on Teacher Self-Report instruments

The results found in the studies mentioned above are pertinent to the development and application of the checklist and diary instruments used in the current research. The work of Hook & Rosenshine (1979), Newfield (1980), and Shavelson & Dempsey-Atwood (1976) can be summarised thus:

1. Teachers' self-reports of their use of specific behaviours should be used with caution,
2. The behaviours used to describe teachers' classroom style should be as many and as subject-specific as possible
3. Behaviour statements ("items") should be pretested or otherwise examined for consistent use by teachers and independent observers,
4. The accuracy of teachers' descriptions is markedly improved if they are based on scales, each scale being made up of a number of items,

These findings indicate that by paying attention to design and application a teacher completed self-report instrument can be a useful means of obtaining data about classroom processes.

Development of a checklist of Computer Studies activities

Previous checklist research

Checklists contain many brief items capable of being read and answered quickly. Response speed can be further increased by using behavioural items and requiring respondents to give only a YES/NO type of response. Thus a checklist can contain many more items than would be feasible in an attitude questionnaire or personality inventory. The feature of being able to use many items is particularly valuable when a wide-ranging subject has to be covered.

Christal (1970) has shown that it is practicable to use a checklist to analyse the task content of jobs and thus avoid the use of extended observation or other methods based on pre-emptive classifications. The other feature of Christal's work was the use of cluster analysis to categorise first operations and then workers. Youngman et al (1978) developed a similar methodology for the analysis of engineering jobs and, later, for the description of teachers' jobs (Youngman, 1982).

Youngman's development of the checklist methodology is available from his report (Youngman, 1979b). A brief consideration of his study follows as it was partly on the evidence of the quality of his findings that it was decided to use a checklist instrument for the investigation of Computer Studies teaching.

Youngman's study of Teachers' Jobs

Youngman (1979b) used a checklist of 245 items which were separate and identifiable teaching operations. From teachers' responses Youngman derived 14 distinct teaching activities containing from six to 13 operations in each. Four of the activities described classroom procedures. and the remainder covered activities involving organisational and administrative aspects of the teacher's job. The alpha reliability coefficients of scales based on the teaching activities were in the range 0.67 to 0.92, their validity was assessed by examining the correlation betweeen the activity-scale scores and teachers' ratings of their involvement with the activities. These ratings were obtained from teachers' responses to a separate matrix. Five of the 14 activities achieved a correlation of 0.7 or above with the corresponding rating. A comparison of teachers' activity scores with their biographic data showed the instrument discriminated between teachers of different subjects, between teachers at different levels of responsibility and between groups of teachers with and without pastoral duties (Youngman, 1983).

Youngman's results show that reliable and valid measures of teachers' jobs may be derived from a wide-ranging checklist. There appears to be no theoretical obstacle to using the same approach to study the work of one selected group of teachers. By adopting a naturalistic stance it should be possible to identify intrinsic roles of teachers as opposed to confirming imposed perceptions or expectations. The naturalistic stance of the checklist approach was thought especially valuable in a subject characterised by a wide range of possible activities and relatively little previous research. On these grounds it was judged that a checklist offered a practicable and valid means of studying the teaching of Computer Studies. The study itself would provide an opportunity to evaluate the effectiveness of this approach.

Development of the Pilot Activities Checklist

Because no previous study of Computer Studies teaching was available to act as a guide, teachers themselves were used to supply the information needed to construct the checklist items. Twenty teachers of Computer Studies were individually interviewed in their own schools for 35-45 minutes. The teachers were drawn from three different LEAs. The sample included both male and female teachers, a number of school types (single sex, mixed, 11-16, 11-18, 13-18) and teachers with a range of training, qualifications and experience.

At the start of each interview the teacher was assured of the confidentiality of the interview and the information obtained. He or she was then invited to talk about their classroom activities, their methods of teaching, and any subject-related or other activity arising from involvement with Computer Studies. Emphasis was placed on the need for a description of what was done, not roles, duties or responsibilities. The interviewer intervened only when it was necessary, for example, to elicit a more precise description of a teaching operation. Each interview was recorded and later analysed to give a list of teaching operations for that teacher. Individual interviews produced from 39 to 96 teaching operations; from the twenty interviews a total of 1184 operations was derived. Because this number of operations is much larger than any acceptable checklist could accommodate, some selection and refinement was necessary.

The first stage of the revision comprised a classification of the operations from each interview using the eleven categories listed in Table 6.1. The purpose of the classification was to assist the identification of similar operations so that a reduction in the initial number could be made. For each category duplicated and very similar operations were eliminated.

	Category	Total operations recorded
1	Computer assisted learning	81
2	Teacher personal development	110
3	Programming	179
4	Subject matter	44
5	Resources (provision & care)	173
6	Equipment (provison and care)	77
7	Direction of pupil activities	190
8	Use of audio-visual equipment	56
9	Syllabus, examinations, projects	34
10	Out of lesson operations	80
11	Classroom organisation	84
12	Unclassified	76
	Total	1108

Table 6.1 Categories used for initial sorting of teaching operations identified in teachers' recorded interviews

In the next stage, items were retained, or combined with a closely similar item, or several items were absorbed into a more general item. After completion of this reduction stage the checklist contained 348 items and was shown to an LEA Advisor for Computer Studies and three experienced teachers who had not taken part in the interview phase. The four were asked to review the list for overlapping or unclear items and to suggest any further operations pertinent to Computer Studies teaching. As a result of their comments and suggestions, twenty items were reworded or split into two items, and four new items were added to give a checklist of 361 items.

The checklist was arranged as an A5 booklet with about 28 items per page. A photo-reduced format was chosen as a means of diminishing the apparent size of the booklet and reducing printing costs whilst maintaining a clear appearance. As in the booklet Activities in Computer Studies Teaching used in the main study, it contained a one-page statement about the research and instructions for answering the checklist.

The 361-item Pilot Activities Checklist was distributed to teachers in 24 LEAs. One copy was sent addressed to The teacher of computer studies in 300 schools chosen randomly from the Education Year Book (1983). In the following six weeks 128 replies were received. A further 13 replies were received later but were not included in the analysis.

Analysis of the Pilot Checklist responses

The purpose of the analysis was to generate a classification of the checklist operations that could be used to describe the pattern of teaching adopted by different teachers. A full account of the method of analysis is given in Chapter 8. The description here is confined to the essentials required to show how results from the Pilot Checklist were used to develop the final form of the instrument.

Cluster analysis of the responses showed 20 groups containing from 7 to 37 behaviours. Each group of items represented a Teaching Activity. Table 6.2 records a description of each Activity and the number of operations within it. No more than a broad description can be given for some of the larger groups.

	Activity description	Number of items Initial	Retained
1	General teaching (common activities)	28	14
2	General teaching (uncommon activities)	24	10
3	Classroom organisation	12	9
4	Use and care of resources	16	12
5	Software resources and CAL	17	9
6	Informality, out of lesson contacts	30	11
7	Outside help, pupil individualisation	29	10 + 10
8	Information and computer abilities	18	12
9	Teacher as programmer	6	6
10	Microelectronics	21	11
11	Formality and control in lessons	19	10
12	General teaching	12	10
13	Use of textbooks	6	6
14	Project work	18	9
15	Pupil individualisation	16	10
16	Use of audio-visual aids	37	11
17	Teacher seeks/gives technical help	10	9
18	Pupils engage in individual work	24	11
19	Use of wordprocessor	7	7
20	General teaching	11	11
	Totals	361	206

Table 6.2 Description of Activities derived from the Pilot Checklist

For each teacher 20 Activity scores were calculated to show his or her use of these Activities. Cluster analysis of the 128 sets of Activity scores, indicated four groups of teachers. A Scheffe test using the Activity scores showed 18 of the 20 scales discriminated between the four teacher groups. All scales were retained.

Development of final form of the checklist

Although no respondent had commented adversely on the length of the 361-item Pilot Checklist, it was felt this would be too onerous when respondents were also required to provide other information or to complete any other questionnaire. For this reason some reduction was desirable.

First, the face validity of groups of operations clustered together as a teaching activity was examined. Operations not having face validity with other operations in the group were discarded. Operations failing to discriminate between the teacher groups were also discarded. At this stage 204 items of the original 361 remained in the checklist. Two additional teaching behaviours suggested by respondents were added. The distribution of the retained operations between the scales is given in Table 6.2

The 206 item version of the checklist was used in the main study described in Chapter 8 onwards, a copy is included in the Appendix.

Merits of the CS Teaching Checklist

The likely usefulness of the checklist as a means for obtaining valid and reliable data about Computer Studies teaching can be assessed with the aid of the 5-point summary of research on self-report instruments given earlier.

The checklist contains 206 subject-specific items and therefore meets Point 2 of the research findings summary. Operations (items) included in the checklist were obtained from practising teachers, were subjected to scrutiny and to pilot testing before further selection. This development process fully meets the requirements of Point 3.

Cluster analysis was used to group the Pilot study behaviours into Activities each containing about 10 items. These Activities have shown moderately high reliability and meet the requirements of Point 4.

As will be described later, in the main study the validity of checklist Activities was assessed through correlations with an Importance-rating matrix and through relationships between teaching style and teacher personal variables. The stress placed on establishing the validity of the derived measures is in keeping with cautious approach advocated in Point 1.

The rating matrix

Because cluster analysis will always find groups within data, it was important to have some means to establish the validity of the Activities found in the checklist analysis. For this purpose teachers were asked to rate the importance in Computer Studies teaching of given statements of teaching behaviour. To avoid imposing external notions of Computer Studies teaching, the behaviours to be rated were descriptions of 17 Activities derived from the pilot form of the checklist.

The format and purpose of the 17-item Rating matrix were discussed at the July Forum. The panel agreed that teachers should be asked to rate the importance of each Activity on a three point scale; Above average, Average and Below average. A separate category of No importance was also provided. Teachers were asked to place about equal numbers of the 17 Activities in each of the three importance ratings. Correlations between Importance ratings and teachers' Activity scores would be used to validate the cluster groupings.

The Job questionnaire

The rationale of studying teachers' attitudes

Although, as reported in Chapter 3, results of research on the relationships between teacher characteristics and pupils' attitudes have often been inconclusive and contradictory, Haladyna et al (1983) found significant correlations between pupils' attitudes toward science and teachers' attitudes and interest in science teaching. On this evidence it was thought possible that teachers' attitudes towards computers and teaching about computers might be conveyed to pupils during discussions held in lessons and at other times. Also job perceptions might influence the choice of teaching activities and the length of time spent on preparing and using them. Therefore a study of teachers' attitudes toward the teaching of Computer Studies was thought desirable.

The semantic differential technique

A semantic differential format was chosen for the assessment of teachers' attitudes to their job because this type of instrument is relatively easy to devise and complete. As the answer format of the instrument contrasts with that of the checklist it was hoped that it would provide respondents with some mental relief and improve their motivation to continue.

The semantic differential instrument (Osgood, 1952; Osgood, Suci & Tannenbaum, 1957) consists of seven-point rating scales that are bipolar, each end of the scale or 'pole' being defined by an adjective or adjectival phrase (eg weak-strong, practical-theoretical). Analysis of data from studies using semantic differential instruments has consistently shown that three factors account for a major proportion of the score variance. The three EPA factors are **evaluation** (important-unimportant, exciting-boring), **potency** (hard-soft, easy-difficult) and **activity** (fast-slow, sharp-blunt).

In the current study teachers were asked to rate the concept "The job of a computer studies teacher" on an inventory of 29 bipolar scales. The scales were selected from a pool of 150 items found in the literature on semantic differential studies (Osgood, Suci & Tannebaum, 1957), others used in a study of engineering jobs (Youngman, Oxtoby, Monk & Heywood, 1978). The three EPA factors were represented in the 29 scales. Because the scales had been used in previous studies, it was thought unnecessary to carry out pilot trials of the questionnaire, and so not "use-up" teachers who might otherwise be willing to take part in the main study.

Analysis of Semantic Differential responses

Traditionally semantic differential instruments have been analysed by factor analysis and this procedure was used in the present study and the resulting scales were examined for reliability and validity.

Background and biographic data

One page of the teacher instrument was used to collect some biographic data about the respondent. The review of research on teaching and learning given in Chapter 3 showed the absence of significant relationships between teacher personality variables and pupils' learning outcomes. These general results determined the nature and quantity of personal and biographical data collected in the study.

No data of a psychological or similar nature was sought. The personal information requested was restricted to non-intrusive items such as gender, teaching experience and qualifications. These were:

Sex of teacher
Length of teaching experience
Length of teaching experience, in Computer Studies
Length of industrial experience in computing
Academic qualification in computing
Teacher training in Computer Studies
Other teaching subject(s)
School type and age-range.

This information was collected on a single page placed in the booklet after the checklist. The respondent's name and school were not requested.

The Invitation to teachers

The final page of the Teacher Booklet was used to invite teachers to take a further part in the research. Teachers were asked

(1) to allow one or more of their fifth year Computer Studies classes to answer the pupil questionnaire, and/or

(2) to complete a lesson diary for a short sequence of CS lessons.

Teachers wishing to take a further part ticked the appropriate box(es) and filled in their name and school address.

Diary instruments

Previous diary research

The diary is another form of self-report instrument. Diaries have been used in the study of tasks performed by managers (Stewart, 1967,1975) and in a study of engineers' jobs (Youngman et al, 1978). The concept of the diary is familiar enough for the problems of interpreting or summarising free-format accounts to be evident. In Stewart's study the managers described their work on pre-coded pads. It is perhaps significant that in a study of teachers' activities throughout the working day, Hilsum and Cane (1971) and Hilsum and Strong (1978) preferred the difficulties and expense of using observers to a diary-based study.

Tamir (1983) advocates the use of a part-structured questionnaire - the Self Lesson Report Form (SLRF) - as a means of obtaining valid descriptions of science lessons. The structured portion of the SLRF seeks information about the lesson-time use of audio-visual aids and other resources and the management of the lesson. The unstructured part of the SLRF was described by Tamir as the "heart" of the instrument. It requires the teacher to describe, in chronological order, what happened in the class. The SLRF is in effect a one-lesson diary report form. The part-structured nature of the instrument appears to try to combine an objective study of some non-controversial facets of science teaching with a naturalistic report of actual events as perceived by the teacher.

Teachers used the SLRF to report on 250 science lessons in junior and senior high schools in Israel. To establish instrument reliability, 40 of these lessons were observed by an independent observer who also used the SLRF. The level of agreement between teachers' reports and those of the observer on the frequency of classroom events varied according to the nature of the activity, the average was about 80%. The 250 reports were analysed to indicate the pattern of science education in Israel within the limits of the sample schools.

Tamir opines that the reliability and validity of the SLRF are high because teachers are asked to report on one specific lesson and are therefore less prone to make generalisations. He concludes that lesson reports obtained by use of the SLRF are sufficiently reliable to serve as indicators of curriculum practices.

The lesson diary report form (LDRF)

A structured diary-like instrument, the Lesson Diary Report Form (LDRF), was designed to facilitate teachers' reporting of Computer Studies lessons. The instrument was designed to enable teachers to record quickly the teaching and learning tactics adopted in the lesson, the resources used by teachers and pupils and how the pattern of activities varied during the session. In contrast to Tamir's instrument a structured format was used for the whole of the LDRF in the hope that a structured instrument would gather more reliable information about classroom events. The increased reliability would come in several ways because:

(a) more operations could be covered in a given response time;
(b) compared to a free account a list is less open to the effects of social bias; and
(c) all teachers would report on the same activities.

The items included in the LDRF embodied the author's experience as a teacher trainer in Computer Studies. Use was also made of the information gained from practising teachers during the production and Pilot trial of the checklist. To establish instrument validity, an early version of the LDRF was examined by three experienced teachers studying for a post-graduate award in the teaching of Computer Studies. Their comments and suggestions were incorporated in a subsequent revision.

Each LDRF is contained on one double-sided A4 sheet without the use of photo-reduction, a copy is given in Appendix B. The LDRF has sections asking for information about:

Lesson type (9 are listed plus "other").
Resources used by the teacher (10 listed).
Resources used by the pupils (7 listed).
Type of homework set ("None" plus 8 types).
Teacher satisfaction with the lesson (a five point scale).
Teaching and learning activities (14 listed) used in the first, second and final third of the lessons.

It also has a space for teachers to give a brief description of the lesson or comments about special features if they wish to do so.

Because all the LDRF items are closed and require only a simple tick or circled indication, the form takes only a few minutes to use. Teachers were asked to complete it as soon as possible after the end of the lesson.

A <u>Diary Booklet</u> consisted of seven LDRFs fastened together with a cover sheet for some basic information about the teacher, the number, gender and ability range of the pupils, the classroom facilities, and the date and duration of the lesson.

Although the Diary Booklet of the present study and the SLRF of Tamir are both teacher self-report instruments, they differ in their structure and application. In the LDRF study no analysis or quantitative use was made of the teacher's comments or unstructured account of the lesson and, because each Diary Booklet contained seven LDRFs for teachers to report a sequence of lessons, it was more likely that the resulting record would be representative of their classroom activities. Because it contains many subject specific items approved by teachers the Diary Booklet appears to meet the requirements of self-report instruments established earlier.

Summary

This chapter has described the purpose and development of the four test instruments included in the Teacher Booklet. A fifth instrument, the Lesson Diary Report Form, which was sent only to teachers indicating their willingness to take a further part in the study, has also been described.

The analysis of teachers' responses to the Booklet scales is described in Chapter 8. The information obtained in the Diary Study is analysed and discussed in Chapter 11.

CHAPTER 7

THE MEASUREMENT OF PUPIL CHARACTERISTICS AND LEARNING: INSTRUMENT SELECTION AND DESIGN

The research objectives set out in Chapter 5 required pupils to be assessed for:

1. learning outcomes in Computer Studies,
2. their perceptions of the classroom environment.

Overview of the Pupil Booklets

Because it would be unreasonable to ask a pupil to provide all the information required in a single sitting, and as it had been decided to ask schools to release pupils on one occasion only, the pupil booklet was arranged in two parts. One half of each class would complete Part A whilst the other half answered Part B. The two parts were colour coded for ease of reference and to help teachers achieve a spread of booklets around the class. Each part of the booklet was of 16 A5-size pages.

Part A (Blue) contained

The CARAQ instrument: 72 Likert-type items assessing eight dimensions of attitudes toward computers.

An Anxiety scale: pupils were instructed to select words from a list of 60 to describe their feelings about "A Job using a Computer".

The Job questionnaire: a semantic differential instrument of 29 bipolar scales used to judge "A Job or Career using a Computer"

A Personal Data Survey: pupils were asked about their gender, choice of school subjects, use of a home-computer, experience of computer assisted learning, and interest in Computer Studies.

Part B (Pink) contained

A classroom environment questionnaire: 95 items to assess ten dimensions of the classroom environment

The Anxiety scale: as in Part A
The Job questionnaire: as in Part A
The Personal data survey: as in Part A.

This chapter explains the choice of instruments used in the pupil booklet and, where necessary, gives a description of each.

Choice of attitude instrument

For the proposed study, there were three paths to obtaining the required attitude measure:

1. To develop a new Likert format instrument.
2. To develop a new SD format instrument
3. To use an existing computer attitude instrument

Production of a Likert Scale

The production of a wholly new Likert scale is a lengthy, multi-stage process. When a new attitude dimension is to be assessed it is generally necessary to start with the identification, writing and selection of a pool of suitable items. This is followed by trials, evaluation and possibly further trials. The development, testing and validation of the CARAQ followed these procedures (Moore, 1984).

The Semantic Differential technique.

The format and basic properties of the semantic differential technique have been mentioned previously in Chapter 6.

The development of a semantic differential questionnaire is made easier by the considerable amount of research data that has been accumulated on the use of a large pool of adjectival pairs. Scales for a semantic differential instrument may be selected from those used in published studies.

Comparisons of the Likert and semantic differential techniques have been made. Some studies, McCallon and Brown (1971), Schofield and Start (1978), who used both techniques to assess college students' attitudes to mathematics, found correlations of 0.70 or higher between corresponding concepts on the two instruments. Schibeci (1977, 1982) working with science students age 14-16 years in Western Australia found correlations in the range 0.06 to 0.52 for five pairs of concepts in semantic differential and Likert-type instruments. His results indicate that the semantic differential and Likert techniques may not always be interchangeable. The scales used in SD questionnaires are usually non subject specific. This makes it possible to use the same scales to rate several or many concepts, hence attitudes on these concepts may be compared.

The lack of specificity is both a strength and a weakness of the SD format. The use of simple, non-specific items, simplifies administration of the instrument with younger or less-able students. It may be for this reason that Williams et al (1983) and Harvey & Wilson (1985) used the Semantic Differential format to investigate the attitudes toward computers held by 10-year olds. However, the lack of specificity probably results in some loss of clarity of the concept or attitude dimension being assessed. Thus the SD may not be as sensitive to small differences of attitudes as Likert instruments.

It was decided not to develop a semantic differential questionnaire to assess pupils' attitudes for three reasons.

1. It was not planned to compare pupils' attitudes on many diverse concepts. Therefore the flexibility of the scales was of no significance.

2. The study was with older and more able groups who should have no problems of reading or comprehension. Hence the simplicity of the scales was not of great value.

3. A semantic differential instrument might lack the precision needed to distinguish between the attitudes of pupils having slightly different classroom or other experiences. The need for the highest possible discrimination seemed to outweigh any possible greater ease of construction attached to this format.

Choice of attitude scales (from existing instruments)

Reasons of economy of time and effort argued for the use of one or more existing attitude instruments and against the development of fresh scales. Guidelines for the measurement of attitudes in science education given by Gardner (1975a) and Munby (1980) were written for the development of new attitude instruments but apply equally to the selection of a scale or scales from among available instruments.

The guidelines may be summarised as follows:

1. There should be a clear specification of the single theoretical construct underlying each scale. All items within one scale should relate to a single attitude object. Attitudes toward logically or psychologically distinct concepts should be measured and reported as separate scales.

2. Instruments should be trialled on a sample which is comparable to the target population for which the instrument is intended. Results of the trial use should be used to show the properties of the separate scales of the instrument and items within the scales.

3. Results of the trial should be examined to determine whether the sensitivity and discrimination of the scale(s) are likely to be adequate for the proposed application.

The guidelines can be applied to aid the choice of scales from those described in Chapter 2. The requirement that each scale should be based on a single clearly identified theoretical construct argues against instruments in which scales have been derived by factor analysis. The GATC scale of Reece & Gable (1982) falls into this category as it was derived by factor analysis from a pool of thirty items representing affective, behavioural and cognitive domains. The ten items retained in the GATC are drawn from all three domains and refer to a number of different constructs, thus the scale possesses empirical rather than theoretical validity.

The studies of Bannon et al, Griswold and Wagman were all carried out with samples of undergraduate and postgraduate students in the United States. For this reason their results may not be applicable to use of the same questionnaire with school-age pupils in England and Wales. In contrast, the CARAQ instrument was trialled on samples of secondary level comprehensive school pupils age 14-15 years which is a close match to the target population of the current study.

Gardner (1975a,) suggests that scale reliabilties (alpha values) should be around 0.8 for use with groups. The three computer attitude scales used by Richards et al (1986) had reliabilities from 0.72 to 0.88. These scales were, however, determined by factor analysis rather than on theoretical grounds. The reliabilities of the CARAQ scales generally lie within the range recommended for studies based on groups. The alpha values ranged from 0.69 to 0.87 at pretest and 0.75 to 0.90 at the posttest. The alpha values might have been higher if factor analysis had been used in their derivation. When constructing the CARAQ scales, items were deliberately chosen in such a way as to ensure that scales were broadly based (Moore, 1984, Chapter 6). In determining the item content of the scales, scale validity through breadth was rated as more important than achieving the highest possible value of internal reliability through item selection.

Finally, as Gardner suggests, results of previous studies should be examined to see which instrument scale(s) discriminate between different sub-groups of the study samples. Table 2.3 shows several computer attitude scales discriminated successfully between groups of different ages, between pupils with and those without a home computer and, sometimes, between males and females. In addition the CARAQ instrument also detected the effects of computer assisted learning and the different attitudes held by pupils in "science" and "non-science" subject groups.

The CARAQ scales meet Gardner's three guidelines of theoretically based constructs, previous research with a sample of a similar age and background to the final target population, and demonstrated discrimination between sub-groups. The CARAQ instrument has the additional advantage of using seven scales, THREAT, SCHOOL, CAREER, LEISURE, SOCIAL, EMPLOY and FUTURE, a greater number than any other computer attitude instrument listed in the table. An instrument with a large number of scales has the potential to provide a more complete description of pupils' attitudes.

On the grounds of construct validity, trials experience, discriminating power and number of scales the CARAQ instrument was equal or superior to other instruments and appeared suitable for the proposed study.

The SATISFACTION scale

At the July Forum it was suggested that pupils' pleasure and satisfaction in using a computer, seeing a program work sucessfully or controlling a robot-like device would be an important outcome of some Computer Studies lessons.

Acting on this suggestion, ten Likert-type items expressing SATISFACTION were prepared and added to the CARAQ instrument. A statement of the SATISFACTION scale and a typical item is shown in Table 7.1. All the items from this scale can be found in the full form of the pupil questionnaire shown in the Appendix.

Name	Description	Sample Item
SATISFACTION	Pupils' satisfaction in using or programming a computer or microcomputer	Programming a computer to do new tasks can be a satisfying challenge

Table 7.1 Description of SATISFACTION scale (New CARAQ scale)

Computer anxiety: concept and measurement

The term anxiety is interpreted as "dread and foreboding based on some diffuse or specific expectation of harm, rather than an obvious external threat" (Sieber et al, 1977 p.13). An additional attitude dimension **anxiety** was identified from a study of the literature on attitudes to computers, mathematics and science. Pupil confidence and efficacy in using computers implies absence of anxiety. Thus whether explicitly stated or not, the reduction of anxiety is an important affective goal in courses of Computer Studies. The meaning of Computer Anxiety and its measurement are the subjects of this section.

Two references to the measurement of Anxiety were given in Chapter 2. Dambrot et al (1985) found that maths anxiety was a predictor of computer attitude scores for both male and female undergraduates. Lloyd & Gressard (1984b) included 10 anxiety items in a questionnaire used by students age 13 to 20+. They found Computer Anxiety was negatively associated with experience, no gender difference was detected. The results are not directly applicable to the present study because the students were learning from computers and not learning about computers.

Studies have shown that teachers' classroom behaviours and teaching activities can affect levels of student anxiety. Student anxiety is reduced by positive reinforcement and an increased level of direction during learning (Zimmerman, 1970); by greater communication and teacher support (Cameron, 1975); and the use of individualised instruction (Lewis & Adank, 1975). A study of anxiety in science classrooms was made by Fraser et al (1983). The level of anxiety in 116 classes of Australian pupils age 14-15 years was studied in relationship to pupils' perceptions of the classroom environment. Anxiety levels were found to be lower in classrooms perceived as having greater PERSONALISATION, PARTICIPATION, INVOLVEMENT, AFFILIATION, TEACHER SUPPORT, ORDER & ORGANISATION, RULE CLARITY and INNOVATION. Anxiety was also reduced by ensuring a lower level of Teacher control. Fraser et al draw attention to the unexpected result that higher levels of classroom investigation were linked with <u>increased</u> student anxiety.

This current study of Computer Anxiety had three aims:

1. To investigate the reliability and usefulness of a measure of student anxiety when used with students of computer studies.

2. To investigate relationships between pupils' anxiety about computers and teachers' activities in computer studies lessons.

3. To investigate relationships between pupils' anxiety about computers and perceptions of the computer studies classroom environment.

Some similarities between pupils' attitudes toward science and their attitudes toward computers have been noted. For this reason it was decided that the investigation of pupils' anxiety about computers would be modelled on the study of science anxiety carried out by Fraser et al (1983) using a questionnaire due to Zuckermann (1960) and modified by Docking (1978). The instrument (Table 7.2) consists of a checklist of 21 key words embedded in an alphabetically arranged list of 60 adjectives. The respondent's anxiety score is obtained by summing the scores for the 21 words marked + and -.

This scale is answered easily and quickly and is said to be subtle and robust. Docking & Thornton (1979) suggest the subtlety of the measure makes it less likely that respondents will hide anxiety. The same researchers suggest the scale is robust with regard to test situation and the order of presentation within a battery of instruments. When used by Fraser et al, (1983) the internal consistency was 0.83, the mean anxiety score was 8.7 (range 0-21) and the standard deviation 3.6.

Instructions: The words below could describe how you feel about a job or career using a computer. Read through the list of words and underline those which describe how you generally feel about a job of this kind. You may underline as many or as few words as you wish.

absorbed	afraid(+)	aimless	ambitious	annoyed
aware	bored	calm(-)	careless	cautious
challenged	cheerful(-)	cheated	comfortable	confused
contented(-)	creative	curious	dedicated	desperate(+)
disappointed	efficient	entertained	excited	fearful (+)
fortunate	frightened(+)	happy(-)	hopeless	impatient
incapable	inspired	interested	joyful(-)	lazy
loving(-)	miserable	misplaced	nervous(+)	organised
overloaded	panicky(+)	pleasant(-)	pleased	productive
pushed	refreshed	regretful	rewarded	satisfied
secure(-)	serious	shaky(+)	steady(-)	tense(+)
terrified(+)	thoughtful(-)	upset (+)	weary	worried(+)

Table 7.2 Instrument for measuring anxiety. From Zuckerman (1960) and Docking (1978) via Fraser et al (1983). The positive and negative signs are not shown in the respondent's copy.

Measurement of perceptions of a computer-job

Table 2.2 shows the CARAQ scale of CAREER assesses students' attitude toward a job or career in computing. In the validation study (Moore, 1985b) students taking Computer Studies expressed a significantly greater interest in a computer-based career than other student groups. In the new study, however, the whole sample would be of students taking Computer Studies and who might therefore have very favourable attitudes toward a computer career. There was a possibility that a scale of only seven items would not easily discriminate within a group of students all of whom had at least moderately favourable attitudes.

Because of this doubt and because encouraging pupils to consider a computer-based career is an important aim of computer education, it seemed worthwhile to develop a new test of pupils' attitudes to the "job" concept. Based on the discussion of the previous section, a semantic differential instrument was chosen. This type of instrument could be developed quite quickly by selecting scales that had been used in previous studies, could be answered in a short time and has many scales thus increasing the possibility that a link with classroom activities will be shown. Semantic differential responses may be subjected to factor analysis to reveal sets of scales that pupils have answered similarly. These sets of scales (or factors) may themselves reveal further information about pupils' conceptions of "A Computer-Job". This analysis would form a useful contrast with the a priori approach used to establish the CARAQ scale CAREER.

Preliminary selection of scales for the pupil instrument showed that many of them were the same as those included in the teacher SD instrument for the concept "The Job of a Computer Studies Teacher". It was realised that use of the same set of scales would make it possible (though not necessarily useful) to compare pupils' and teachers' responses to the two similar concepts. For this reason the decision was taken to use **exactly** the same set of 29 scales in the two instruments. The semantic differential questionnaire on the concept "A Job or Career using a Computer" was the only instrument in the pupil booklet using this format.

Classroom environment measures

The meaning and measurement of pupils'perceptions of the classroom environment and the choice of five scales from the ICEQ and four from the CES instruments have been described and explained in Chapter 4. It was hoped that the nine chosen scales would assess almost all important dimensions of the Computer Studies classroom environment. The nine scales have teaching and learning activities by teachers and pupils as their main focus.

A decision was made to include a scale assessing pupils' perceptions of the level of resource provision because the teaching of Computer Studies may be linked to the equipment available. Several speakers at the July Forum endorsed the inclusion of a RESOURCES scale in the pupil questionnaire.

A scale Materials usage is contained in The Inventory of Affective Aspects of Schooling (Haladyna & Shaughnessy, 1982). A typical item "There are good materials for this class" indicates the general, non-specific nature of the scale. Because of its generality the scale was regarded as unsuitable for assessment of the Computer Studies classroom environment. The same comments apply to the Materials Environment scale of the LEI instrument.

List of items for RESOURCES scale

1. There is usually sufficient equipment and materials in CS lessons
2. The Computer Studies equipment is reliable and easy to use
3. Students have to waste time waiting for their turn to use a microcomputer
4. It is often necessary to move or find microcomputer equipment before it can be used in CS lessons
5. Because equipment has to be shared, students don't get a lot of practical work done in CS lessons
6. The school is well equipped for Computer Studies
7. The CS equipment is usually set up and ready for use
8. In Computer Studies we are able to see and use many sorts of computer and microelectronics equipment
9. Most pupils have enough time to use the micro in CS lessons
10. There are sufficient books to help with CS projects

Note: each item had True/False response format

Table 7.4 Items of the RESOURCES scale

Items for a new scale RESOURCES were prepared and vetted by the author's colleagues. The purpose of the scale was "to assess the extent to which pupils perceive an adequate level of resource provision, maintenance and management". The items were written with a True-False response format in order to accommodate them in the Pupils' Booklet amongst the CES items. The items are shown in Table 7.4. There was no opportunity to Pilot Test the items before including them in the pupil questionnaire.

Personal data questionnaire

Some pupil personal data was required to assess the validity and discriminating properties of the teacher and pupil scales. For these reasons pupils were asked to supply information about their gender, choice of school-subjects, home-use of a microcomputer and experience of computer assisted learning. Home-use of a micro was split into four categories; games, educational materials, school-work and revision, programming. CAL-experience was requested according to five subject groups; maths, science and technical subjects, languages, arts subjects, and craft subjects. Pupils were also asked to indicate their level of interest in Computer Studies as they remembered it at the start of the course and how it had changed.

Summary

This chapter has described the purpose, choice and development of the scales included in the two-part pupil questionnaire. For the assessment of pupils' attitudes toward computers it was decided to use the CARAQ instrument,the seven scales of which have been shown to have satisfactory concept validity, acceptable internal consistency reliability and to discriminate between groups of pupils according to independent variables. Although existing scales of the CARAQ were to be used without modification, an additional scale SATISFACTION was added.

An additional scale RESOURCES was added to a battery of nine clasroom environment scales chosen from the ICEQ and CES instruments. These scales were chosen because of their proven relationships with affective outcomes in science education or for their face validity with the author's impressions of Computer Studies teaching in schools.

The pupil tests also included a scale to measure Computer Anxiety and another to assess pupils' concepts of "A Job or Career using a Computer". The personal data section of the pupil questionnaire was restricted to five items, gender, choice of school subjects, home-use of a microcomputer, experience of CAL, and level of interest in Computer Studies.

CHAPTER 8

DISTRIBUTION OF THE TEACHERS' BOOKLET AND ANALYSIS OF THE RESPONSES

Distribution of the Teachers' Booklet

Copies of the Teachers' Booklet were distributed in September 1985 by post as follows

To named teachers who had taken part in the Pilot Study	105
To named teachers of Computer Studies in schools of Humberside LEA	95
To The Teacher in charge of CS in non-metropolitan LEA schools (*)	350
To The Teacher in charge of CS in metropolitan LEA schools (*)	290
	Total 840

Notes: (*) Within each LEA schools were randomly chosen from the Education Yearbook
No booklet was sent to any ILEA establishment
Schools who had been contacted in the Pilot study but who had not taken part (or had done so anonymously) were not included.

Each booklet was accompanied by a letter setting out the purpose of the study and a reply-paid envelope for the return of the booklet. All booklets were posted in the period 13-23 September 1985. Reminder requests were sent as necessary to Humberside teachers whose replies had not been received on December 1st. To the end of March 1986, 253 completed boooklet were received, a raw response rate close to 30%.

Data from Wellington (1987) can be applied to the raw response rate in order to allow for schools who received a booklet but did not teach Computer Studies. Even in the rather unusual sample used by Wellington, only 71% of schools taught Computer Studies for O-level or CSE examinations. If Wellington's data is applied to the random sample contacted in the present study, the estimated response rate from eligible schools is 42%. It will be higher if the Wellington figure is an over estimate of the percentage of all schools teaching Computer Studies.

About 20% of the responses were made anonymously possibly because some individuals wished to avoid taking any further part in the study, or to be certain that no statement or answer could be attributed to a named source. Alternatively, and this is thought to be the most likely explanation, teachers might have returned an unnamed booklet for reasons connected with the industrial action in schools (see below).

The effects of the industrial action in schools

The period of the empirical work in schools, from September 1985 to March 1986, coincided with the longest and most bitter period of industrial action known in the teaching profession. The action in schools had marked effects on the study. In October and November very many teachers telephoned, wrote or returned the unused Booklet saying they could not consider completing it during the period of the industrial dispute. The most intense phase of the action finished in the second half of the Spring term and a few further Booklets were returned at this time. Unfortunately it was then too late to distribute further questionnaires. Teachers said they were very busy trying to catch up with work missed during the earlier part of the year.

The return of 253 Teacher Booklets has to be judged against the background of a difficult period in schools. Although the representativeness of the teacher sample may have suffered as a consequence of the low return rate, both teacher and pupil samples were sufficiently large to permit detailed analyses to be made. It was hoped that the teacher sample would include representatives of all styles of teaching.

The original research design included provision for interviews with a sample of the teachers who completed the questionnaire. It proved impossible to undertake these interviews for reasons stemming directly from the industrial action in schools. For the period immediately after sending out the booklets, the teachers were unavailable during school hours. When conditions were more normal in March onwards, it was too late, the teachers by then had only a hazy recollection both of the booklet and their reactions to the items. For the same reason it was too late to interview sufficient teachers to undertake a test-retest reliability study.

Personal characteristics of the teacher sample

Tables 8.1 to 8.8 summarise the personal data supplied by the 253 teachers who returned a completed booklet.

The gender data in Table 8.1 show one-quarter of the teachers taking part in the study were female. This proportion of female teachers matches data quoted in DES statistics for the proportion of girls taking Computer Studies examinations in 1985 (See also Table 1.1). The teacher data suggest although male teachers are in the majority, the subject is far from being a a "male preserve" as it is sometimes described.

	Gender	
	Male	Female
N	191	59
%	76	24

Table 8.1 Gender breakdown of teacher sample

		Total Teaching Experience years			
		< 2	2-5	6-10	11+
Total	N (%)	13 (5)	33 (13)	81 (33)	120 (49)
Male	N (%)	8 (4)	22 (12)	60 (32)	98 (52)
Female	N (%)	5 (8)	11 (19)	21 (36)	22 (37)

Table 8.2 Teaching experience of teacher sample

Table 8.2 indicates half of this sample of teachers had been teaching for 11 or more years. Ninety percent of the teachers worked in mixed-sex schools (Table 8.3)

		Girls	Boys	Mixed	11-16	11-18 years
Total	N (%)	10 (4)	14 (6)	226 (90)	79 (32)	171 (68)
Male	N (%)	5 (3)	11 (6)	175 (92)	62 (33)	128 (67)
Female	N (%)	5 (8)	3 (5)	51 (86)	17 (29)	42 (71)

Table 8.3 School type of teacher sample

Data in Table 8.4 show about half the sample had from 2 to 5 years experience of teaching Computer Studies; the median experience was about 5 years. This contrasts with the data for total teaching experience where the median is about 9 years. These data suggest many teachers began teaching Computer Studies after some years of teaching another subject.

	CS Teaching Experience years			
	< 2	2-5	6-10	11+
Total N (%)	30 (12)	129 (51)	66 (26)	24 (10)
Male N (%)	23 (12)	99 (52)	47 (25)	11 (21)
Female N (%)	7 (12)	30 (51)	19 (32)	3 (5)

Table 8.4 Computer Studies Teaching experience of teacher sample

Data on the other subject taught by these Computer Studies teachers are given in Table 8.5. Four-fifths of the sample gave mathematics as their other teaching subject.

	Teaching subject (in addition to Computer Studies)					
	Maths	Sciences	Technical	Arts	Languages	Other.
Total N (%)	190(81)	21(9)	8(3)	10(4)	2(1)	3(1)
Male N (%)	141(79)	20(11)	7(4)	6(3)	2(1)	2(1)
Female N (%)	49(87)	1(2)	1(2)	4(7)	0(0)	1(2)

Table 8.5 Additional subject taught by teacher sample

The academic and teacher training qualifications of the teachers are summarised in Tables 8.6 and 8.7. Only a small percentage of the sample had a degree or equivalent in Computer Science. This contrasts with the situation in secondary school science where a majority of teachers have a degree in their teaching subject. The proportion of teachers who had undertaken an award-bearing course of teacher training was also quite small, it was around one-fifth taking fulltime and parttime together.

	Computer Science (Academic) Qualification		
	Degree/HND/HNC	College Cert.	None
Total N (%)	34 (13)	56 (22)	163 (65)
Male N (%)	24 (12)	43 (22)	127 (66)
Female N (%)	10 (17)	13 (22)	36 (61)

Table 8.6 Academic qualification in CS of teacher sample

	Computer Studies Teaching Qualification			
	FT	PT (award)	PT (no award)	None
Total N (%)	14 (6)	32 (13)	113 (45)	94 (37)
Male N (%)	11 (6)	23 (12)	89 (46)	71 (36)
Feamle N (%)	3 (5)	9 (15)	24 (41)	23 (39)

Table 8.7 Teaching qualification in CS of teacher sample

Teachers were also asked whether they had any industrial experience that involved the use of computers. The responses, summarised in Table 8.8 show about one-fifth of the sample had some relevant industrial experience. For about half of these the experience had been for two years or less.

	Industrial Experience with computers		
	None	<2 years	3+ years
Total N (%)	199 (79)	23 (9)	31 (12)
Male N (%)	147 (76)	20 (10)	27 (14)
Female N (%)	52 (88)	3 (5)	4 (7)

Table 8.8 Industrial Experience of teacher sample.

The eight teacher background variables give a broad description of the characteristics of the sample and will be tested as predictors of teaching style and pupil outcomes in later sections. Further studies of the sample were not undertaken because the uncertain status of the self-chosen sample would make it difficult to generalise any findings from the sample to Computer Studies teachers as a whole. Also the small numbers in some categories, e.g. females with industrial experience, would have made it difficult to detect sample characteristics.

Identification of Teaching Activities from the Checklist responses

Teachers' responses to the 206 checklist items were either 1, indicating the respondent made use of the behaviour, or zero indicating non-use. Cluster analysis was used to search this binary data for groups of behaviours having similar use-patterns. The clustering technique used was that of hierarchical, centroid fusion in which the 206 individual behaviours were successively combined into 205, 204, 203, ... 3, 2, 1 group(s) by joining together the individual items or groups with most nearly similar response patterns. A simple distance coefficient was used as the measure of similarity between use profiles. Following procedures outlined by Everett (1974), an optimal configuration of 19 groups was derived by inspection from the fusion graph or data representing the clustering process. Each of the 19 distinct groups of teaching behaviours represents a Teaching Activity. The number of behaviours in each Activity ranged from six to eighteen.

Examination of the checklist behaviours grouped together by the cluster analysis showed a high degree of similarity, in almost all cases it was possible to identify just one or two themes that embraced all or nearly all the behaviours within an Activity cluster. Fifeteen items of the original 206 lacked face validity with the other behaviours in their cluster and were dropped from the cluster and all further analysis. No relocation of items between clusters (Activity groups) was made.

The descriptions of the Teaching Activities were confirmed by a panel of four experienced teachers who were in complete agreement that the descriptions given by the researcher were both adequate and accurate. Table 8.9 lists the descriptions of the 19 Teaching Activities and gives a typical checklist behaviour for each. A complete list of the behaviours within each Teaching Activity is given in the Appendix.

Scale No.	Activity-scale description (based on item content)	Typical behaviour in this Activity (*)
1	General teaching via books, pupil programming on micros	Issue more than one textbook during the course
2	General teaching via tests, making notes, class discusssion	Require pupils to make their own notes about a film/video
3	Differentiation of pupil work via individual exercises, materials	Use different sets of programming exercises for fast and slow pupils in the same class
4	Teacher interest in pupils' career & leisure interests during & after lessons	Talk to pupils about their leisure time use of home-micro
5	Use of pupil-centred & pupil-directed study exercises	Tell pupils their essays should include material they have discovered themselves
6	Obtain and use of new teaching ideas from other teachers, INSET-courses, journals	Implement teaching idea from journal or educational text
7	Use of wallcharts,TV and videos, other non-computer audio-visual aids	Use diagrams or articles from computer magazine for wall display
8	Concern for and use of microcomputer network, wordprocessors	Use a wordprocessor for preparation of handouts and worksheets
9	Microelectronics; demonstration and pupil use, course attendance	Demonstrate thermistor or other sensor connected to input port
10	Use of computer hardware and other peripherals for teaching	Demonstrate bar-code reader
11	Use of worksheet-based exercises, routine keyboard exercises	Require pupils to answer a worksheet in conjunction with a video
12	Pupil participation in lessons	Ask pupils to talk about their project
13	Pupils encouraged to find out about computers for themselves	Encourage pupils to write to firms to seek information about computers/applications
14	Teacher concern for provision of h'ware resources and up-to-date information	Make personal visit to computer site to obtain ideas or information for CS teaching
15	Teacher demonstration and pupil-use of software packages	Set pupils exercises based on <u>use</u> of file-handling package
16	Teacher involvement with computer-based school administration	Teacher involvement with computer-based school-administration
17	Use of micro for data handling, use of commercial materials	Use micro to process data collected by pupils with another teacher
18	Concern for computing as a professional study, courses for other staff	Belong to a professional computing group (BCS, CEG, MUSE....)
19	Use of simulation materials, demonstration of LOGO, CAD, teletext etc	Use simulation of teletext for demonstration or pupil work

(*) Full lists of the behaviours included in each Activity appear in Appendix 8.

Table 8.9 Description and sample behaviour of the 19 Activities derived by cluster analysis from the 206 item teacher checklist

A teacher's use of the behaviours in a particular Activity was used to calculate an <u>Activity score</u>. For each teacher the number of positive indications of the behaviours in an Activity was totalled and divided by the total number of behaviours within the Activity. The resultant fraction was multiplied by 1000 and rounded to an integer to give the Activity score for the teacher on that Activity. In this way 19 Activity scores were calculated for each of the 253 teachers who completed the checklist. Each Activity score is a measure of the teacher's use of a particular group of behaviours.

Scale No.	Activity-scale description (based on item content)	N of items	Mean /1000	Alpha Rel.	Mean corr.
1	General teaching via books and pupil programming on micros	9	598	0.549	0.105
2	General teaching via tests, making notes from books, and use of videos	13	526	0.743	0.368
3	Differentiation of pupil work via individual exercises, materials	11	663	0.719	0.340
4	Teacher interest in pupils' career & leisure interests during & after lessons	9	726	0.696	0.364
5	Use of pupil-centred & pupil-directed study exercises	9	623	0.688	0.329
6	Use of new teaching ideas from other teachers, courses, journals	10	774	0.753	0.422
7	Use of wallcharts,TV and videos, other non-computer audio-visual aids	9	822	0.685	0.370
8	Concern for and use of microcomputer network, wordprocessors	10	705	0.748	0.380
9	Microelectronics; demonstration and pupil use, course attendance	10	331	0.842	0.300
10	Use of computer hardware and other peripherals for teaching	14	254	0.693	0.404
11	Use of worksheet-based exercises, routine keyboard exercises	12	338	0.662	0.358
12	Pupils talk to class, demonstrate programs etc, provide resources	11	364	0.751	0.354
13	Pupils encouraged to find out about computers through personal contacts	11	430	0.735	0.399
14	Teacher concern for provision of h'ware resources and up-to-date information	14	561	0.724	0.431
15	Teacher demonstration and pupil-use of software packages	10	587	0.798	0.394
16	Teacher involvement with computer-based school administration	5	547	0.803	0.255
17	Use of micro for data handling, use of commercial packages	10	402	0.725	0.439
18	Concern for computing as an academic study, courses for other staff	7	445	0.614	0.288
19	Use of simulation materials, demonstration of LOGO, CAD, teletext etc	7	429	0.757	0.362

Table 8.10 Description of the 19 Activities derived from the checklist responses with statistics of the Activity-scale scores.

Table 8.10 shows the Activity-scale description, mean score and internal reliability (Cronbach alpha value) of the 19 Activity scores. The mean scores cover the range 252/1000 (Activity 10, Use of computer hardware for teaching) to 822/1000 (Activity 7, Use of non-computer AV-aids). These are "mid-range" values suggesting that the 19 scales have sufficient range to discriminate between the preferences of different teachers. The reliability values are moderately high for scales of about 10 items and indicate the likely usefulness of the 19 Activities as measures of teacher behaviour. The results are in agreement with the finding of Shavelson & Dempsey-Attwood (1976) that composite (grouped) measures are stable indicators of teaching behaviour.

The commonality of the scales as measures of a single construct, i.e. teaching behaviour, was investigated by the use of factor analysis. A simple varimax-rotation analysis identified two orthogonal factors accounting for 40% and 12% of the score variance. Only the score for Activities Nos. 1 and 16 failed to have a factor loading of at least 0.4. The simplicity of the factor structure together with the high percentage of the score variance associated with the first factor are interpreted as showing the scales measure a single construct.

The independence of the 19 Activities could be estimated from the matrix of interscale correlations. Because of the size of the matrix, it is more convenient to examine the mean correlation of each Activity score with the other 18 Activity scores. The mean correlations (Table 8.10) range from 0.11 to 0.45. These are not high values, they are consistent with the view that the Activities measure <u>different</u> dimensions of a <u>common</u> construct.

T-tests were carried out to see whether the scales discriminated between sub-groups of the sample according to six variables of gender, experience and qualifications with the results shown in Table 8.11. The number of discriminations significant at $p <= 0.05$ is 25, over four times that expected by chance alone. The results show that 13 of the 19 scales discriminated between one or more of the subgroups.

Scale No.	Activity-scale description (abbreviated)	Gender M/F 191/59	Indexp Yes/No 54/199	TTexp <6/6+ 46/201	CSTexp <6/6+ 90/163	CSQA Yes/No 90/163	CSQE Yes/No 46/207
		Significance values of T-test results					
2.	General teaching via tests, notes from books, videos	-05					
4	Teacher interest in pupils' career and leisure interests	-05	05				
6.	Use of new teaching ideas					01	005
7	Use of wallcharts, other non-computer AV aids					02	
8	Concern for and use of network, wordprocessors		01			005	05
9	Microelectronics; demon. & pupil use, course attendance	000	01	05			
10	Use of computer hardware, peripherals for teaching						05
11	Use of worksheet, routine keyboard exercises	-02					
14	Teacher concern for h'ware resources and information					01	
15	Teacher and pupil-use of software packages		002			05	
16	Teacher in computer-based administration	001			02		
18	Concern for academic study, courses for staff			01	005	000	
19	Use of simulations LOGO, CAD, teletext etc		02			02	05

Notes: 1. A positive correlation favours Males, greater experience or the qualification.
2. Decimal points omitted
3. Activities with t-test prob. >0.05 are not shown

Table 8.10 T-tests on Teacher-Activities by Teacher Gender (M-F), Industrial Experience (Indexp), Total teaching experience (TTexp), Computer Studies teaching experience (CSTexp), CS qualification Academic (CSQA) and CS Studies qualification Educational (CSQE).

The identification of alternative Teaching Styles

After establishing that the 19 Activities were reliable, discrete and discriminating measures of teaching behaviour, cluster analysis was used to group the 253 teachers according to the pattern of their activity scores, thus creating a typology of styles of Computer Studies teaching. Again, the method of hierarchial centroid fusion was applied using a simple distance coefficient (Ward, 1963) as the measure of the similarity between teacher profiles. Inspection of the fusion graph suggested the presence of five groups of teachers. Each teacher group is made up of individuals who make similar use of the 19 Teaching Activities. Because these teacher

Scale No.	Activity-scale description (based on item content)	Teaching Style Group 1	2	3	4	5
1	General teaching via books and pupil programming on micros			+		-
2	General teaching via tests, making notes from books, and use of videos		+	+	-	-
3	Differentiation of pupil work via individual exercises, materials		+	+	-	-*
4	Teacher interest in pupils' career & leisure interests during & after lessons		+	+		-
5	Use of pupil-centred & pupil-directed study exercises		+	+		-
6	Use of new teaching ideas from other teachers, courses, journals	+	+		-	-*
7	Use of wallcharts,TV and videos, other non-computer audio-visual aids	+	+	+	-	-
8	Concern for and use of microcomputer network, wordprocessors		+		-	
9	Microelectronics; demonstration and pupil use, course attendance		+	-	-	-
10	Use of computer hardware and other peripherals for teaching		+		-	-
11	Use of worksheet-based exercises, routine keyboard exercises	-	+	+	-	-*
12	Pupils talk to class, demonstrate programs etc, provide resources		+	+	-	-
13	Pupils encouraged to find out about computers through personal contacts	-	+	+	-	-*
14	Teacher concern for provision of h'ware resources and up-to-date information		+		-	-
15	Teacher demonstration and pupil-use of software packages	+	+		-	-
16	Teacher involvement with computer-based school administration		+	-	-	-
17	Use of micro for data handling, use of commercial packages		+		-	-*
18	Concern for computing as an academic study, courses for other staff		+	-	-	-
19	Use of simulation materials, demonstration of LOGO, CAD, teletext etc		+	-	-	-
	N in Teaching-style group	99	61	17	44	32

Note: * indicates Activity use in Style 5 is significantly less than use in Style 4.

Table 8.12 High and low use of Activities within the five Teaching-Style groups. Data for 253 teachers.

groupings were derived from an analysis of the pattern of use of teaching activities, they are interpreted as five distinct <u>Styles of</u>

Computer Studies teaching. These five Styles were innate, i.e. derived from the data without reference to any external classification or category system at either the Activity or behaviour level.

Descriptions of the five teaching styles were obtained by analysing use of the 19 Activities within each style. One-way analysis of variance was used to identify significantly high or low use of an Activity within each style. The Scheffe procedure was used to reduce the risk of Type I errors. Table 8.12 shows the results of this analysis. Based on Table 8.12 the five Styles can be described as follows:

Type 1 (99 teachers, 39% of the sample)

This group shows the lowest number of departures from "average" teaching. The teachers record higher than average use only for Activities 6, 7 and 15 indicating use of new teaching ideas, audio-visual aids, and software packages respectively. This Style makes less than average use of worksheets and routine keyboard exercises (Activity 11) and personal contacts by pupils (Activity 13).

Type 2 (61 teachers, 24% of the sample)

This group shows higher than average use of all Activities except Activity No. 1 (General teaching based on textbooks). The group is unique in showing higher than average use of eight Activities, Nos. 8, 9, 10, 14, 16, 17, 18 and 19. Teachers in this Style-group have a very "positive-style" and make extensive use of **all** types of teaching Activities and resources.

Type 3 (17 teachers, 7% of the sample)

Teachers in this group show higher than average use of several Activities but fewer than teachers in Style Group 2. Teachers in Style Group 3 make unique use of Activity No. 1 (General teaching based on textbooks). This style is distinguished from Style Group 2 by less use of microelectronics (Activity No. 9), non-involvement with computer-based school administration (No. 16), less interest in professional concerns (No. 18), and less use of simulations etc (No. 19). This style may be summarised as showing a positive approach to teaching activities except those that require the **teacher** to be involved with microcomputer use.

Type 4 (44 teachers, 17% of the sample)

This group of teachers record lower than average use on 16 of the 19 Activities. The group is unique in recording lower than average use of Activity No. 8 (concern for microcomputer networks and wordprocessors). A detailed comparison of this Style with Style 5 (below) shows that Style 4 has the lowest use of Activity 16 (computer-based school administration) and also of Activity 7 (use of non-computer audio-visual aids).

Type 5 (32 teachers, 13% of the sample)

Teachers in Style-group 5 make lower than average use of 18 of the 19 Activities. This Style is unique in its lower than average use of Activity 1 (General teaching based on textboooks), Activity 4 (Teacher shows an interest in pupils' career and leisure interest+s), and Activity 5 (use of pupil-centred teaching). These teachers show the lowest frequency of use of Activities, 3, 6, 11, 13 and 17. Teachers in this group share many characteristics with those in Style Group 4; both groups show lower than average use of many Activities. Overall, Style 5 teachers show a lower level of use of teaching Activities than the already lower than average use shown teachers in Style Group 4.

The Venn diagram, Figure 8.1 shows some of the similarities and differences between the five teaching styles. The diagram makes clear the

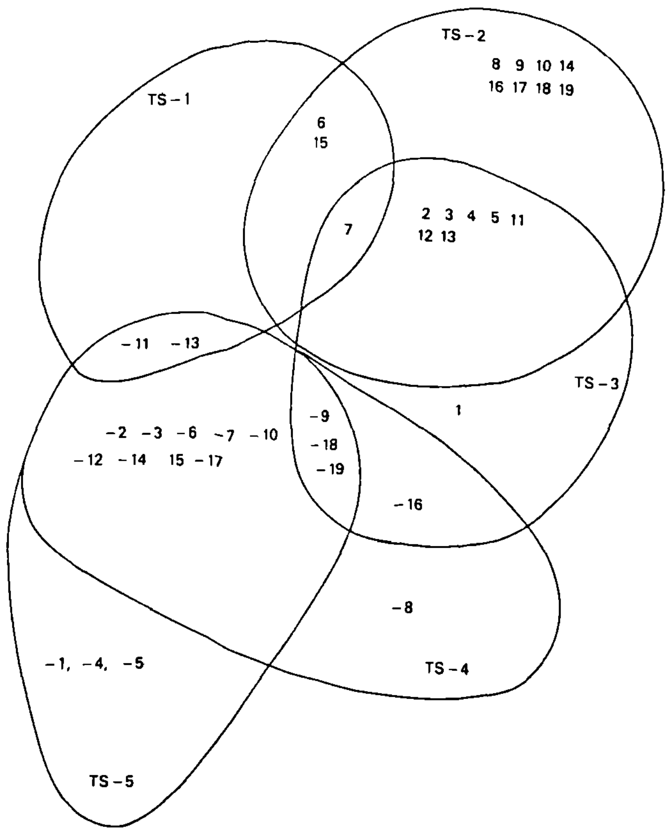


Figure 8.1 Venn diagram of the location of higher (+) and lower (-) than average uses of the 19 Activity scales within the five Teacher-Style groups

close similarities between the two "positive" teaching Styles, Types 2 and 3, and between the two "negative" Styles, Types 4 and 5. The diagram reinforces the view that Style-groups 2 and 3 are distinguished by the teachers' attitude to their own use of the micro (Activities 9, 16, 18, 19). The diagram also indicates that the two negative Styles 4 & 5 are distinguished by teachers' use of Activities 1, 4 and 5. All these involve pupils. Group 5 teachers have a lower use of pupil-related activities. Correspondingly, Group 4 teachers have the lower use of the machine-oriented activity number 8.

Confirmation of the five teaching styles

Although the interpretation of the cluster analysis and the analysis of variance results left little doubt as to the existence of five distinct Styles of teaching, some additional support for the grouping was sought. Discriminant analysis was chosen as a technique appropriate for confirming the allocation of each of the 253 teachers to one of the five Teaching-Style groups.

The discriminant analysis used the sets of 19 Activity scores as the independent variables to confirm the placing of the teachers into one of the five Style groups. In discriminant analysis new uncorrelated variables, termed canonical discriminant functions (CDFs), are formed from linear combinations of the independent variables. It was found that three CDFs were sufficient to place 92% of the teacher sample in the same Style group as found in the original cluster analysis thus confirming the identification of five Styles of Computer Studies teaching.

Table 8.13 gives the weighting of each Teaching Activity within the three functions and shows that two Activities, No.2 (General teaching - tests), and No.14 (Teacher concern for resources), had weightings of zero in all three functions. That is, these two Activities were not of significance in discriminating between the five Teaching Styles. Since the two Activities do not have zero level of use the result shows that they are used equally in the different Style groups.

Scale No.	Activity-scale description (based on item content)	Scale weighting values x 10^4 CDF1	CDF2	CDF3
1	General teaching via books and pupil programming on micros	0.72	15.0	- 1.85
2	General teaching via tests, making notes from books, and use of videos	0.00	0.00	0.00
3	Differentiation of pupil work via individual exercises, materials	11.0	7.74	15.8
4	Teacher interest in pupils' career & leisure interests during & after lessons	3.44	13.4	36.4
5	Use of pupil-centred & pupil-directed study exercises	4.52	14.3	15.2
6	Use of new teaching ideas from other teachers, courses, journals	3.21	-12.5	-3.30
7	Use of wallcharts,TV and videos, other non-computer audio-visual aids	7.20	-12.0	-26.9
8	Concern for and use of microcomputer network, wordprocessors	5.89	-10.4	- 3.84
9	Microelectronics; demonstration and pupil use, course attendance	6.34	- 1.15	2.90
10	Use of computer hardware and other peripherals for teaching	20.3	8.09	7.50
11	Use of worksheet-based exercises, routine keyboard exercises	11.1	24.7	-18.6
12	Pupils talk to class, demonstrate programs etc, provide resources	13.1	- 1.08	-11.8
13	Pupils encouraged to find out about computers through personal contacts	10.4	15.2	-27.8
14	Teacher concern for provision of h'ware resources and up-to-date information	0.00	0.00	0.00
15	Teacher demonstration and pupil-use of software packages	9.54	0.05	15.9
16	Teacher involvement with computer-based school administration	15.4	-18.7	- 5.28
17	Use of micro for data handling, use of commercial packages	17.1	- 7.34	-19.9
18	Concern for computing as an academic study, courses for other staff	6.59	2.21	17.3
19	Use of simulation materials, demonstration of LOGO, CAD, teletext etc	6.64	- 5.00	8.06
	CDF Scale standard deviation	2.51	1.54	1.16

Data for 253 teachers.

Table 8.13 Weighting of the Activity Scale scores within each canonical discriminant function (CDF)

The three functions are of decreasing significance in distinguishing between the Teaching Style groups. CDF1 accounted for 73% of the Activity score variance, CDF2 for 19% and CDF3 for 5%.

Because of their relationship to teaching activities, the CDFs are alternative measures of Teaching Style. Because the three functions include above-average (+) and below-average (-) weightings of the 19 Activities, they could also be used to describe the characteristics of teachers.

A teacher will receive a high score on CDF1 if he or she

limits pupil involvement to resource concerns	(+12, +13)
makes use of ideas from books, other teachers	(+6)
makes use of a wide range of computer-based and other teaching aids	(+7, +8, +9, +10, +17)
is involved with computer-based school administration	(+16)
is involved with computer-use by other teachers	(+15, +18)

These are the characteristics of a teacher who has a high level of computer interest, who makes use of a range of teaching aids.

A teacher obtains a high score on CDF2 for

frequent use of textbooks and worksheets	(+1, +11)
less than average use of microcomputers, microelectronics, software, hardware	(-8, -9, -17, -19)
is not often involved with other teachers	(-6, -16, -18)
encourages pupils to find about computers privately	(+13)
takes an interest in pupils' leisure and learning	(+4, +5)

These are the characteristics of a teacher who prefers to use books and worksheets, who takes an interest in pupils but prefers to avoid the use of computer based resources both alone and with other teachers.

Teachers obtains high scores on the third discriminant function, CDF3, if they

avoid use of books and worksheets	(-1, -11)
make frequent contact with pupils	(+3, +4, +5)
prefer unstructured pupil work	(-12, -13)
make minimal use of class-level aids	(-7, -17)
encourage pupils to use software	(+15, +19)
help other staff	(+18)

These are the characteristics of a teacher interested in pupil-centred teaching.

Oneway analysis of variance of the teachers' scores on the three canonical functions produced the results shown in Table 8.14. The table shows the coordinates of the Teaching Style group centroids on the CDF axes and indicates high (+) and low (-) use of the three functions within the five Teaching Styles. The table shows how the CDFs distinguish between the "positive" styles of teachers in Groups 2 and 3, and between the "negative" styles of those in Groups 4 and 5. When interpreting the table it is necessary to recall that the three functions CDF1, CDF2, and CDF3 are in decreasing order of importance in establishing group membership.

CDF No.	Characteristics of teachers with high scores on this function (*)	Teaching-style Group 1	2	3	4	5
1	Teacher concerned with content and professional interests; uses new methods; wide range of aids.	0.20	3.28 +	0.34	-3.23 -	-2.60 -
2	Teacher shows preference for books and worksheets; tends to avoid computer hardware.	-0.66 -	0.28	2.45 +	1.46 +	-1.81 -
3	Teacher prefers pupil-centred teaching, low use of class-level resources; unstructured lessons.	0.48 +	-0.17	-1.21 -	0.38 +	-1.04 -

(*) See text for full description of teacher characteristics

+ (-) indicates a significantly higher (lower) score on this function

Table 8.14 Description of the five Teaching-style groups by means of the three canonical discriminant functions and location of Teaching Style group centroids.

Table 8.14 may be compared with the Venn diagram of Figure 8.1. The first line of the table shows that the most important function, CDF1, distinguishes a strongly positive style (No. 2), two negative styles (4 and 5) and two neutral styles (1 and 3). These three groups of Teaching Styles can also be found on the Venn diagram. The next function, CDF2 which places emphasis on computer-based activities, distinguishes between Styles 1 and 3 with Style 3 as the more positive. The third function CDF3 makes further distinctions between the Teaching-Style groups mostly on the basis of pupil contact and pupil-centred activities.

The close correspondence of the Venn diagram to the summary of the discriminant analysis shown in Table 8.14 does not extend understanding of the Teaching Styles already given but lends considerable support to the validity of the analyses.

Relationships between Teaching-style and Teacher Background Variables

Table 8.15 gives a summary of chi^2 tests carried out on cross-tabulation tables of teacher background variables of gender, years of teaching, qualifications and industrial experience arranged according to Teaching Style. The data show that, in this sample, a teacher's Style is related to gender, academic and teacher training qualifications and teaching subject. Style seems to be unrelated to industrial experience, length of teaching experience both total and in CS, and school-type.

Teacher Variable		Teaching-style Group 1	2	3	4	5	Chi^2 Value	Test Sig.
	(N =	99	61	17	44	32)		
Gender	Female	15	14	6	18	7	13.4	0.01
	Male	84	47	11	26	25		
Teaching Experience	0-5 years	19	9	3	11	4	2.73	NS
	6+ years	78	51	14	30	28		
Academic Qual. in computing	Yes	45	25	4	10	6	13.1	0.02
	No	54	36	13	34	26		
Teacher training Qual. in CS	Yes	69	43	11	19	17	15.7	0.01
	No	30	18	6	25	15		
Industrial Experience	Yes	23	17	3	7	4	4.36	NS
	No	76	44	14	37	28		
Other teaching subject	Maths	72	40	12	38	28	9.4	0.05
	Other	27	21	5	6	4		
School Type	Mixed	86	56	17	36	31	6.13	NS
	Single Sex	13	5	0	8	1		
CS-teaching experience	0-5 years	62	39	10	35	17	7.46	NS
	6+ years	37	22	7	9	15		

Table 8.15: Crosstabulation of teacher variables by Teaching-style group

Male teachers predominate in Style Group 1 whilst females are relatively more common in Groups 3 and 4. Teachers with a degree or college qualification in computing are more likely to be found in Styles 1 and 2. Although teachers of mathematics were in a majority in all Style-groups, the ratio of their superiority was lowest in Style 2.

T-tests were made on the means of the three canonical discriminant functions between sub-groups of the sample formed according to gender, teaching experience, qualifications, industrial experience, other teaching subject, and school-type. From the results shown in Table 16 it can be seen that each teacher personal variable is significantly related to one CDF. This suggests that the canonical functions are associated with specific teacher characteristics.

Teacher Variable		Significance of level of t-test CDF1	CDF2	CDF3
Gender	Female Male	NS	-0.001(*)	NS
Teaching Experience	0-5 years 6+ years	NS	-0.05	NS
Academic Qual. in computing	Yes No	NS	NS	-0.01
Teacher training Qual. in CS	Yes No	NS	-0.05	NS
Industrial Experience	Yes No	0.05	NS	NS
Other teaching subject	Maths Other	-0.05(^)	NS	NS
School Type	Mixed Single Sex	NS	NS	NS
CS-teaching experience	0-5 years 6+ years	NS	NS	NS

(*) Negative sign shows females have the higher mean score
(^) Negative sign shows non-maths have the higher mean score

Table 8.16: Summary of results of t-tests on canonical discriminant functions by teacher variables.

The table shows high scores on CDF1 are positively associated with industrial experience Using this result with the descriptions of the CDFs given in Table 8.12 shows teachers with industrial experience in computing are more likely to use a wide range of computer hardware and teaching aids. High scores on CDF2 are associated with female teachers. The negative correlation with general teaching experience and Computer Studies teaching qualifications confirms that teachers who are trained or experienced in the teaching of Computer Studies are more likely to use computer resources in preference to books and worksheets. The third function, CDF3, is associated only with academic qualifications. A teacher with an academic qualification in computing is less likely to engage in pupil-centred activities, will make use of class-level aids books and worksheets, and is less likely to ask pupils about their career and leisure interests.

No previous survey of Computer Studies teachers is available for the comparison of data. Therefore it is impossible to say whether the relationships between teacher variables and Teaching Style agree with other findings. The results are however understandable at a naive level. It is reasonable that a person with industrial experience of computers should show a preference for working with resources and also that a trained teacher with some experience will make more use of resources. To this extent the findings give further support to the validity of the checklist and the subsequent analyses.

The "activity"-importance rating matrix

In the Teachers' Booklet the items included in the Rating Matrix were described as Activities in order to avoid the use of the more technical term behaviours. Inverted commas will be used to distinguish the matrix "activities" from the 19 Teaching Activities derived from the checklist.

One reason for including the importance matrix in the teacher booklet was to obtain an additional measure of the checklist validity. Unlike the internal consistency validity pointed out previously, the rating-matrix provides an external source of validation.

The "activity"-matrix is shown in Table 8.17 with the number of responses received in each response category. The means shown were obtained by assigning values of

Above average = 1, Average = 2, Below average = 3, No value = 4

(This method of scoring gives a scale mean of 2 if the "No value" category is ignored, a mean of 2.5 if this category is included.)

The data show that one "activity", Writing programs for administration and other teachers (Activity 7), was thought of No value to Computer Studies teaching by over one-third of respondents. Three other "activities", No.2 (Encourage pupils to provide resources), No.8 (Incorporate microelectronics) and No.14 (Allow pupils to participate in and choose teaching activities) were thought of little importance in Computer Studies teaching, all three had means of 2.5 and above. The "activities" rated as most important by teachers were No.1 (organisation and supervision), No.16 (Actively seek new teaching ideas), No.15 (Link teaching to industry/commerce) and No.10 (Clear and precise tasks). Three of these four are general teaching techniques and are not specific to Computer Studies. The "activities" linked to computers, software and technology (Nos 6, 3, 8 and 13) obtained rankings of 5th, 6th, 15th, and 13th.

T-tests were made on matrix responses to determine whether they were related to the five teacher variables of industrial experience, academic and teacher training qualifications in computing, and teaching experience both total and in Computer Studies. Of the 85 separate t-tests, only two showed a significance value at the 0.05 level or above. As this number is expected to occur by chance alone, it is concluded that the teachers' ratings of the "activities" is independent of their personal characteristics.

Matrix "activity"	Importance Rating					
	Above Aver. (1)	Aver. (2)	Below Aver. (3)	No Value (4)	Mean	Rank Order
1. Organise and supervise the work of groups and individuals	171	78	4	0	1.340	1
2. Encourage pupils to provide resources for teaching/learning	18	83	148	4	2.545	14
3. Use computer software for teaching	100	105	23	0	1.597	5
4. Maintain informal contact with pupils both in and out of lessons	76	122	54	1	1.921	9
5. Seek external help or advice for CS-teaching or information	79	125	49	0	1.881	8
6. Utilise the full potential of the micro as a teaching aid	133	87	32	1	1.609	6
7. Write programs for school administration and other teachers	18	27	119	89	3.111	17
8. Incorporate microelectronics theory and practical into CS lessons	32	55	154	12	2.577	15
9. Make full use of available textbooks	75	119	35	4	1.953	10
10. Set pupils clearly and precisely specified tasks and exercises	145	90	18	0	1.498	4
11. Allow pupils to work freely to develop their own ideas	97	113	41	2	1.794	7
12. Make use of non-computer resources	38	155	60	0	2.087	12
13. Make use of technical/electronic aids	49	116	86	2	2.162	13
14. Allow pupils to participate in and to choose the teaching activities	13	55	168	17	2.747	16
15. Link CS teaching to ideas and practices of industry and commerce	152	84	17	0	1.466	3
16. Actively seek new teaching ideas	172	69	12	0	1.368	2
17. Provide pupils with individualised learning experiences	72	103	76	2	2.032	11

Table 8.17 Response frequencies and means of Importance-rating matrix

	Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Importance-rating matrix items																
1.	General T., textbooks, programming									+30						-11		
2.	General T., tests, notes, videos		+25				+13		+12	-12								
3.	Differentiation of pupil work								+15		-16	+22						+23
4.	Interest in p's career and leisure		+23						+13	-18		+11						
5.	Pupil-directed study and exercises		+21									+17						
6.	Collaboration, use of new ideas			+13					+19	-16	-16			+12				+13
7.	Use of non-computer AV aids	-11	+12	+13			+13		+15					+10				
8.	Use of micros, network, word-p								+12	-24	-14							+11
9.	Microelectronics, theory and pract.								+37	-19				+28	-12		-12	
10.	Use of computer hardware		+13				+18	+16	+24	-20	-13	+14		+16				
11.	Worksheet exs., routine keyboard		+19	+12			+15		+16					+20				
12.	Pupil involvement in lessons		+28							-21		+11						+14
13.	Pupils find out about computers		+20							-12		+22			+11			+20
14.	Concern for resources, information		+18					+16		-18		+20						+18
15.	Use of software packages			+23					+23	-17			+15					+10
16.	Teacher helps computer school admin.					-11		+30	+12									
17.	Use of database, comm. programs			+13			+15	+13	+21	-16			+14					+12
18.	Professional concerns, other staff					-18		+17	+17	-16								+13
19.	Use of LOGO, CAD, Teletext etc			+22	-12		+13		+22	-17		+14	+14					

Note: Only correlations significant at $p <= 0.05$ are shown. Decimal points omitted.
Statements of the Importance rating matrix are given in Table 8.17.

Table 8.18 Table of correlations between 17 Activity-Importance Rating Matrix items and 19 Teaching Activities

Importance ratings can be used as an indicator of the validity of the checklist and the subsequent analysis if it is assumed that teachers will, when circumstances allow, use activities they regard as important and will not use activities they regard as unimportant. In other words, validity of the Teaching Activities is supported by significant correlations between teachers' ratings of statements on the Rating-matrix and their scores on corresponding Activities.

Table 8.18 shows the correlations between teachers' scores on the 17 Importance-matrix items and scores on the 19 (checklist) Activities. As already explained, the two sets of activities do not correspond exactly because the matrix items were derived from the Pilot Study which used a different form of the checklist. The lack of exact correspondence between the rows and columns of the tables requires that each matrix "activity" has to be compared with two or more of the list of 19 checklist Activities. To aid clarity, correlations with a significance of less than 0.05 have been omitted. Significant correlations are obtained only when the matrix items and cluster-analysis Activities are similar. Similar results were obtained by means of oneway analysis of variance between Activities and matrix items. A table showing the significance of the relationships established through analysis of variance is given in Appendix C. Although both tables give the same view of the relationships between the two sets of variables, it is convenient to work with the table of correlations since this also contains the sign of the direction of the relationship.

A few examples will be used to show the extent of the agreement between teachers' scores on the 19 Activities and the 17 matrix items. Considering first Activity 3, Differentiation of pupil work, this is found to have significant positive correlations with three Matrix items. No. 8 is Microelectronics for which pupils often do practical work in small groups; No.11 is Pupils work freely to develop their own ideas; No.17 (with the highest correlation) makes direct mention of invidualised learning experiences. Thus all these pairs of correlations are meaningful. The remaining correlation of r = -0.16 between Differentiation and Matrix Activity 10, Set pupils clearly specified tasks, is also meaningful and in the expected direction. Thus on this Activity there is complete agreement between the checklist analysis and teachers' responses to the Importance-rating matrix.

Matrix "activity" 9, Make full use of available textbooks, has a positive correlation with Teaching Activity 1 (General teaching based on textbooks) and a negative correlation with 13 of the remaining 18 Activities. This is as expected, teachers who differentiate pupil work, who use new ideas, utilise computer hardware and software as teaching aids, encourage pupil involvement and are concerned about a wide range of resources, are teachers who will (usually) make less use of textbooks.

Other rows and columns of the table may be used to show the correspondence between the 19 checklist-derived list Activities and items in the Importance-matrix. The finding of very few significant correlations between Activities and the three items rated as most important (Nos.1, 15 and 16) may be a statistical effect. When 60% or more of teachers give the same response, the range of scores is restricted and it becomes difficult to obtain a significant correlation.

The finding of significant correlations between matching activities and very few other pairs supports the validity of the checklist instrument and the scales of Teaching Activities as measures of teachers' classroom behaviours.

Analysis of the Job-of-a Computer-Studies-Teacher attitude questionnaire

Teachers were asked to use a 29-scale semantic differential instrument to describe their feelings about <u>The Job of a Computer Studies Teacher</u>. A condensed form of the instrument and a breakdown of responses are given in Table 8.19.

Scale Descriptors Score (1)	Score (7)	Mean	Factor Loadings F1 (20%)	F2 (10%)
Valuable	Worthless	2.2332		0.675
Tense	Relaxed	4.0988		
Successful	Unsuccessful	2.9407		0.423
Involves much responsibility	Involves no responsibility	2.1779	0.441	
Interesting	Boring	2.000		0.501
Unfriendly	Friendly	5.3043	-0.428	
Modern	Out-of-data	2.2530		0.428
Safe	Risky	3.0593		0.356
Comfortable	Uncomfortable	3.3913		0.383
Difficult	Easy	2.7194		
Varied	Repetitive	2.4822	0.611	
Authoritative	Participative	4.6719		
Well-defined	Ill-defined	4.8498		0.325
Needs imagination	Needs no imagination	2.0119	0.389	
Necessary	Not necessary	2.6719		0.637
Unpleasant	Pleasant	5.4704		-0.306
Requires teamwork	No teamwork required	3.1304	0.365	
Demanding	Undemanding	1.6759	0.603	
Involves many things	Involves one thing	1.4427	0.396	
Requires experience	No experience required	2.3202	0.396	
Practical	Theoretical	4.2372		
Useful	Not useful	2.5138		0.740
Technical	Non-technical	2.7470		
Fits with other subjects	Does not fit with other subjects	2.9289		
Non-specialised	Specialised	5.3755		
Suitable everyone	Suitable few only	4.6245		
Active	Passive	2.0830	0.379	
Healthy	Unhealthy	3.6640		
Training needed	No special training	1.9605		

Table 8.19 Summary of responses and factor loadings for semantic differential scales "The Job of a Computer Studies Teacher".

The distribution of responses was studied by factor analysis. Two factors were found accounting for 20% and 10% of the score variance. Factor 1 of nine scales (as shown in Table 8.18) summarises the demands of computer studies teaching. This factor includes items relating to the potency and activity components of the EPA structure (responsibility, experience, teamwork). Factor 2, of 10 scales, is concerned with evaluation (valuable, modern, interesting, pleasant). Nine scales which included Training/No-Training, Technical/Non-Technical, Practical/Theoretical and Specialised/Non-Specialised did not load to either of the two principal factors.

Using the sets of scales loading to the two factors, two jobscores were calculated. Table 8.20 shows the observed means of both jobscales were lower than the scale midpoint, this shows that teachers had generally favourable views of both the Demands (JOBSCORE1) and the Evaluation (JOBSCORE2) of their work. The alpha reliabilities of the scales were 0.69 and 0.80 for JOBSCORE1 and JOBSCORE2 respectively.

	JOBSCORE1 (Factor1)		JOBSCORE2 (Factor 2)
N of scales (items)	9		10
Scale mid-point	36		40
Scale Mean	20.0		28.4
Scale stand. devn.	5.58		8.02
Alpha reliability	0.69		0.80
Inter-scale correlation		0.68	

Table 8.20 Characteristics of two JOBSCOREs derived from Job-of-a-Computer Studies Teacher questionnaire

T-tests were carried out on the means of groups divided according to gender, teaching experience, qualifications and industrial experience. The results shown in Table 8.21 show only one significant difference ($p<0.05$) and suggest teachers' views of their work as measured by the two Jobscores are independent of a wide range of personal teacher variables.

Variable	Group		N	Means	SD	T-value	T-prob
Jobscore1	Gender	Male	191	20.2199	5.575	0.85	0.398
		Female	59	19.5085	5.643		
Jobscore2		Male	191	27.8973	8.057	1.78	0.079
		Female	59	29.9831	7.833		
Jobscore1	Acad.Qual	Yes	90	19.5667	5.033	1.00	0.316
		No	163	20.2669	5.859		
Jobscore2	Acad.Qual	Yes	90	27.5444	7.545	1.36	0.175
		No	163	28.9387	8.257		
Jobscore1	TT in CS	Yes	46	19.8478	4.482	0.27	0.787
		No	207	20.0580	5.806		
Jobscore2	TT in CS	Yes	46	25.3913	7.476	3.02	0.040
		No	207	29.1208	8.001		
Jobscore1	Indus.Exp	Yes	54	19.2037	5.275	1.26	0.210
		No	199	20.2412	5.653		
Jobscore2	Indus Exp	Yes	54	26.8704	7.709	1.67	0.210
		No	199	28.8693	8.073		
Jobscore1	CS T. Exp	0-5yr	159	20.5472	5.836	1.92	0.056
		6+ yr	90	19.1889	5.068		
Jobscore2	CS T Exp	0-5yr	159	28.5597	8.076	0.47	0.636
		6+ yr	90	28.0056	8.047		
Jobscore1	Total TExp	0-5yr	46	21.1957	6.156	1.48	0.144
		6+ yr	201	19.7363	5.452		
Jobscore2	Total TExp	0-5yr	46	29.5217	7.760	1.13	0.262
		6+ yr		28.0746	8.120		

Table 8.21 T-tests on Teacher Jobscores by teacher variables

Correlations were calculated between teachers' Activity-scores and the two JOBSCOREs. The data in Table 8.22 shows the JOBSCOREs were significantly correlated to scores on most of the 19 Activities. All correlations indicated that a higher Activity score was associated with more favourable Jobscores. Only four Activities (Nos 1, 4, 5 and 13) failed to show a correlation of significance 0.05 or greater with one or both Jobscores. It is a common feature of these four Activities that they make no mention of the classroom use of microcomputers and computer materials.

The Table shows eight Activities had a correlation significant at p=0.002 or better. All these Activities are related to resources, hardware, software and the use of computer equipment. The high and low levels of associations between the 19 Activity scores and the Jobscores show teachers' feelings about their job are expressed in the level of computer resource use in their classrooms.

Activity No.	Pearson Corr. value Jobscore1	Jobscore2
1	0792	0656
2	1459 **	0070
3	1154 **	1186 **
4	0954	0676
5	0013	0562
6	1603 **	1413 *
7	1739 **	1144 *
8	1622 **	1924 ***
9	1355 *	2032 ***
10	1593 **	2587 ***
11	1605 **	1209 *
12	1613 **	1145 *
13	0850	0414
14	2381 ***	2539 ***
15	2482 ***	2801 ***
16	0945	1058 *
17	1866 ***	2146 ***
18	2085 ***	1885 ***
19	1991 ***	2271 ***

*, **, ***, Sig. at p = 0.05, 0.01, <0.002

Table 8.22 Correlations between Jobscores and Activity-scores

Although the Jobscores are related to teachers' behaviours as measured by other variables, they may nevertheless be useful additional measures of teachers' characteristics. Because the Jobscores are attitudinal in origin, they may be significantly correlated to one or more dimensions of pupils' attitudes to computers or to their perceptions of the classroom environment.

Summary

Completed questionnaires were obtained from 253 teachers, the return rate of about 40% is attributed to coincidence between the study and a period of industrial dispute in schools. The sample of teachers reported a range of length of teaching, academic and professional qualifications and industrial experience. It is thought reasonable to assume that the sample represents all major teaching variables pertinent to Computer Studies teaching.

Cluster analysis of teachers' responses to the 206-item checklist demonstrated 19 groups of Teaching Activities. The use of cluster analysis made it unnecessary to refer to any external classification or grouping. Teachers' Activities measured by the checklist of behaviours showed significant correlations with responses to the importance-rating of similar items presented as a separate matrix. These correlations were interpreted as demonstrating the validity of the checklist method of measuring Computer Studies teaching activities.

Teachers were grouped into five Teaching Styles according to their pattern of use of the 19 Activities. The five Styles could be simply described in terms of the above average, average and below average use of the Activities. A teacher's Style was found to be associated with the four variables of gender, teaching subject and academic and professional qualifications in Computing.

Discriminant analysis was used to confirm the placing of individual teachers into the appropriate Teaching Style group. The 92% correspondence between placings made by the two methods supports both the validity of the concept of Teaching Style in Computer Studies and its identification via the Checklist. The discriminant function analysis provided three additional variables which may be useful as measures of teaching behaviour.

Teachers also used a semantic differential instrument of 29 scales to describe their feelings about The Job of Computer Studies Teacher. From the responses factor analysis derived two factors accounting for 29% of the score variance. One factor could be equated to the Activity and Potency dimensions of the EPA structure whilst the other represented the Evaluation dimension.

These two factors which were used as Jobscores had moderate alpha reliabilities and mean values indicating teachers' had generally favourable views of their work. The Jobscores were found to be unrelated to teacher personal characteristics but were positively associated with 15 of the 19 Teaching Activities. The four omitted Activities were those unrelated to computer use whilst the eight Activities showing highest correlations made specific mention of the use of hardware and software. It appears that teachers' feelings about their work are expressed in the level of computer-related resources used in their classsrooms.

The descriptive statistics described in this chapter have established the characteristics of the teacher sample and have been used to derive a number of scales. The 19 Activities, three Canonical Discriminant Functions and two Jobscores Variables will be used to study relationships between teachers' behaviours and pupil outcomes.

CHAPTER 9

DESCRIPTIVE ANALYSIS OF THE PUPIL DATA

Distribution of the Pupils' Booklet

A total of 158 teachers responded to the invitation to take a further part in research and were sent pupil booklets. Before the closing date at the end of the Spring Term 102 sets of completed questionnaires were received. Applying the data from Wellington as described in Chapter 8, it is found that the 102 returns represent about 1 in 5 of the eligible teachers receiving a Teachers' Booklet. Information provided by the teachers showed the questionnaires had been used between the end of November 1985 and the end of February 1986. Teachers who were contacted about non-return of the questionnaires said that, much as they would like to help the research, they felt all pupils' school time should be used to make up for lessons lost during the industrial dispute. Thus the return rate of 60% for the pupil booklets is a further consequence of the teachers' industrial action of 1985-86.

The 102 sets of questionnaires included 1163 Part A and 1198 Part B portions. Tables 9.1 to 9.4 show the gender, subject choices, use of a home computer and computer assisted learning experience of the pupils completing the questionnaire.

Description of the pupil sample

	Number	Percent
Boys	1573	68
Girls	747	32
Total	2320	100

Table 9.1 Gender breakdown of pupil sample

Table 9.1 shows that 68% of the sample were boys; this is a little lower than the figure of 70% given in Table 1.1 based on DES statistics for Computer Studies examinations in 1984 and 1985.

The subject choices of pupils is summarised in Table 9.2. The impression given by the data is of a wide spread of subjects accompanying Computer Studies. The high figures for separate science subjects and CDT/TD with the low figure for General/Modular Science are consistent with the policy of making Computer Studies available only to average and above average pupils observed in some schools during the 1984 study.

Subject	All %	Boys %	Girls %
Physics	60.2	77	29
Chemistry	41.5	46	32
Biology	37.6	28	60
General Sci.	9.0	9	10
CDT/TD	30.9	44	7
For. Languages	46.3	37	63
History Geography	75.7	78	68
Art Music Drama	27.1	25	33
Domestic Science	7.9	4	18
Office Practice	11.5	5	28
Craft subjects	33.1	37	28

Table 9.2 Subject choice of pupil sample

The majority of pupils reported some experience of using a home computer. In Table 9.3 the playing of arcade-type games is shown as the most common use, more "educational" uses are much less frequent. Boys report more frequent use than girls in all categories except "Educational Games" for which there is no significant gender difference. Both these findings are in close agreement with data quoted by Mohamedali et al (1987) from a survey of a general school population.

Use		Very Often	Quite Often	A few times	Occas-ionally	Never
		Frequency				
Arcade games	All %	25	29	18	21	7
	Boys %	32	33	17	15	4
	Girls%	12	21	22	32	13
Educational games	All %	<1	5	17	38	40
	Boys %	<1	5	18	39	37
	Girls%	<1	5	15	36	44
Schoolwork & revision	All %	4	14	15	25	42
	Boys %	4	15	18	26	37
	Girls%	4	12	10	23	51
Programming	All %	14	26	22	21	18
	Boys %	17	29	22	20	12
	Girls%	8	19	20	23	30

Table 9.3: Pupils' use of a home computer

In accordance with the wishes of teachers, pupils were not asked if they owned a home microcomputer. However, an estimate of the number who had easy-access to a machine at home can be made from the data in Table 9.3. The top line of the table indicates that more than 50% of the sample had access to a home computer "Quite Often" or "Very Often". This is matched by the figures for programming which show that 40% of the sample used a micro for programming "Quite Often" or "Very Often", and a further 20% indicated some programming. On this data it is hypothesised that about 50% of the sample had easy access to a home microcomputer. This estimate matches the results of Mohamedali et al (1987) who found that 50% of the general school population in their survey schools had a microcomputer at home.

An ownership level of around 50% does not appear to be unduly high for a sample of pupils all of whom were taking Computer Studies as an examination subject. The data for School work and revision show less than 20% of responses in the "Very Often" or "Quite Often" frequencies combined. This value is less than half that for "Programming".

School Experience of Computer Assisted Learning (%)					
School subject	Very often	Quite often	A few times	Occas- ionally	Never
Mathematics	0.3	2.2	7.5	16.5	73.2
Science, tech subjs	1.0	1.8	6.0	24.1	67.1
Languages,English	0.2	0.8	1.3	4.1	93.6
Hist.,Geog.,Econ	0.2	0.7	1.8	8.2	89.1
DomSci,Craft,OffPrac	0.3	2.0	2.8	6.3	88.6

Table 9.4 Pupils' experience of computer assisted learning

Table 9.4 shows that computer asssisted learning was not common in the sample schools. In all subjects, only a minority of pupils report any CAL experience. Even in mathematics, a subject commonly taught by Computer Studies teachers, 73% of pupils said they had never seen or used CAL materials. The data for CAL-experience in science are higher but this is explained, at least in part, by the fact that many pupils were taking two or three science-technology subjects. The finding that pupils have limited experience of CAL in all subjects with slightly higher frequencies in science & technology subjects matches data found in the author's 1984 study and other results quoted by Wellington (1987). Because most pupils lack experience of meaningful applications of microcomputers at home and in the general school curriculum, their experiences of microcomputers in Computer Studies lessons are potentially of great importance.

Analysis of the attitudes toward computers data

Part A of the Pupil Questionnaire contained the CARAQ scales, this was completed by about half the pupils in each of the 102 classes taking part in the pupil survey.

Using the returns of these 1163 pupils, the mean, standard deviation and alpha reliability for each of the eight scales were calculated. The data in Table 9.5 show the new scale SATISFACTION has comparable values of standard deviation and alpha reliability to the other scales.

Scale Name	N of items	Scale-Range Min.	Max.	Mean	SD	Alpha rel.
SATISFACTION	10	10	50	22.66	6.32	0.732
EMPLOY	11	11	55	32.50	7.91	0.810
THREAT	10	10	50	28.63	7.54	0.783
FUTURE	9	9	45	24.42	5.71	0.695
SOCIAL	11	11	55	31.80	7.11	0.731
CAREER	7	7	35	20.04	6.98	0.878
LEISURE	7	7	35	19.73	6.89	0.869
SCHOOL	9	9	45	19.63	5.74	0.769

Based on responses of 1163 students

Table 9.5: Summary statistics of responses to the Computers and Robots Attitude Questionnaire.

The values obtained for CARAQ scale reliablities are close to those reported in the validation study (Moore, 1984). Both sets of values are shown in Table 9.6. The finding of slightly lower values of scale reliability in the present study is attributed to the use of a more nearly homogeneous population. This characteristic may also explain the lower values of mean inter-scale correlations found in the present study if it is assumed that the more "specialist" population was better able to distinguish between the different attitudinal dimensions.

Scale Name	Alpha reliabilities Current	1984*	Mean Interscale corr. Current	1984*
SATISFACTION	0.732	---	0.477	----
EMPLOY	0.810	0.867	0.452	0.658
THREAT	0.783	0.811	0.400	0.500
FUTURE	0.695	0.750	0.340	0.436
SOCIAL	0.731	0.813	0.573	0.679
CAREER	0.878	0.878	0.526	0.626
LEISURE	0.869	0.902	0.521	0.619
SCHOOL	0.769	0.855	0.505	0.650

(*) Moore (Thesis, 1984)

Table 9.6 Comparison of CARAQ scale statistics in two studies.

Table 9.7 summarises results of t-tests on the CARAQ scales when pupils were sub-divided according to their gender and, in other tests, according to experience of CAL, use of a home computer and level of science subject choice. A full table of the results is given in the Appendix.

Boys had a more favourable attitude toward computers on all scales and Table 9.7 shows this was highly significant on all scales except SCHOOL and FUTURE for which the level of significance was 0.05. The strength of the gender effect on the CARAQ scores is a little surprising in light of results of studies reported in Chapter 2 which found that male-female differences were either non-significant or restricted to a few scales of a multi-scale battery. Previous work with the CARAQ had also found that gender effects were small when course group was controlled.

The data also showed that boys and girls with a high level of Home-use generally have more favourable attitudes toward computers. Table 9.7 shows the effect of home-use was significant at the 0.001 level on all scales for boys. Although the effect of homeuse on girls' attitudes on the scales THREAT and FUTURE was not significant. In both cases the group with the higher level of Homeuse had the more favourable mean score. The favourable effect of experience on attitudes was also found by Enochs and by Harvey & Wilson who worked with pupils aged about 12 years and also by Mohamedali et al with a non-specialist secondary school sample. It seems that Computer Studies lessons over a period of 15-22 months do not disturb a common pattern of experience-attitude relationships.

For both sexes, experience of CAL is significantly associated with favourable attitudes on the SCHOOL scale. This result shows that even at the low level of this type of computer use found in this study, CAL-experience in addition to that received in Computer Studies improves pupils' attitude to the school-use of computers. For girls only, CAL-experience also has significant correlations to the EMPLOY and CAREER scales. In looking to previous research to corroborate these findings, it is necessary to distinguish between computer assisted instruction (CAI) and more "open" forms of CAL now more often found in UK schools. Whilst CAI has generally shown no correlation with students' attitudes (Griswold, 1984), other forms of computer-based teaching have shown significant correlations, (Clarke, 1985). Thus the finding in the current study of a weak association between unspecified CAL experiences and attitudes is not at variance with previous research.

CARAQ Scale	T-test and Scheffe test results for sample subgroups							
	Gender		Home-use of micro		CAL-experience		Science Group test	
	B	G	Boys High/Low	Girls High/Low	Boys High/Low	Girls High/Low		
N	778	357	625/153	179/178	258/520	107/250		
SATISF.	0.001		0.001	0.01	NS	NS	3>2	2>1
EMPLOY	0.001		0.001	0.002	NS	0.001	3>2	2>1
THREAT	0.001		0.001	NS	NS	NS	3>1	2>1
FUTURE	0.05		0.001	NS	NS	NS	3>1	2>1
SOCIAL	0.001		0.001	0.005	NS	NS	3>2	2>1
CAREER	0.001		0.001	0.001	NS	0.001	3>2	2>1
LEISURE	0.001		0.001	0.001	NS	NS	3>2	2>1
SCHOOL	0.05		0.001	0.001	0.01	0.05	3>1	2>1

Note: Scheffe test
Group 1 Pupils taking neither Physics nor CDT/TD
Group 2 Pupils taking either Physics or CDT/TD (**not** both)
Group 3 Pupils taking both Physics and CDT/TD
> indicates "has a more favourable attitude than"

CAL Experience
High Exp group if at least one reponse of A few times, Quite Often or Very Often
Low Exp group otherwise

Home-use
High Use group if Arcade-games = Quite Often or Very Often or Programming = Quite Often or Very Often
Low Use group otherwise

Table 9.7 Summary of results of sub-group tests on CARAQ scales

Table 9.7 also shows the results of an analysis of variance (Scheffe procedure) of the attitudes of groups formed according to pupils' level of science & technology study. Three levels of sci-tech study were identified as (1) No sci-tech, in this group were placed pupils taking neither Physics nor CDT/TD, (2) Average sci-tech, this group contained pupils taking either Physics or CDT/TD, (3) High sci-tech, a group of pupils taking both Physics and CDT/TD. The results show that within the limits imposed by this conservative test, pupils in the high sci-tech group have the most favourable attitudes whilst "no sci-tech" pupils have the least favourable attitudes. These results agree with previous results obtained with the CARAQ mentioned in Chapter 2.

Analysis of the classroom environment data

A total of 1198 Part B booklets containing the ten classroom environment scales were obtained from the 102 classes involved in this part of the study. Because of an error in the printing of the Part B booklets six items were omitted from the classroom environment scales. Three items were from the scale INNOVATION and one from each of the scales INVOLVEMENT, TASK ORIENTATION and ORDER & ORGANISATION.

Scale Name	N of items	Scale-Range Min	Scale-Range Max	Mean	SD	Alpha Rel.
PERSONALISATION	10	10	50	29.65	6.80	0.785
PARTICIPATION	10	10	50	30.15	6.31	0.737
INDEPENDENCE	10	10	50	31.16	6.04	0.675
INVESTIGATION	10	10	50	25.33	5.88	0.746
DIFFERENTIATION	10	10	50	23.85	6.45	0.724
RESOURCES	10	10	30	22.41	5.08	0.744
INVOLVEMENT	9	9	27	17.34	4.89	0.588
TASK ORIENTATION	9	9	27	20.55	3.79	0.527
ORDER&ORGANISATION	9	9	27	18.50	5.57	0.807
INNOVATION	7	7	21	12.35	3.10	0.430

Data is based on responses of 1198 students.

Table 9.8: Summary statistics of responses to Classroom Environment Questionnaire

The mean, standard deviation and alpha reliability values for each of the ten CE scales are given in Table 9.8. The measured reliability values range from 0.43 to 0.81 with most values being around 0.7. Table 9.9. shows that the reliability data obtained for the ICEQ and CES scales in the current study are very similar to those obtained by Fraser & Fisher (1983) when the scales were used with 116 classes of Australian science students aged 14-16 years.

The data for the RESOURCES scale are comparable with those of the other scales; in particular the mean correlation with the other scales probably justifies treating this scale as a further measure of pupils' perceptions of the Computer Studies classroom.

Scale Name	Alpha Reliability Current	Alpha Reliability Fraser*	Mean Inter-scale corr. Current	Mean Inter-scale corr. Fraser*
PERSONALISATION	0.785	0.82	0.46	0.36
PARTICIPATION	0.737	0.78	0.42	0.35
INDEPENDENCE	0.675	0.78	0.16	0.16
INVESTIGATION	0.746	0.74	0.36	0.32
DIFFERENTIATION	0.724	0.72	0.21	0.29
RESOURCES	0.744	----	0.27	----
INVOLVEMENT	0.588	0.65	0.47	0.43
TASK-ORIENTATION	0.527	0.59	0.34	0.33
ORDER & ORGANISATION	0.807	0.74	0.45	0.40
INNOVATION	0.430	0.52	0.20	0.19

* Fraser, B.J. & Fisher, D.L. (1983), Assessment of Classroom Psychosocial Environment, Western Australia Institute of Technology.

Table 9.9 Comparison of statistics of Classroom Environment scales

Table 9.10 shows that gender differences in perceptions of the Computer Studies classroom environment were not large. Boys had more favourable perceptions on the RESOURCES and TASK ORIENTATION scales but these were significant only at the 0.05 level.

The Table also shows the effects of home-use of a microcomputer on pupils' perceptions of the classroom environment are different for boys and girls. For boys, Homeuse increases the level of perception of the PARTICIPATION and INVOLVEMENT dimensions. For girls, Homeuse is positively associated with the dimensions of INVESTIGATION, INVOLVEMENT and INNOVATION.

Classroom Environment Scale	T-test and Scheffe test results for sample subgroups					
	Gender	Home-use of micro		CAL-experience		Science
	B G	Boys High/Low	Girls High/Low	Boys High/Low	Girls High/Low	Group test
(N)	795 390	621/174	193/197	259/536	126/267	
PERSONALISATION	NS	NS	NS	0.002	0.005	NSD
PARTICIPATION	NS	0.005	NS	0.05	NS	NSD
INDEPENDENCE	NS	NS	NS	NS	NS	NSD
INVESTIGATION	NS	NS	0.001	0.005	0.05	NSD
DIFFERENTIATION	NS	NS	NS	NS	NS	NSD
RESOURCES	0.05	NS	NS	NS	NS	NSD
INVOLVEMENT	NS	0.005	0.05	NS	NS	NSD
TASK ORIEN.	0.05	NS	NS	NS	NS	NSD
ORDER & ORG	NS	NS	NS	NS	NS	NSD
INNOVATION	NS	NS	0.05	0.05	NS	NSD

Note: Science group test
Group 1 Pupils taking neither Physics nor CDT/TD
Group 2 Pupils taking either Physics or CDT/TD (**not** both)
Group 3 Pupils taking both Physics and CDT/TD
NSD indicates No Signicant Difference between groups was found

CAL Experience
High Exp group if at least one reponse of A few times, Quite Often or Very Often
Low Exp group otherwise

Home-use
High Use group if Arcade-games = Quite Often or Very Often
or Programming = Quite Often or Very Often
Low Use group otherwise

Table 9.10 Summary of results of sub-group tests on CE scales.

The data show that CAL-experience has quite similar effects on the classroom perceptions of boys and girls. The finding that the PARTICIPATION and INNOVATION tests reach the 0.05 level of significance for boys but are not significant for girls may be an effect of the smaller sample size in the girls' test. Although the differences do not reach the 0.05 level, in both cases, the group of girls with the higher CAL-experience had the higher mean scale-score. Table 9.10 also shows the results of Scheffe tests carried out on the ten scales according to pupils' membership of the science-technology groups defined above. No discrimination between the three groups was found by this test. It was concluded that in this sample and on these ten scales, the choice of science-technology subjects has no significant association with pupils' perceptions of the Computer Studies classroom environment.

The data described in this section show pupils' perceptions of the Computer Studies environment are largely independent of the variables of gender, home-use of a microcomputer, experience of CAL and the pupil's choice of science-technology subjects. These are significant results. If pupils' opinions about Computer Studies lessons are largely independent of external factors, it may be easier to detect differences arising from events within lessons.

Analysis of the Anxiety scale data

Word	Sign	Freq	Word	Sign	Freq	Word	Sign	Freq
absorbed		22	afraid	+	8	aimless		12
ambitious		45	annoyed		14	aware		23
bored		34	calm	-	21	careless		8
cautious		26	challenged		49	cheerful	-	16
cheated		6	comfortable		30	confused		24
contented		26	creative	-	42	curious		28
dedicated		29	desperate	+	10	disappointed		14
efficient		36	entertained		18	excited		18
fearful	+	6	fortunate		17	frightened	+	7
happy	-	19	hopeless		14	impatient		18
incapable		11	inspired		23	interested		54
joyful	-	14	lazy		20	loving	-	7
miserable		15	misplaced		11	nervous	+	17
organised		40	overloaded		17	panicky	+	15
pleasant	-	28	pleased		20	productive		37
pushed		13	refreshed		8	regretful		14
rewarded		35	satisfied		35	secure	-	23
serious		30	shaky	+	11	steady	-	23
tense	+	24	terrified	+	9	thoughtful	-	38
upset	+	8	weary		18	worried	+	16

Table 9.11 Data from Anxiety questionnaire (Parts A and B responses)

Table 9.11 shows the frequency of use of each of the 60 words in the Anxiety questionnaire. For each pupil, 1 mark was added to the Positive-Anxiety score each time a (+) word was underlined. One mark was added to the pupil's Negative-Anxiety score when a (-) word was underlined. Each pupil's Total-Anxiety score was calculated by the expression

(Total) Anxiety = (Positive-Anxiety) - (Negative-Anxiety) + 10

The table shows a wide range of frequencies of use of the active words in the list. The highest value is 42% for creative, this is closely matched by the 38% recorded for thoughtful. Both these are 'negative' words indicating absence of anxiety. Some positive anxiety words record quite low frequencies of use; these include fearful, (6%), frightened (7%), and afraid and upset at 8%.

The Anxiety scale differs from many other questionnaires in that respondents are under little pressure to respond to each word on the list. Hence if a list is returned with very few words underlined it is not apparent whether this is a true reflection of the respondent's anxiety or is the result of lack of attention to the questionnaire. Lack of attention could arise through time-pressure or the use of an over-long test-battery.

In light of the low frequencies observed for some words in the list, it is worth considering the effect of extremes of pupil behaviour on the resulting Anxiety Score. Four types of behaviour can be imagined.

Type 1 A pupil underlines all words in the list. This pupil receives a total of 11 for Positive-Anxiety from the ten + words, and a score of 10 for Negative-Anxiety for the ten - words. The pupil receives an Anxiety score of 11 - 10 + 10 = 11.

Type 2 A pupil ignores all words. This pupil has an Anxiety Score of 10

Type 3 A pupil underlines only the + words. The Anxiety score is 21.

Type 4 A pupil underlines only the - words. The Anxiety score is zero.

These examples serve to show that the Anxiety scale runs from zero indicating complete lack of anxiety to 21, representing extreme Anxiety. The scale mean is 10.5 and this is also the score that would be obtained from a random set of responses. Pupils who choose to ignore or to use all words also receive scores near the scale mean.

Source	N	Mean	SD	Max	Min	KR_{20}
Part A	1135	9.266	3.242	21	0	0.798
Part B	1186	9.146	3.356	21	0	0.794

Table 9.12 Summary statistics for Anxiety scale

Table 9.12 gives the range of scores and the mean score for groups of pupils answering the Anxiety scale in Part A and Part B of the Pupil Instrument. In both groups the full range of possible scores is obtained and the observed means are close to the scale mid-point. The scale reliabilities (KR_{20} values) are similar to those of other scales in the pupil instrument. The mean reliability value of almost 0.80 is close to the value of 0.83 obtained by Fraser et al (1983) working with middle school science students. The mean score at 9.2 is higher than the 8.3 found by Fraser et al whilst the value of 3.3 for the current standard deviation compared with 3.6 is lower. The results may indicate that 16 year olds are more worried about computers than 14-year olds are about science.

Further analyses of the Anxiety data were carried out on the Part A and Part B responses combined. T-tests were carried out on the mean scores of sample groups formed according to gender, home-use of a microcomputer and CAL-experience. The summary data in Table 9.13 show that boys have a lower level of Computer Anxiety than girls.

Table 9.13 shows for both boys and girls a higher level of Homeuse is associated with a lower level of Anxiety. This means that for both genders, the self-chosen activities of using a computer at home to play games or for extra programming have significant association with pupils' level of Computer Anxiety. It is perhaps surprising that this association is sufficiently strong to be detected in a sample of pupils all of whom have spent 15-20 months on Computer Studies and when the time spent in home-use may be quite short.

Variable	Group	N	Mean	S.D.	T-value	Sig.
Gender	Boys	1574	8.8977	3.378	-6.32	0.001
	Girls	747	9.8474	3.379		
HomeUse (Boys)	High	1246	8.6953	3.304	-11.14	0.001
	Low	327	9.6843	3.135		
HomeUse (Girls)	High	372	9.3333	3.376	-4.18	0.001
	Low	375	10.3573	3.307		
CAL-Exp (Boys)	High	517	8.7676	3.520	-0.86	NS
	Low	1056	8.9300	3.545		
CAL-Exp (Girls)	High	230	9.2304	3.195	-3.28	0.01
	Low	517	10.1219	3.531		

Table 9.13 Group comparisons on the Anxiety Scale

The data in Table 9.13 show that for boys experience of CAL is without much effect on their level of anxiety. In this instance the additional computer experience gained at school during CAL sessions is not detectable. For girls, additional CAL experience is associated with reduced levels of anxiety. The greater effect of CAL on girls' attitudes was noted previously in the data shown in Table 9.7.

Analysis of the attitude-to-job data

The analysis of the pupils' responses to the 29-scale semantic differential questionnaire on A Job or Career using a Computer followed the same pattern as for the teacher data. In the factor analysis of the pupil data, two factors were found accounting for 22% and 10% of the score variance. Table 9.14 shows the highest item loadings to the two factors.

Scale Descriptors (1)	(7)	Mean	Factor Loadings F1 (22%)	F2 (10%)
Valuable	Worthless	2.6811	0.566	
Tense	Relaxed	3.9725		
Successful	Unsuccessful	2.7654	0.568	
Involves much responsibility	Involves no responsibility	2.5616		0.419
Interesting	Boring	3.4371	0.399	
Unfriendly	Friendly	4.3435	-0.345	
Modern	Out-of-data	1.6362	0.563	
Safe	Risky	2.4371	0.534	
Comfortable	Uncomfortable	3.0119	0.528	
Difficult	Easy	3.4070		
Varied	Repetitive	3.8992		0.500
Authoritative	Participative	2.4977		0.300
Well-defined	Ill-defined	3.3537	0.396	
Needs imagination	Needs no imagination	3.5282		0.448
Necessary	Not necessary	3.2961	0.422	
Unpleasant	Pleasant	4.5108	-0.287	
Requires teamwork	No teamwork required	3.7421		0.324
Demanding	Undemanding	2.9869		0.398
Involves many things	Involves one thing	2.7713		0.520
Requires experience	No experience required	2.6984		0.586
Practical	Theoretical	4.2829		
Useful	Not useful	2.5565	0.569	
Technical	Non-technical	2.6938		0.376
Fits with other subjects	Does not fit with other subjects	3.2850	0.410	
Non-specialised	Specialised	5.1643		-0.468
Suitable everyone	Suitable few only	4.2397		
Active	Passive	4.5485		0.582
Healthy	Unhealthy	4.6785		0.431
Training needed	No special training	2.4182		0.596

Sample size 2361

Table 9.14 Summary of pupil responses and factor loadings for semantic differential scales "A Job or Career using a Computer"

Factor 1 is an evaluative factor, it includes valuable, modern, useful, and other value-judgement scales. Factor 2 includes both activity scales (such as healthy, many things) and potency scales (responsibility, experience, teamwork). It is worth noticing that although pupils included a total of 25 scales in the two factors compared with the 19 scales used by the teachers, the percentage of factored variance was almost the same. Both groups omitted the scales of Practical/Theoretical, Suitable Everyone/Suitable for few and Difficult/Easy

Statistics for the two JOBSCALES based on the factors are shown in Table 9.15. On both scales the mean score is less than the scale midpoint showing that pupils generally have a favourable opinion of a job or career that requires use of a computer. A similar result was found for the two Jobscores calculated from the teachers' responses. The reliabilities of the two jobscales of 0.84 and 0.74 are comparable with those of other scales in the pupil questionnaire. They are slightly higher than the reliabilities found for the two teacher jobscales, the difference is attributed to the greater number of bipolar scales included within each pupil factor.

	JOBSCORE1 (Factor1)		JOBSCORE2 (Factor 2)
N of scales (items)	12		13
Scale mid-point	48		52
Scale Mean	35.6		41.9
Scale stand. devn.	10.9		9.64
Alpha reliability	0.84		0.74
Inter-scale correlation		0.59	

Data from 2361 pupils

Table 9.15 Characteristics of two JOBSCOREs derived from pupil questionnaire "A Job or Career using a Computer"

A t-test was carried out on the JOBSCORE data to discover whether boys and girls have different conceptions of A Job or Career using a Computer. The results in Table 9.16 show boys and girls have very different views of a computer-related career or job when these are measured on the Evaluative factor (JOBSCORE1) but do not differ significantly in their views on the Potency & Activity factor (JOBSCORE2).

Variable	Group	N	Means	SD	T-value	Prob.
JOBSCORE1	Boys	778	36.0835	11.227	-3.51	0.000
	Girls	357	38.5238	10.729		
JOBSCORE2	Boys	778	41.7879	9.704	-0.78	0.433
	Girls	357	42.2549	9.136		

Table 9.16 T-test results for JOBSCORES of gender groups

Because the CAREER scale of the CARAQ instrument also measures pupils' ideas about working with a computer, it is of some interest to examine the correlations between pupils' scores on the two sets of scales. Table 9.17 shows all the correlations were positive confirming that a more favourable attitude on each CARAQ scale is associated with a more favourable concept of a job working with a computer. Generally the correlations between the JOBSCORES and the CARAQ scales are similar to the inter-scale correlations of the CARAQ instrument. The confirms that the two JOBSCORES belong to the same "attitude-space" as the scales of the CARAQ.

The highest correlation in Table 9.17 is between the CAREER and JOBSCORE1 scales. The observed correlation of 0.671 shows that a fraction of $(0.671)^2 = 0.45$ of the score variance is common to the two scales. This confirms that JOBSCORE1 is a valid but alternative measure of pupils'career aspirations. The CARAQ scale of SATISFACTION has the highest correlation with the JOBSCORE2 scale, i.e. the Potency-Activity dimension. This is an understanable association that confirms JOBSCORE2 as an additional attitude dimension.

	Correlations with CARAQ Scales (N = 1161)							
	SAT	EMP	THR	FUT	SOC	CAR	LEI	SCH
Jobscore1	616	498	389	347	593	671	609	533
Jobscore2	412	247	162	288	351	380	356	352

Decimal points omitted. All correlations were significant $p<0.001$

Table 9.17 Correlations between Jobscore and CARAQ scales

The Interest in Computer-Studies data

Pupils were asked to complete a two-part item to indicate the level of their interest in Computer Studies at the time they selected the subject and how this interest had changed over the period of the course. The first part of the item asked pupils to indicate their interest in computer studies <u>at the time they selected their optional subjects</u>. For most pupils this would have been almost two years previously. For their response, pupils were asked to select one answer from "Very Keen", "Quite keen", "Didn't mind", "Not very interested", and "There wasn't another choice".

The second part of the item read "Compared with the time you started CS, how interested are you now?" Again a five-point response scale was provided, "Much more interested", "A little more interested", "About the same", "A litle less interested", and "Much less interested".

A cross-tabulation of the responses to the two parts of the item is given in Table 9.18. Four regions of the table can be distinguished. At the top left-hand corner there is a pleasingly large group of pupils who had and retain considerable interest in Computer Studies. In the bottom right-hand corner there is a much smaller group of pupils who expressed lack of interest in CS both at the time they "chose" the subject and at the present time. The bottom left-hand corner of the table is almost empty, it shows that very few pupils who started without an interest in CS have been won over to a more interested state. Finally there is in the remaining top right-hand part of the table, a moderately large group of pupils who started with keen or very keen interest and who are now a little less

Interest in Computer Studies

Score	THEN	Score	NOW: Much more interest (1)	A little more interest (2)	About the same (3)	A little less interest (4)	Much less interest (5)	Totals Boys Girls
(1)	Very Keen	Boys	155	164	153	96	61	629
		Girls	29	39	37	35	19	159
(2)	Quite Keen	Boys	71	163	215	164	111	714
		Girls	36	94	114	120	68	432
(3)	Didn't Mind	Boys	9	32	47	26	41	155
		Girls	2	19	27	20	25	93
(4)	Not very Int'rstd	Boys	2	4	10	3	8	27
		Girls	1	6	7	2	14	30
(5)	No other Choice	Boys	1	6	3	4	22	36
		Girls	3	10	6	2	7	28
	Totals	Boys	238	369	428	293	243	1571
		Girls	71	168	191	179	133	744

Table 9.18 Cross-tabulation table of Interest in Computer Studies when the subject was chosen ("THEN") against present interest ("NOW")

interested or much less interested in CS. The size of this group shows that a substantial number of pupils are dissatisfied with their experiences in Computer Studies. The loss of interest of this group may simply be an expression of the well-known loss in pupils' attitudes to all subjects as they move through the secondary school. There is however a possibility that the decline may be linked to one or more of the measured pupil, classroom or teacher variables.

Summary

Completed questionnaires were obtained from 2300 pupils in 102 classes. Data on the frequency and type of pupils' Homeuse of a microcomputer and experience of CAL at school agreed with data for more general school populations quoted elsewhere. Descriptive statistics for the eight CARAQ scales and the ten classroom environment scales indicated they gave reliable and valid measures of Computer Studies pupils' attitudes and perceptions. The Anxiety scale and the two JOBSCOREs were also shown to give valid and reliable assessments of pupils' attitudes.

From the CARAQ scores boys were shown to have more favourable attitudes toward computers on all scales. Use of a homecomputer and experience of CAL at school generally improved the attitudes of both boys and girls though in some instances the differences in the group means were not significant. For girls only, experience of CAL had a highly signficant effect on the CAREER scale. On the scale of Computer Anxiety boys had lower scores than girls. Pupils' perceptions of the classroom environment were found to be largely independent of gender, Homeuse, CAL-experience and choice of science subjects.

Analysis of responses to the job questionnaire showed a two factor structure. On one factor, evaluation, boys had a significantly more favourable score whilst on the other factor, potency-activity, there was no gender difference. It was shown that over the time pupils had being taking Computer Studies a large group of pupils had retained or increased their initial interest in the subject whilst another moderately large group showed a decline in interest.

CHAPTER 10

THE EFFECT OF TEACHER AND PUPIL VARIABLES ON PUPILS' ATTITUDES TOWARD COMPUTERS AND PERCEPTIONS OF THE COMPUTER STUDIES CLASSROOM ENVIRONMENT

Multiple regression analysis

Multiple regression analysis was used to study possible relationships between teacher, classroom and pupil variables. Multiple regression analysis seeks to predict one or more criterion variables (here the various dimensions of pupils' attitudes) on the basis of a number of independent predictor variables (teacher characteristics, teaching style and pupil characteristics). Classroom environment variables were criterion variables in some investigations and predictor variables in others.

All the analyses employed the technique of backward elimination which commences with all variables included in a trial regression equation that predicts a value of the criterion variable. Variables not making a significant contribution to the predicted value of the criterion score variance are then successively removed from the equation. At each step the least significant variable is removed until all remaining variables reach the pre-chosen significance level with the adjusted equation. The significance of the final regression equation is estimated from the R^2 value, the fraction of the criterion variable score that is matched by the value calculated from the regression equation.

Because the regression equations include the effects of inter-variable correlations a variable may be omitted from the final regression equation if it has a high correlation with other variables. If two predictors are highly correlated with each other, one will necessarily attract a low importance in the regression equation because some of its effect will be have been included with the other. Interaction effects sometimes make it difficult to identify the relative importance of variables within an equation.

Each regression equation is an interdependent structure and it is necessary to be cautious when attempting to identify the importance of individual predictors within it. In the present study analysis was limited to identifying the variables included in the equations of several criterion variables. It is suggested that these are the variables that should be investigated when considering how attitude changes may be brought about.

Conversion of variables

Nominal and categoric data were converted to dichotomous (binary) form before being included in the regression analysis.

Pupils' choice of school subjects was used to generate two dichotomous variables SCGP (representing science group membership) and ARTSGP (for arts group membership). The new variables were defined by the equations

SCGP = 1 if pupil chooses two or more from physics, chemistry, CDT
= 2 otherwise

ARTSGP = 1 if pupil chooses two or more from Hist/Geog, Art, DomSci,Craft
= 2 otherwise

Pupils' home-use of a micro was also converted to binary form

BHUSE1 = 2 if the home-use of a micro for games was given as Never
= 1 otherwise

Variables of BHUSE2, BHUSE3 and BHUSE4 were similarly defined according to the home-use of a micro for educational games, school work and programming respectively.

Similarly, pupils' experience of CAL in mathematics, science, languages, art and crafts were used to define variables, BCAL1, BCAL2, BCAL3, BCAL4 and BCAL5. A further variable BTCAL (total CAL as a binary variable) was computed to represent total experience of CAL.

BTCAL = 1 if the pupil responded A few times, Quite often, or Very often to any CAL item
BTCAL = 1 if the pupil gave two or more responses of Occasionally

BTCAL = 2 otherwise

Because the study of Office Practice frequently includes the use of a word processor, pupils' responses of 0 or 1 to this subject category were included as a binary variable OFFPR in some of the regression analyses.

The effect of pupil and teacher variables on pupils' attitudes toward computers

In these analyses the criterion variables were the pupils' scores on the eight computer attitude scales of SATISFACTION, EMPLOY, FUTURE, THREAT, SOCIAL, CAREER, LEISURE and SCHOOL. In each analysis the predictor variables were teacher and pupil personal characteristics. For the teachers these were gender and the three canonical discriminant functions CDF1,2,3. The pupil variables used were gender, subject choice as SCGP, ARTSGP and OFFPR and the nine binary variables showing use of a home computer and experience of CAL.

Table 10.1 shows the results of the eight regression analyses, one for each criterion variable. The table shows a considerable number of significant correlations between teacher and pupil characteristics and pupils' scores on the eight attitude scales. The maximum correlation shown in the table is 0.342 between BHUSE4 (Use of a home-computer for programming) and the scale LEISURE. The pupil variable BHUSE4 also has significant values of correlations with all other attitude scales. The CAL-variables have smaller correlations with the eight criterion variables. The table also shows that generally the teacher variables have low correlations with pupils' attitudes.

Predictor Variables	Criterion variables: Pupils' attitudes to computers (*)							
	SAT	EMP	THR	FUT	SOC	CAR	LEI	SCH
PSEX	**179**	**200**	**162**	043	147	**175**	**272**	060
TSEX	013	-005	-016	-021	-017	037	050	037
CDF1	**073**	-028	-017	048	009	043	**059**	**062**
CDF2	**-072**	-071	**-074**	000	-039	007	-024	-060
CDF3	**058**	-044	-015	021	-024	025	015	018
BHUSE1	**072**	124	071	062	067	**082**	**074**	070
BHUSE2	143	123	093	095	128	**190**	**226**	152
BHUSE3	**220**	**214**	**144**	**131**	**213**	**290**	**316**	**210**
BHUSE4	**280**	**278**	**166**	**165**	**249**	**311**	**342**	**275**
BCAL1	-015	012	-014	021	-017	037	033	017
BCAL2	065	107	046	012	046	067	**120**	080
BCAL3	**-083**	**-060**	-037	022	**-058**	**-050**	**-050**	014
BCAL4	009	007	006	-003	016	016	001	030
BCAL5	**013**	011	005	020	-008	**042**	000	063
SCGP	**220**	**236**	**175**	**081**	**195**	**198**	**252**	**132**
ARTSGP	069	**119**	073	-001	**096**	**118**	**071**	027
OFFPR	-008	-057	-043	**046**	-027	-029	021	021
BTCAL	043	**061**	015	031	021	051	048	**096**
R^2%, initial eqn	16	15	7	4	12	18	25	12
R^2%, final eqn	15	15	6	4	11	18	24	10

Notes: Decimal points omitted
See text for definitions of variables BHUSE1 to BTCAL
Variables used in the final regression equation shown in **bold**
(*) Variables are SATISFACTION, EMPLOY, THREAT, FUTURE, SOCIAL, CAREER, LEISURE and SCHOOL
N = 1006, correlations with an absolute value > 0.081 are sig. at $p < 0.01$, correlations >0.062 are sig. at $p < 0.05$.

Table 10.1 Table of correlations between eight dimensions of pupils' attitudes toward computers and 18 teacher and pupil variables

Table 10.2 shows the variables included in the final regression equation. Positive (negative) signs are used to indicate that an increase (decrease) in the predictor variable (LH-side) is associated with a more (less) favourable attitude on the criterion variable. In the gender rows, a positive sign indicates male, in the group variables SCGP, ARTSGP, OFFPR and BTCAL, a + sign indicates membership of that group/subject. A blank in the table shows the predictor variable is not included in the final regression equation of the criterion variable.

Predictor Variables	(*)Criterion Variables: Pupils' attitudes toward computers							
	SAT	EMP	THR	FUT	SOC	CAR	LEI	SCH
PSEX	+	+	+			+	+	
TSEX								
CDF1	+						+	+
CDF2	-		-					
CDF3	+							
BHUSE1	-					-	-	
BHUSE2						+	+	
BHUSE3	+	+	+	+	+	+	+	+
BHUSE4	+	+	+	+	+	+	+	+
BCAL1								
BCAL2							+	
BCAL3	-	-			-	-	-	
BCAL4								
BCAL5	+					+		
SCGP	+	+	+	+	+	+	+	+
ARTSGP		+			+	+	+	
OFFPR				+			+	
BTCAL		+						+
R^2%, initial eqn	16	15	7	4	12	18	25	12
R^2%, final eqn	15	15	6	4	11	18	24	10

Note: See text for definitions of variables BHUSE1 to BTCAL
(*) Variables are SATISFACTION, EMPLOY, THREAT, FUTURE, SOCIAL, CAREER, LEISURE and SCHOOL

Table 10.2 Showing variables included in the regression equations using teacher and pupil variables as predictors of pupils' attitudes toward computers.

Example The table shows that a high level of pupil SATISFACTION is associated with:

higher CDF1 and CDF3 values from the teacher
a lower CDF2 value from the teacher
boys, the + sign shows boys have the more favourable attitudes
a lower value of BHUSE1, ie less home-micro use for arcade games
a higher value of BHUSE3, ie more home-micro use for school work
a higher value of BHUSE4, ie more home-micro use for programming
a lower value of BCAL3 ie less experience of CAL in language teaching
a higher value of BCAL4 ie more experience of CAL in arts subjects
a higher value of BCAL5 ie more experience of CAL in craft subjects
SCGP, membership of the science group ie the taking or two or more science/technology subjects
The final regression equation accounts for 15% of the SATISFACTION scale score variance.

Some features of Tables 10.1 and 10.2 merit comment.

1. The most significant variables across all eight attitude dimensions are BHUSE3, BHUSE4 and SCGP as these are included in the final regression equation of every one of the eight attitude scales. The results show significant associations between use of a home computer for school work and for programming, the studying of science and technical subjects and having favourable attitudes toward computers. The tables of regression equation data (Appendix) show these variables have the highest weightings in the final equations. The importance of these three variables was also noticed in the t-test tables given in Chapter 9.

2. The finding that boys have more favourable attitudes than girls agrees with previous research on attitudes toward computers. It is however a little surprising that in the regresion equations of five attitude scales (SATISFACTION, EMPLOY, THREAT, CAREER and LEISURE) both pupil gender and science group membership are included. Previous research quoted in Chapter 2, including that with the CARAQ scales, has shown that pupil gender is not significant when group membership is controlled. This is not the case here. Although the inclusion of the variable SCGP in the regression equation might be expected to take account of group membership, pupil gender still makes a significant contribution to the prediction.

3. The significance of the inclusion of variable BCAL3 in five equations is not understood since only 6.4% of pupils report experience of CAL in languages and the higher percentages of CAL use in science and mathematics are without equivalent effects.

4. Teacher gender was included in none of the regression equations predicting pupils' scores on the eight attitude scales. The absence of an association between gender, a basic teacher variable, and pupils' attitudes supports the findings of Druva & Anderson (1983) that teacher variables have only weak or insignificant associations with pupil learning outcomes. It also justifies the decision not to include a study of other teacher personal variables in the current research.

Teachers' characteristics as measured by the three CDF variables were found to play only a small part in the determination of pupils' attitudes other than that of SATISFACTION for which all three CDFs are included in the regression equation. Pupils' attitudes on this scale are improved if teachers:

are concerned about their subject and use a wide range of teaching aids (+CDF1)

make use of computer hardware and relatively less use of books and worksheets (-CDF2)

use pupil-centred activities and are concerned about pupils' career and leisure interests (+CDF3).

Pupils have more favourable attitudes on the scale THREAT (i.e. they feel <u>less</u> threatened by computers) if the teacher has a lower score on CDF2, i.e. if the teacher makes <u>more</u> use of computer hardware.

The low values of the correlation coefficients shown in Table 10.1 suggest that the CDFs play only a minor part in the regression equations for pupils' attitudes. This was confirmed by carrying out separate analyses that excluded these variables. For the scale SATISFACTION the value of R^2 fell from 0.14 to 0.13 whilst for the scales THREAT, CAREER and LEISURE it remained at the same value.

5. The variable ARTSGP (pupil is taking two or more Arts subjects) was <u>positively</u> correlated with pupils' attitudes toward computers. Thus ARTSGP is not an opposite of Science Group.

6. The predictive power of the final regression equation varies across the attitude dimensions, it is not very strong in any case. For the four scales of THREAT, FUTURE, SOCIAL and SCHOOL the R^2 value is at or below the 10% level, it appears that these dimensions of pupils' attitudes are only slightly related to the teacher and pupil characteristics considered here.

The effect of teacher and pupil characteristics on pupils' perceptions of the computer studies classroom environment

In these analyses the criterion variables were the ten dimensions of classroom environment whilst the predictor variables were the same 18 teacher and pupil characteristics used in the previous section. The results of the analyses are shown in Tables 10.3 and 10.4.

Predictor Variables	(*) Criterion variables: Pupils' classroom perceptions									
	RES	INV	T-O	O&O	INN	PER	PAR	IND	VES	DIF
PSEX	-038	071	**-056**	049	007	-008	051	036	057	**010**
TSEX	**099**	050	**-114**	043	052	010	**052**	**160**	**-050**	**130**
CDF1	057	**087**	**049**	**142**	**079**	**096**	039	**104**	**098**	039
CDF2	**-197**	030	-017	**-073**	046	**093**	**041**	**023**	039	**119**
CDF3	026	**054**	022	**045**	**049**	**050**	**054**	**-082**	**066**	**097**
BHUSE1	**061**	051	026	034	022	024	075	028	066	030
BHUSE2	040	**163**	**091**	**092**	**104**	**110**	**164**	020	**190**	016
BHUSE3	031	**143**	**080**	088	**108**	**165**	**156**	**073**	**170**	021
BHUSE4	043	**136**	072	**105**	064	086	**151**	**029**	**163**	**075**
BCAL1	-004	**-046**	-014	**-085**	**086**	046	037	**-050**	085	043
BCAL2	-018	051	-003	**042**	012	075	069	020	034	001
BCAL3	**080**	011	019	-013	060	027	005	012	042	-014
BCAL4	-016	034	-006	033	031	**086**	050	**061**	018	031
BCAL5	056	**058**	036	033	074	101	**071**	-058	**117**	**044**
SCGP	**-061**	**091**	-021	057	014	007	059	**073**	016	**-040**
ARTSGP	-028	032	-019	-026	025	-006	029	040	-037	019
OFFPR	049	-040	011	009	-026	012	-013	-002	037	-004
BTCAL	014	019	-007	-028	078	**114**	067	-013	**100**	033
R^2%, initial	6	7	4	6	4	7	6	7	10	7
R^2%, final	6	6	4	6	3	7	6	6	9	6

Notes: Decimal points omitted
See text for definitions of variables BHUSE1 to BTCAL
Variables used in the final regression equation shown in **bold**
(*) Classroom environment scales are RESOURCES, INVOLVEMENT, TASK-ORIENTATION, ORDER & ORGANISATION, INNOVATION, PERSONALISATION, PARTICIPATION, INDEPENDENCE, INVESTIGATION and DIFFERENTIATION
N = 1031, correlations with an absolute value > 0.081 are sig. at $p < 0.01$, correlations >0.062 are sig. at $p < 0.05$.

Table 10.3 Table of correlations between ten dimensions of pupils' classroom environment perceptions and 18 teacher and pupil variables

Table 10.3 shows that most correlations between teacher and pupil characteristics and perceptions of the classroom environment have a small value. The maximum value in the table is approximately 0.200 compared with values in excess of 0.3 found in Table 10.1. .In contrast to Table 10.1 Table 10.3 shows that variables associated with the teacher have correlation values comparable with those of variables measuring pupils' use of a home computer and their experience of CAL.

Table 10.4 shows only the variables retained in the regression equations. The signs have the same significance as given for Table 10.2.

Predictor Variables	(*) Criterion variables: Pupils' classroom perceptions									
	RES	INV	T-O	O&O	INN	PER	PAR	IND	VES	DIF
PSEX			-							+
TSEX	+		-				+	+	-	+
CDF1		+	+	+	+	+		+	+	
CDF2	-			-		+	+	+		+
CDF3		+		+	+	+	+	-	+	+
BHUSE1	+									
BHUSE2		+	+	+	+	+	+		+	
BHUSE3		+	+		+	+	+	-	+	
BHUSE4		+		+			+	+	+	-
BCAL1		-		-	+			-		
BCAL2				+						
BCAL3	+									
BCAL4						+		+		
BCAL5		+					+		+	+
SCGP	-	+						+		-
ARTSGP										
OFFPR										
BTCAL						+			+	
R^2%, initial	6	7	4	6	4	7	6	7	10	7
R^2%, final	6	6	4	6	3	7	6	6	9	6
R^2%, Ex-CDFs	3	5	3	2.5	3	4.5	5	5	7	2.5

Note: See text for definitions of variables BHUSE1 to BTCAL
Variables used in the final regression equation shown in **bold**
(*) Classroom environment scales are RESOURCES, INVOLVEMENT, TASK-ORIENTATION, ORDER & ORGANISATION, INNOVATION, PERSONALISATION, PARTICIPATION, INDEPENDENCE, INVESTIGATION and DIFFERENTIATION

Table 10.4 Showing teacher and pupil variables included in the regression equations predicting pupils' perceptions of the classroom environment.

Example: in the case of the TASK-ORIENTATION scale, Table 10.4 shows that pupils perceive the classroom as more task-oriented when:

the pupil is female
the teacher is female
the teacher has a high CDF1 score
the pupil makes more use of a home-micro for educational games (BHUSE2)
the pupil makes more use of a home-micro for school work (BHUSE3)

These five variables make up the final regression equation; this equation predicts 4% of the score variance on the TASK-ORIENTATION scale.

Some other features of Tables 10.3 and 10.4 merit comment.

1. One or more variables of Homeuse of a microcomputer is correlated with each of the classroom environment dimensions. Playing games (BHUSE1) is the least important home-use variable.

2. The variables BCAL1 (CAL for mathematics)and BCAL5 (CAL for crafts) are each associated with four classroom environment variables. This pattern contrasts with that for pupils' attitudes toward computers (Table 10.2) for which only BCAL3 (CAL for languages) was related to several scales. Although increased use of CAL in mathematics increases pupils' perception of the level of INNOVATION, it reduces perceived levels of INVOLVEMENT, ORDER & ORGANISATION, and INDEPENDENCE. The variable BCAL5, use of CAL in craft subjects, has a positive correlation with four scales. The difference between the effects of CAL in mathematics and in craft subjects may be linked to a marked difference in the mode of use of the resource in these subjects.

3. Pupils' perceptions on the scales of RESOURCES, PARTICIPATION, INDEPENDENCE and DIFFERENTIATION are increased by male teachers whilst female teachers are associated with higher perceptions of TASK ORIENTATION and INVESTIGATION.

4. Teachers who have a high weighting on the composite variable CDF1 are associated with high pupil scores on all but three classroom

environment scales. The variable CDF1 may also be linked with the scales of RESOURCES, PARTICIPATION and DIFFERENTIATION through their indirect association with male teachers who have the greater industrial experience.

5. The negative association of CDF2 with the scale RESOURCES is as expected. High scores on CDF2 are obtained by teachers who make less than average use of computer resources, therefore the negative entries for CDF2 confirm that the non-use of computer equipment is accompanied by lower levels of RESOURCES and ORDER & ORGANISATION. Other results for CDF2 suggest that teachers are able to personalise their lessons, differentiate between pupils and also increase levels of pupil participation and independence when there is less use of equipment and more use of books and worksheets.

6. Chapter 8 showed that high CDF3 scores are obtained by teachers who make above average use of pupil-centred activities and who take an interest in pupils' career choices and leisure interests. Table 10.4 shows the expected result that CDF3 scores are positively associated with the CE scales of INVOLVEMENT, PERSONALISATION, PARTICIPATION, INVESTIGATION and DIFFERENTIATION.

7. The regression equations predicting pupils' perceptions of the classroom environment contain from five to nine of the 18 teacher and pupil characteristics. Despite the inclusion of several variables, the equations predict only a small part of the score variance. For none of the CE-scales does the R^2 value exceed 10%. The contribution of the teacher variables CDF1, 2 and 3 to the predicted CE score variance may be estimated from the R^2(Ex CDFs) values given at the foot of Table 10.4.

The effect of teachers' activities on pupils' attitudes toward computers

Although teacher and pupil variables such as gender, industrial experience, and home-use of a microcomputer are outside the control of the class teacher and cannot be manipulated to promote desired attitude changes, teachers may be able to modify their teaching activities to promote desired changes. It is therefore worthwhile to carry out analyses using teachers' activities as the predictor variables. In these analyses the criterion variables were the means of the attitude scores for each class whilst the predictor variables were the 19 Activity-scores of the individual teachers. The sample size was 102, the number of teachers who completed a teacher booklet and also allowed one or more of their classes to answer the pupil questionnaire. A class-level approach is conceptually correct since all the pupils in a class receive the benefit of the same teaching activities.

Teachers' Activity scales	SATIS.	Pupils' Attitudes to computers EMPLOY.	THREAT	FUTURE	SOCIAL	CAREER	LEISURE	SCHOOL
01 Gen.Tch; books	-106	**-136**	-068	-014	-015	-053	017	-046
02 Gen.Tch; notes	-011	-081	-021	**-044**	-033	-059	+048	-040
03 Diffrn of work	-004	**-181***	-074	-023	-096	044	004	028
04 Interest in C/L	**131**	-082	-196*	**318****	-055	038	095	085
05 St.controlled exs	044	-128	**-132**	**-077**	**-108**	105	094	-023
06 Ideas from other T	110	-105	-066	072	-024	053	080	161
07 Non-comp AV aids	-001	-002	039	-005	085	026	-040	-030
08 Use of micro,networks	140	-092	-084	-018	-030	-085	-012	048
09 Microelectronics	**212***	026	**274****	-057	**215***	060	073	026
10 Computer hardware	124	008	087	086	156	111	065	077
11 Worksheet exs	**-111**	-187*	-179*	049	-099	-023	054	-077
12 Student involvement	118	**099**	-056	160	050	118	112	061
13 Student contacts	015	-098	-151	085	-095	-048	007	-009
14 T resource concern	159	**028**	-027	**200***	076	081	083	140
15 Use of CAL packages	171*	-132	039	030	035	069	076	132
16 T. does sch admin	196*	-075	-008	099	-032	-039	135	173*
17 Use of dp packages	128	**-149**	-017	023	-013	098	103	094
18 INSET,help other T	214*	-011	027	071	085	080	079	**205***
19 LOGO, CAD,teletext	048	-151	**-107**	-018	-025	-030	-019	020
R^2 regression equation %	10	15	16	22	7	zero	zero	4
Multiple correlation	315	392	400	465	270	000	000	205
F-value of regress. eqn	016	006	<001	<001	024	---	---	040

Notes: Decimal points omitted.
* significant at p = 0.05, ** p = 0.01   N = 102
Variables retained in the regression equation shown in **bold**

Table 10.5   Correlations between pupils' attitudes toward computers and teachers' Activity-scale scores.

Tables 10.5 and 10.6 show the results of these analyses. Table 10.5 shows the values of the correlations between teachers' scores on the 19 Teaching Activities and pupils' scores on the eight CARAQ scales. The table shows that only 14 of the 152 correlations reach the 0.05 level of significance. Ten of the 19 Activity scales have no significant correlation with any attitude dimension. The highest correlation is 0.32 between Activity 4 (Teacher shows interest in pupils' career and leisure interests) and the FUTURE scale. This high value makes it a little surprising that the same Teacher Activity does <u>not</u> have a significant correlation with either the CAREER or LEISURE scales. The Table shows neither of these two attitude scales has a significant correlation with any Teacher Activity.

Regression equations based on the 19 Teaching Activities predicted from zero to 22% of the attitude score variance. Table 10.6 emphasises that the number of significant criterion-predictor relationships was only a small fraction of the possible number and was confined to a few Activities,

Scale No.	Abbreviated Activity description	Computer Attitude scales* SAT	EMP	THR	FUT	SOC	CAR	LES	SCH
1	Gen.teaching,books		-						
2	Gen.teaching,notes				-				
3	P-Differentiation		-						
4	T-interest in p's	+			+				
5	P-directed exs.			-	-	-			
6	New teaching ideas								
7	Non-micro AV aids								
8	Network, word-p								
9	Microelectronics	+		+		+			
10	C.hardware								
11	Worksheets	-							
12	P. help in lessons		+						
13	P seek info' on c.								
14	T seeks resources		+		+				
15	Use of software								
16	T helps school admin								
17	DP and comm. prgrs		-						
18	Academic concerns								+
19	LOGO,CAD, Teletext			-					
R^2% final regression eqn		10	15	16	22	7	0	0	4

(*) Variables are SATISFACTION, EMPLOY, THREAT, FUTURE, SOCIAL CAREER, LEISURE and SCHOOL

Table 10.6 Showing variables included in the regression equations using teacher Activities as predictors of pupils' attitudes toward computers only <u>four</u> had significant associations with two or more attitude dimensions. Two of the four Activities were concerned with use of resources. The other two, Direction of pupil work and Teacher interest in pupils, were mentioned as significant in the findings of McGarity & Butts (1984). The zero R^2 value of CAREER and LEISURE shows these two attitudes are not predictable from the Teachers' Activity scores although they had the highest percentages of predicted variance when teacher and pupil personal characteristics were used as the predictors (in Table 10.2). It is interesting to notice that the two highest R^2 values in Table 10.6 were for the dimensions of FUTURE and THREAT which showed the lowest values when teacher and pupil personal characteristics were employed as the predictor variables (Table 10.2).

The regression equations account for 10% or less of the score variance on five of the eight attitude dimensions. This agrees with the finding of Sweitzer & Anderson (1983) that the effects of teachers' classroom activities on pupil outcomes are small and often insignificant.

The effects of teachers' classroom activities on pupils' perceptions of the computer studies classroom environment

The interactions between teachers' activities and pupils' perceptions of the classroom environment are represented in Tables 10.7 and 10.8. Table 10.7 shows that Teachers' Activities have 37 significant interactions with classroom environment variables of the possible number of 190. Two Activities (Nos 2 and 19) are without a significant correlation and one classroom environment measure, PARTICIPATION, is related to none of the 19 Teacher Activities. Table 10.8 shows only the interactions of variables retained in the final regression equation of each classroom perception scale.

Teachers' Activity Scale scores	(*) Classroom environment scales Rsrcs.	Invol.	TaskOrn	Ord&Org	Innov	Pers.	Part.	Indep.	Inves.	Diff.
1 Gen.Tch; books	-181*	013	094	-017	-025	-058	-106	002	028	**-108**
2 Gen.Tch; notes	-036	022	032	096	**-013**	-004	-006	091	138	021
3 Diffrn of work	-081	108	-061	021	128	176*	063	133	080	**282****
4 Interest in C/L	-098	108	024	096	183*	**218***	117	004	187*	058
5 St.controlled exs	-038	**193***	061	164*	228*	221*	162	109	207*	**320****
6 Ideas from other T	171*	153	032	141	**235****	148	068	123	100	091
7 Non-comp AV aids	175*	**175***	**207***	**261****	051	076	072	017	148	-016
8 Use of micro,ntwks	**265****	065	141	169*	**257****	118	076	042	184*	095
9 Microelectronics	155	119	174*	195*	060	094	094	-038	185*	005
10 Computer hardware	070	123	081	146	181*	112	082	031	**252****	111
11 Worksheet exs	-078	062	064	-010	**198***	111	057	020	135	141
12 Student involvment	**-236****	-011	-031	091	020	058	005	092	124	092
13 Student contacts	-109	**-040**	**-098**	001	106	075	-021	**201***	019	073
14 T resource concern	-078	044	093	133	148	136	-006	076	200*	079
15 Use of CAL packages	178*	074	147	243**	148	**166***	050	**-092**	198*	-014
16 T. does sch admin	188*	-030	004	112	**-062**	-077	-095	024	-028	009
17 Use of dp packages	113	097	086	166*	152	091	041	078	136	**031**
18 INSET,help otherT	143	040	007	174*	010	-061	-036	**218***	008	001
19 LOGO,CAD,teletext	148	-034	143	096	141	**-059**	-084	-038	036	-084
R^2 reg. equation %	16	9	7	7	19	10	zero	11	6	21
Multiple corr.	398	294	269	261	434	324	000	326	252	461
F-value reg. eqn	≤001	030	024	008	001	012	---	011	011	≤001

Notes: Decimal points omitted.
* significant at p = 0.05, ** p = 0.01 N = 102
Variables retained in the regression equation shown in **bold**
(*) Classroom environment scales are RESOURCES, INVOLVEMENT, TASK-ORIENTATION, ORDER & ORGANISATION, INNOVATION, PERSONALISATION, PARTICIPATION, INDEPENDENCE, INVESTIGATION and DIFFERENTIATION

Table 10.7 Correlations between pupils' classroom environment perceptions and teachers' Activity-scale scores.

Some of the activity-perception relationships shown in Tables 10.7 and 10.8 agree with prior expectation. For example

Activity No. 1 "use of textbooks" has a negative effect on DIFFERENTIATION

Activity No. 4 "teachers' interest in pupils' careers...' has a positive effect on PERSONALISATION

Activity No. 5 "use of pupil-directed ..."is positively associated with DIFFERENTIATION and INVOLVEMENT

Activity No. 10 "use of hardware..." is associated with higher levels of INVESTIGATION

Activity No. 13 "pupils seek information for themselves..." is positively associated with INDEPENDENCE and negatively associated with TASK ORIENTATION.

This last Activity has a negative association with INVOLVEMENT.

Scale No.	Abbreviated Scale description	RES	INV	TO	O&O	INN	PER	PAR	IND	VES	DIF
		Classroom perception scales*									
1	Gen.teaching,books										-
2	Gen.teaching,notes					-					
3	P-Differentiation										+
4	T-interest in p's						+				
5	P-directed exs.		+								+
6	New teaching ideas					+					
7	Non-micro AV aids		+	+	+						
8	Network, word-p	+				+					
9	Microelectronics										
10	C.hardware									+	
11	Worksheets					+					
12	P. help in lesson	-									
13	P seek info' on c.		-	-					+		
14	T seeks resources										
15	Use of software						+		-		
16	T helps school admin					-					
17	DP and comm. prgrs										-
18	Academic concerns								+		
19	LOGO, CAD, Teletext						-				
R^2% final regression eqn		16	9	7	7	19	10	0	11	6	21

(*) Classroom environment scales are RESOURCES, INVOLVEMENT, TASK-ORIENTATION, ORDER & ORGANISATION, INNOVATION, PERSONALISATION, PARTICIPATION, INDEPENDENCE, INVESTIGATION and DIFFERENTIATION

Table 10.8: Regression analysis of teacher activity-scale scores as predictors of pupils' perceptions of the Computer Studies classroom environment.

Only a few Teaching Activities were associated with more than one CE dimension. It is interesting that one of the most significant predictors of CE scores was Activity No. 7, 'Use of non-micro A-V aids'. This activity was positively associated with more CE dimensions than any other single Teaching Activity showing that in Computer Studies classrooms pupils' attention focuses on non-computer resources, possibly because most schools are now satisfactorily equipped with computers. The result agrees with the finding of Ainley (1978) that classroom environment scores were higher in science classrooms that had more resources.

The total number of Activity-Environment interactions is too small for definite conclusions about the importance of individual activities and CE dimensions to be possible. The level of R^2 predicted by the regression equations varies from zero for PARTICIPATION to 21% for DIFFERENTIATION, this is similar to the range found for Activity-Attitude predictions (Table 10.6).

The effect of perceptions of the classroom environment on pupils' attitudes toward computers,

Table 10.9 shows correlations between pupils' perceptions of the classroom environment and their attitudes toward computers. Because the classroom environment and attitude data were obtained by requiring half of each class to answer one set of scales whilst the other half of the class answered the other scales, the analysis has to be at the class level.

Classroom			(*) Attitudes to Computers scales					
Environment Scales	Satis.	Employ.	Threat	Future	Social	Career	Leisure	School
Resources	205*	**-050**	030	050	045	081	157	189*
Involvement	416**	143	173*	**311****	303**	**510****	**418****	**436****
Task Orientation	327**	193*	265**	171*	291**	316**	**172***	214*
Order & Organisation	**455****	**266****	**334****	190*	**351****	**473****	**405*****	352**
Innovation	122	005	-132	168*	101	100	119	129
Personalisation	287**	053	079	248**	210*	273**	240**	382**
Participation	249	109	048	259**	225*	287**	230*	297**
Independence	200*	139	-081	121	094	172*	222*	162
Investigation	329**	144	**238****	281**	**312****	312**	269**	362**
Differentiation	007	-083	-096	-081	**-127**	042	067	-052
R^2 %	21	10	18	10	18	29	23	19
Multiple corr.	454	311	429	311	421	539	476	436
F-value of reg. eqn	<001	007	<001	002	<001	<001	<001	<001

Notes: Decimal points omitted.
* significant at p = 0.05, ** p = 0.01
Variables retained in the regression equation shown in **bold**

Table 10.9 Correlations between students' attitudes to computers and perceptions of the classroom environment

Many of the correlations shown in Table 10.9 are significant at the 0.01 or 0.05 level. This suggests, in keeping with the findings of Ainley (1978) and Talmage & Hart (1977) that pupils' perceptions of the Computer Studies classroom play a significant part in the formation of their attitudes toward computers. This impression is confirmed by the alternative view of the same data shown in Table 10.10.

The R^2 values of the final regression equations range from 10% to 29%, these values are similar to those found by Lawrenz (1976b) using LEI scales and in a meta-analysis by Anderson & Walberg (1974). The attitude dimensions of CAREER and LEISURE are the most strongly related to classroom environment effects.

Classroom Environment Scales	Computer Attitude scales*							
	SAT	EMP	THR	FUT	SOC	CAR	LES	SCH
Resources		-						
Involvement				+		+	+	+
Task-Orientation							-	
Order&Organisation	+	+	+		+	+	+	
Innovation			-					
Personalisation								
Participation								
Independence								
Investigation			+		+			
Differentiation					-			
R^2% final eqn	21	10	18	10	18	29	23	19

(*) Variables are SATISFACTION, EMPLOY, THREAT, FUTURE, SOCIAL CAREER, LEISURE and SCHOOL

Table 10.10: Regression analysis of classroom environment scores as predictors of pupils' attitudes to computers

A feature of the results shown in Table 10.10 is that the variables of ORDER & ORGANISATION and INVOLVEMENT are included in the regression equation of several attitude scales. Of the 16 significant interactions shown in the table, ten involve these variables. The importance of these two dimensions was implicit in the recommendation by McGarity & Butts (1984) that, in order to improve learning outcomes, teachers should pay attention to class management and aim for higher levels of pupil involvement in classsroom activities.

Another CE variable, INVESTIGATION, plays an important part in attitude formation. This dimension has a positive interaction with the two scales of THREAT and SOCIAL. The table shows classrooms perceived as high in INNOVATION are associated with less favourable scores on the THREAT scale. INNOVATION was negatively associated with three of the attitude scales used by Fisher & Fraser (1982a).

The results suggest that teachers may be able to bring about changes in pupils' attitudes toward computers by suitably manipulating the classroom environment. To bring about attitude changes it appears teachers should pay particular attention to the classroom dimensions of INVESTIGATION, INVOLVEMENT and ORDER & ORGANISATION.

The prediction of pupils' Computer Anxiety

This section examines the relationship of teacher, pupil and classroom variables to pupils' Computer Anxiety.

A. Teacher and pupil personal characteristics

Predictor Variables	Correlation (*)	Regression Equation Beta	F	Sig. F
PSEX	-0.192	-0.1246	13.49	0.0003
TSEX	0.025			
CDF1	-0.023			
CDF2	-0.005			
CDF3	-0.028			
BHUSE1	-0.082			
BHUSE2	-0.111			
BHUSE3	-0.199	-0.1279	14.87	0.0001
BHUSE4	-0.203	-0.1163	12.02	0.0005
BCAL1	-0.033			
BCAL2	-0.029			
BCAL3	-0.007			
BCAL4	-0.021			
BCAL5	-0.016			
SCGP	-0.162	-0.0723	4.55	0.0332
ARTSGP	-0.028			
OFFPR	-0.023			
BTCAL	-0.010			

R^2 regression equation 0.085 F = 23.14 Sig. F = 0.0000

(*) Correlations above 0.062 are significant at p= 0.05.

Table 10.11 Correlations and regression analysis results for teacher and pupil characteristics as predictors of ANXIETY.

(In Table 10.11 a negative correlation indicates that less Anxiety, ie a more favourable state, is associated with an increase in the quantity of the predictor variable.)

The table shows that lower levels of Anxiety are associated with males, with the taking of two or more science subjects and higher levels of home-use of a computer for school-work and programming. No computer assisted learning variable and no teacher variable was included in the regression equation for Anxiety and none of the correlations of these variables reached the 0.05 level of significance.

B. Teacher Activities

Table 10.12 summarises relationships between the 19 Teacher-Activities and pupil Anxiety. All the correlations between Activities and Anxiety are of a low value, none reaches the 0.05 significance level.

	Predictor Variable Teachers' Activities	Correlation (*)
1	General teaching, books	-0.073
2	General teaching, notes	-0.071
3	Differentiation of pupil work	-0.057
4	Interest in p. career leisure	-0.011
5	Student controlled exercises	-0.015
6	Use ideas from other teachers	-0.037
7	Use non-computer AV-aids	-0.028
8	Use and care of network, micros	0.092
9	Microelectronics theory and PW	0.041
10	Use of peripherals, comp. h'ware	0.004
11	Worksheet-based exercises	-0.043
12	Student involvement in lessons	0.004
13	Students make own contacts	0.122
14	Teacher concerned about resources	-0.013
15	Use of CAL packages	-0.030
16	Teacher helps comp school admin	0.060
17	Use of data-process packages	0.005
18	INSET, professional concerns	0.070
19	Use of LOGO,CAD, Teletext	-0.046

(*) A correlation value of 0.195 is significant at $p = 0.05$

Table 10.12 Correlations between Teacher-Activities and pupil Anxiety

The initial regression equation containing all 19 Teacher-Activities predicted a fraction 0.108 of the Anxiety score variance. This equation had an associated F-value significance of 0.92 showing that it was not a good predictor. Successive elimination of variables raised the F-significance but this had reached only 0.22 when the last variable (Activity 13) was removed. The elimination of all variables from the regression analysis shows pupils' level of Computer Anxiety is unaffected by teachers' classroom behaviours as measured by the 19 Activity scales. These results show that the variable Pupil Anxiety is similar to other pupil attitudes and are a further demonstration that teacher characteristics and classroom activities have only small effects on pupils' attitudes.

The correlations between pupils' perceptions of the Classroom Environment and their level of Computer Anxiety are given in Table 10.13.

C. Pupils' perceptions of the classroom environment

Classroom environment (Predictor Variables)	Correlation (*)	Computer Anxiety Regression Equation Beta	T-value	T-sig
RESOURCES	-0.147			
INVOLVEMENT	-0.455	-0.455	26.08	0.000
TASK ORIENTATION	-0.293			
ORDER & ORGANISATION	-0.377			
INNOVATION	-0.262			
PERSONALISATION	-0.248			
PARTICIPATION	-0.244			
INDEPENDENCE	-0.116			
INVESTIGATION	-0.325			
DIFFERENTIATION	-0.031			
		$R^2 = 0.21$		

(*) A correlation value of 0.195 is significant at p = 0.05
0.245 p = 0.01

Table 10.13 Correlations between pupils' perceptions of the classroom environment and computer Anxiety

The mean correlation between CE scores and Anxiety scores is moderately high; seven of the ten CE scales have a value that is significant at the 0.05 level. All the correlations are negative showing an improved score on any CE dimension leads to reduced pupil Anxiety.

Only one CE variable, INVOLVEMENT, is retained in the regression equation showing that the level of pupil involvement with events in the classroom is the best predictor of pupil Anxiety about computers. The omission of other CE variables from the regression equation is most probably a consequence of the high inter-scale correlations. The successful prediction of 21% of the Anxiety-score variance by this one variable matches the results obtained by Lawrenz (1976b).

It was shown in Table 10.4 that INVOLVEMENT is significantly correlated with three measures of pupils' home-use of a computer so it is possible that the relationship between ANXIETY and INVOLVEMENT may arise from their common association with one or more of the out-of-school variables. The result that only one CE scale is related to pupils' computer Anxiety contrasts with a study by Fraser et al (1983) in which two ICEQ and three CES scales were significantly associated with science anxiety.

The prediction of pupils' attitudes toward a computer based job or career.

This section examines the relationships of teacher, pupil and classroom variables and teachers' job-attitudes to pupils' attitudes toward a job or career using a computer.

A. Teacher and pupil personal characteristics

Table 10.14 shows results of a regression analysis in which teacher gender and the exogenous pupil variables of gender, homeuse of a computer, experience of CAL and subject choices were used as predictors of the two pupil Jobscores derived from the semantic differential questionnaire. The results show that about 10% of the variance of the more important JOB1 values may be predicted from the four homeuse variables and science group membership. It is interesting that neither teacher nor pupil gender is involved in the regression equation, that all four homeuse variables are included and that BHUSE1, which measures the use of the homecomputer for the playing of games, has a negative correlation with the job attitude score. The table also shows that the regression equation based on two variables measuring homeuse for educational games and schoolwork, predicts only 3% of the JOB2 score.

Predictor Variables	Correlations(*) PJOB1	PJOB2	Regression Equation PJOB1 Beta	F	Sig.F	Regression Equation PJOB2 Beta	F	Sig.F
PSEX	104	027						
TSEX	017	-013						
BHUSE1	038	043	-0.064596	4.029	0.0450			
BHUSE2	161	136	0.066230	4.163	0.0416	0.109834	11.310	0.0008
BHUSE3	249	121	0.160427	23.047	0.0000	0.087869	7.239	0.0073
BHUSE4	246	110	0.165526	21.547	0.0000			
BCAL1	028	-026						
BCAL2	075	018						
BCAL3	-033	-034						
BCAL4	035	-027						
BCAL5	012	012						
SCGP	142	007	0.096910	10.117	0.0015			
ARTSGP	-060	-028						
OFFPR	000	048						
BTCAL	056	008						
Regression equation			R^2= 0.103	F= 22.9	Sig.F=0.0000	R^2=0.026	F= 13.2	Sig.F= 0.0000

(*) Correlations above 0.062 are significant at p= 0.05, above 0.081 significant at p = 0.01.

Table 10.14 Correlations and regression analysis results for pupil jobscores using teacher and pupil characteristics as predictors.

B. Teacher Activities

Table 10.15 shows that none of the correlations between the 19 Teacher-Activities and the two pupil jobscores PJOB1 and PJOB2 reaches the 0.05 level of significance. In a regression analysis for PJOB1, the last remaining variable (Activity 13) was removed when the F-value had reached a significance level of 0.25, whilst in the corresponding analysis for PJOB2, the final variable (Activity 4) was removed at an value of 0.067. These results show that Teachers' Activities cannot be used as predictors of pupils' attitudes towards a computer-related job.

	Predictor Variables (Teachers' Activities)	Correlations (*) PJOB1	PJOB2
1	General teaching, books	0.021	0.025
2	General teaching, notes	-0.017	-0.002
3	Differentiation of pupil work	0.060	0.126
4	Interest in p. career leisure	0.041	0.182
5	Student controlled exercises	0.001	0.131
6	Use ideas from other teachers	-0.018	0.056
7	Use non-computer AV-aids	0.010	0.034
8	Use and care of network, micros	-0.126	0.042
9	Microelectronics theory and PW	0.011	0.012
10	Use of peripherals, comp. h'ware	0.004	0.052
11	Worksheet-based exercises	-0.059	0.082
12	Student involvement in lessons	0.019	0.041
13	Students make own contacts	-0.114	0.078
14	Teacher concerned about resources	-0.003	0.022
15	Use of CAL packages	-0.061	0.094
16	Teacher helps comp school admin	-0.040	-0.023
17	Use of data-process packages	-0.007	-0.022
18	INSET, professional concerns	0.026	-0.034
19	Use of LOGO,CAD, Teletext	-0.096	0.099

(*) A correlation value of 0.195 is significant at $p = 0.05$ ($N = 102$)

Table 10.15 Correlations between Teacher-Activities and pupil Jobscores

C. Pupils' perceptions of the classroom environment

A regression analysis for the pupil jobscales PJOB1 and PJOB2 was carried out using the ten dimensions of pupils' perceptions of the classroom environment as predictor variables. The results are summarised in Table 10.16 which shows that the equations predicted 38% and 18% of the jobscore variances. It is noticed that the value of 38% is higher than for any other regression equation reported in this work and that it is associated with the first, evaluative factor of pupils' job perceptions.

The results of this analysis are in agreement with those in previous sections in finding that the classroom environment variables are moderately sucessful predictors of pupils' attitudes and that these variables are most strongly associated with the Career and Leisure dimensions. The unweighted average R^2 value for PJOB1 and PJOB2 shown in Table 10.16 is very close to the 29% value shown for the prediction of scores on the CAREER scale in Table 10.9. These results contrast with the correlation of only 0.04 between teachers' and pupils' attitudes found in a meta-analysis of 11 science studies by Druva and Anderson (1983). The high value obtained in the current study may be attributed to the pupils' limited knowledge of computer-based careers compared with a wider knowledge of science and the work of scientists. In this circumstance pupils are likely to be strongly influenced by the example given by their own Computer Studies teacher. Whether or not this explanation is acceptable, the high correlation between teachers' and pupils' "job" attitudes is the strongest association found between any dimension of pupils'attitudes and another variable.

Predictor	Correlations(*)		Regression Equation		PJOB1	Regression Equation		PJOB2
Variables	PJOB1	PJOB2	Beta	F	Sig.F	Beta	F	Sig.F
RESOURCES	165	223						
INVOLVEMENT	592	355	0.437577	17.730	0.0001			
TASK-ORIENTATION	359	248						
ORDER & ORGAN	525	331	0.230177	4.629	0.0339	0.202669	4.022	0.0476
INNOVATION	194	274						
PERSONALISATION	419	382				0.294438	8.489	0.0044
PARTICIPATION	355	231						
INDEPENDENCE	116	-056						
INVESTIGATION	460	380						
DIFFERENTIATION	051	138						
Regression equation	R^2= 0.380		F= 30.3		Sig.F=0.0000	R^2=0.180	F= 10.8	Sig.F= 0.0001

Decimal point omitted
(*) N= 102 Correlations above 0.195 are significant at p= 0.05.

Table 10.16 Correlations and regression analysis results for pupil jobscores using pupils' perceptions of the classroom environment as predictor variables.

D. Teachers' attitudes toward the Job of a Computer Studies teacher

The Pearson product-moment correlation coefficients between the teachers' Jobscores and the pupils' Jobscores are shown in Table 10.16. All values reach the 0.001 level of significance. The highest pupil-teacher correlations are between "matching" Jobscores.

Jobscores	Teachers' TJOB1	TJOB2	Pupils' PJOB1
TJOB2	0.681		
PJOB1	0.868	0.578	
PJOB2	0.599	0.771	0.665

Table 10.17 Correlations between Teachers' and Pupils JOBSCOREs (Based on 102 class groups)

Regression analysis was used to predict pupils' Jobscores from the two teacher Jobscores. The analyses showed that TJOB1 used alone was the best predictor of PJOB1 and that TJOB2 used alone was the best predictor of PJOB2. The regression analysis results summarised in Table 10.18 show a strong association between teachers' and pupils' perceptions.

Criterion	Predictor	Beta	R^2	T	Sig. T
PJOB1	TJOB1	0.868	0.754	17.49	0.0000
PJOB2	TJOB2	0.771	0.595	12.13	0.0000

Table 10.18 Regression analysis of teachers' and pupils' job perceptions.

The effect of Teaching Style on pupils' attitudes to computers, perceptions of the classroom environment, Anxiety, and change of interest in Computer Studies

If the variable of Teaching Style is useful it should be possible to show that pupils taught by teachers of different styles develop different attitudes toward computers, perceptions of the classroom environment, and levels of anxiety.

The results of between-styles analysis of variance tests on 21 attitude and classroom environment variables are shown in Table 10.19. A separate analysis was performed for each variable. The table shows that in 19 of the 21 comparisons there was no significant difference (NSD) between any combination of teaching style groups. In the remaining two comparisons the separation of the groups is minimal and differs in structure in the two

Variable	Teaching Style Group Means Gp.1	Gp.2	Gp.3	Gp.4	Gp.5	Test results (Oneway, Scheffe)
RESOURCES	23.48	22.13	22.66	20.66	23.61	(2+3+1+5)>(4+2+3)
INVOLVEMENT	17.86	17.35	17.35	17.14	16.45	NSD
TASK-ORIENTATION	20.79	20.95	19.55	21.05	19.85	NSD
ORD & ORGANISATION	19.67	19.25	17.92	17.68	17.49	NSD
INNOVATION	12.58	12.42	13.36	12.14	11.31	NSD
PERSONALISATION	30.36	30.21	30.24	29.86	27.21	NSD
PARTICIPATION	31.14	29.83	30.58	29.87	28.96	NSD
INDEPENDENCE	31.96	31.59	32.53	30.21	31.34	NSD
INVESTIGATION	25.97	25.60	27.27	24.89	23.18	(4+2+1+3)>(5+4+2)
DIFFERENTIATION	23.83	24.09	27.73	23.13	22.37	NSD
SATISFACTION	22.08	22.26	23.76	23.20	23.04	NSD
EMPLOY	32.11	32.73	32.43	32.37	32.05	NSD
THREAT	28.38	28.31	29.95	28.53	28.35	NSD
FUTURE	24.39	24.03	24.20	24.97	24.10	NSD
SOCIAL	31.42	31.06	32.08	31.84	31.28	NSD
CAREER	19.64	19.83	20.28	19.85	20.52	NSD
LEISURE	19.65	19.40	19.98	20.36	19.95	NSD
SCHOOL	19.06	19.23	20.69	20.01	19.68	NSD
ANXIETY	9.209	9.137	9.506	9.155	9.231	NSD
JOBSC1	35.17	35.88	35.23	35.14	35.66	NSD
JOBSC2	41.50	41.57	41.40	41.67	42.65	NSD

Table 10.19 Results of Scheffe test carried out on means of pupils' classroom environment, attitudes toward computers, anxiety and jobscores of groups taught by five different styles

cases. It is thought likely these two isolated and rather different effects are random and can therefore be set aside. On this assumption, it is concluded that Teaching Style has no effect on pupils' attitudes toward computers, perceptions of the classroom environment, level of anxiety and attitude toward a computer-based job.

The SATISFACTION scale also failed to show any association with Teaching Style possibly because the combination of CDFs included in the regression equation for this scale in Table 10.2 (CDF1 +ve, CDF2 -ve, and CDF3 +ve) corresponds to none of the five Teaching Styles shown in Table 8.13.

As described in Chapter 9, pupils were assigned to one of four THEN/NOW groups according to their interest in Computer Studies at the start of the course and its subsequent change. The groups were:

Group 1: High initial level which has been maintained
Group 2: Low initial level which has been maintained
Group 3: High initial level changing to a lower level later
Group 4: Low initial level changing to a higher level later

THEN-NOW GROUP(*)	Teaching Style Group					Row Total
	Gp.1	Gp.2	Gp.3	Gp.4	Gp.5	
1	522	246	70	242	137	1217
2	32	11	6	19	11	79
3	292	130	37	136	115	710
4	10	4	0	10	2	26
Column Totals	856	391	113	407	265	2032

$Chi^2 = 13.5$, d.f. = 12, Significance = 0.33

(*) THEN-NOW groups were as in the text above.

Table 10.20 Chi-square test of crosstabulation of Teaching Style group against pupils' interest pattern.

Table 10.20 shows membership of the four THEN/NOW groups tabulated against the Style of the teacher. The chi^2 value for the distribution is not significant so it might be concluded that Teaching Style has no significant effect on changes in pupils' interest in Computer Studies. If, however, the THEN-NOW Groups Nos. 2 and 4 are dropped from the analysis, chi^2 becomes significant at the level $p = 0.05$. The condensed form of the analysis is shown in Table 10.21

THEN-NOW Category	Teaching Style Group										Row Total
	Gp.1		Gp.2		Gp.3		Gp.4		Gp.5		
	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp	Obs	Exp	
1	522	514	246	238	70	68	242	239	137	159	1217
3	292	300	130	138	37	39	136	139	115	93	710
Totals	814		376		107		378		252		1927

$Chi^2 = 9.58$ d.f. = 4, Significance = 0.05

(*) THEN-NOW groups were as in the text above.

Table 10.21 Chi-square test of a condensed form of crosstabulation of Teaching Style group against pupils' interest pattern.

Inspection of Table 10.21 shows that Teaching Style Group No. 5 is associated with a lower number than expected of pupils in THEN-NOW category 1 and a higher than expected number of pupils in THEN-NOW category 3 whilst for other Teaching Style groups the observed and expected values were in close agreement. These results show that, compared with other Teaching Styles, Style 5 has a negative effect on pupils' attitudes towards Computer Studies.

Discussion

Seven conclusions follow from the analyses described in this chapter:

1. Pupils' attitudes toward computers as measured by the CARAQ scales are moderately related to pupil personal characteristics of gender, homeuse of a computer and choice of science subjects. These attitudes are not related to the gender of the teacher. The attitude scales of CAREER and LEISURE show the strongest associations with the pupil personal characteristics.

2. Pupils' perceptions of the classroom environment are significantly related to many of the pupil and teacher personal characteristics included in the study. The percentage of the classroom environment score variance predicted by regression based on these characteristics is, however, only about 10%.

3. A small number of the 19 Teacher Activities are significantly associated with pupils' attitudes toward computers. The scales of THREAT and FUTURE show the strongest associations with Teacher Activities whilst the scales of CAREER and LEISURE have no association. Similar results were found for the relationships between Teacher Activities and pupils' perceptions of the classroom environment. Only a small number of Activities were included in the regression equations, these predicted maximum levels of CE score variance for the scales of INNOVATION and DIFFERENTIATION but none of the variance for the scale PARTICIPATION.

4. Pupils' perceptions of the classroom environment were found to be moderately good predictors of their attitudes toward computers. The average score variance predicted by the regression equations was 18% with the scales of CAREER and LEISURE showing the highest values of 29% and 20%.

5. The scale of ANXIETY and the two JOBSCOREs showed associations similar to those shown by the CARAQ scales. Scores on the ANXIETY scale were significantly related to pupil personal characteristics of gender,

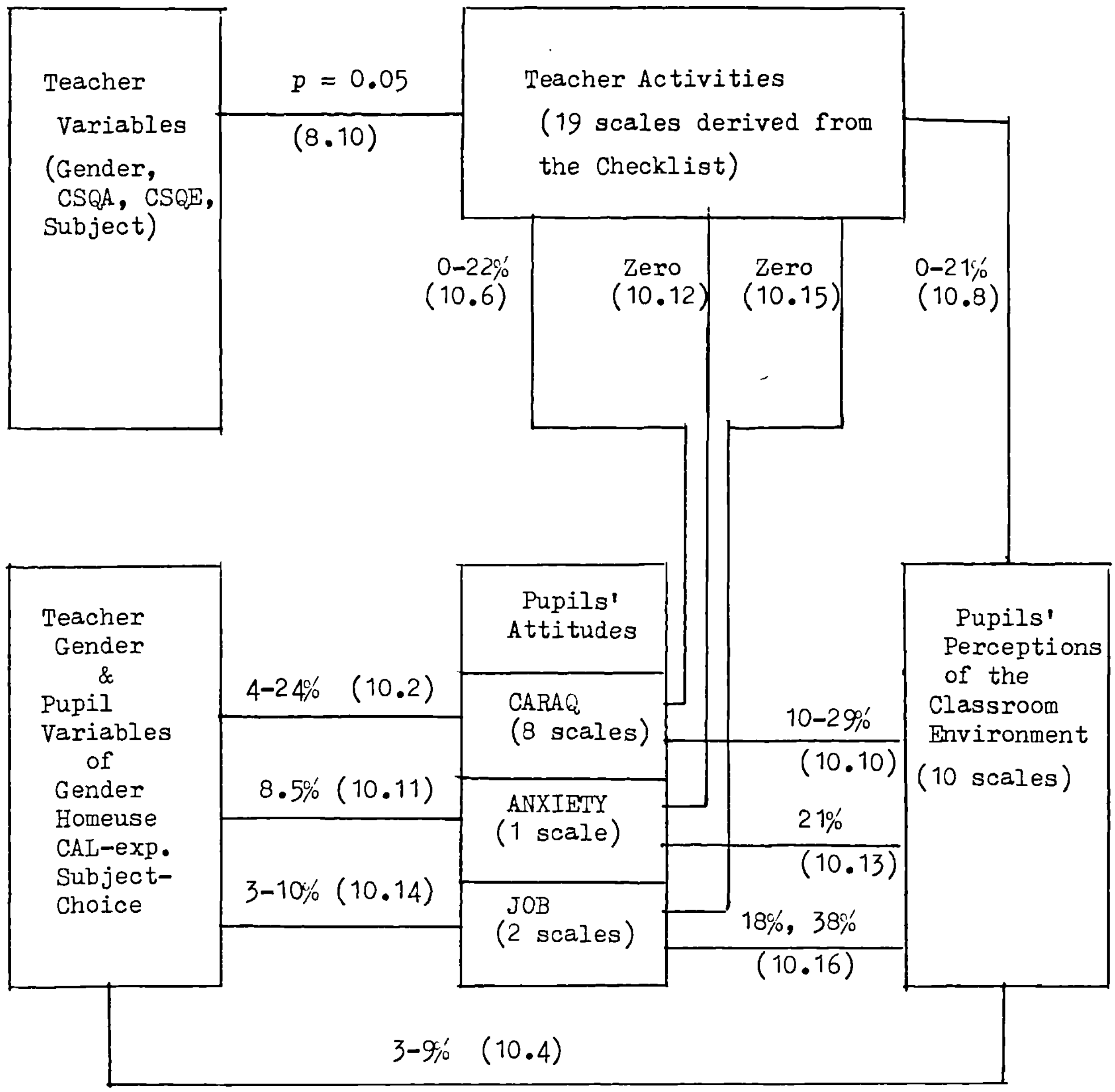
homeuse of a computer and choice of science subjects, were not related to Teacher Activities and to only the INVOLVEMENT scale of the classroom environment measures. The two JOBSCOREs showed the same pattern of associations with the pupil personal characteristics and Teacher Activities but interacted with a total of three CE scales.

6. Three canonical discriminant functions (CDFs) derived from teachers' checklist reponses predicted a significant amount of the attitude score variance only for the SATISFACTION scale. The CDFs interacted with all ten CE scales but predicted substantial portions of the variance for only the scales RESOURCES, ORDER & ORGANISATION, PERSONALISATION and DIFFERENTIATION.

7. The global construct Teaching Style was not significantly associated with pupils' attitudes toward computers, their perceptions of the Computer Studies classroom environment, level of Computer Anxiety nor perceptions of a job or career using a computer. The most negative Teaching Style was associated with a larger than expected number of pupils whose attitudes to Computer Studies had declined.

In terms of the model given in Chapter 3, pupils' attitudes, perceptions of the classroom environment and teacher activity variables interact as shown in Figure 10.1. The diagram is unable to show that although pupils' CE perceptions and teachers' activities have approximately the same mean effect on pupils' attitudes toward computers, the variables in these two groups interact most strongly with <u>different</u> attitude dimensions.

One of the objectives of the study was to determine the suitability of some classroom environment scales for use in Computer Studies. In this chapter it has been shown that two CE scales, PARTICIPATION and INDEPENDENCE, were used in none of the regression equations predicting pupils' attitudes from CE perceptions. The scales PERSONALISATION and DIFFERENTIATION were each used in only one regression equation. Since all four of these scales come from the ICEQ instrument, it appears that the ICEQ is not particularly suitable for use in Computer Studies classrooms.



Notes Percentage values refer to the range of R^2 values obtained by regression analysis.

Figures in parentheses are Table references for the quoted R^2 values.

Figure 10.1 Representation of the interactions between attitudes, classroom environment perceptions, teacher and pupil variables.

CHAPTER 11

THE DIARY STUDY

Aims of the Diary Study

The Diary Study, a survey of Computer Studies lessons, was based on use of the Lesson Diary Report Form (LDRF) described in Chapter 6. The aims of the survey were:

1. To demonstrate that the Lesson Diary Report Form can be used to collect significant and reliable data about the teaching of Computer Studies to pupils most of whom were studying for examinations at age 16+.

2. To discover whether the format or content of Computer Studies lessons are affected by teacher variables including teacher-training and teaching-experience.

3. To discover whether Computer Studies lessons vary in format or content according to the ability of the pupils.

The teacher sample

The Teacher Booklet included an invitation to interested teachers to take part in a Diary Study of Computer Studies teaching. Two copies of the Diary Booklet were sent to 84 teachers who responded to this invitation. Each Diary Booklet consisted of seven LDRFs together with a cover sheet for recording some basic information about the class and the teacher. A total of 61 teachers (47M, 14F) returned 96 Diary Booklets. Individual teachers recorded from 6 to 14 lessons of the total of 692 lessons. Data on the Diary Study teacher sample are shown in Tables 11.1 to 11.5

Total Teaching Experience	N_T	(%)	N_L	(%)	CSS *(%)
0 - 2 years	3	5	33	5	5
3 - 5 years	7	1	90	13	13
6 -10 years	16	27	169	24	32
11+ years	35	57	400	58	46

Legend: N_T = Number of teachers N_L = Number of lessons
* CSS Comparative data from the Checklist Study Sample of 253 teachers

Table 11.1 Teaching Experience of Diary Study teacher sample

CS-Teaching Experience	N_T	(%)	N_L	(%)	*CSS (%)
0 - 2 years	8	13	88	13	8
3 - 5 years	30	49	334	48	51
6 -10 years	15	25	175	25	26
11+ years	8	13	95	14	10

Legend: N_T = Number of teachers N_L = Number of lessons
* CSS Comparative data from Checklist Study sample of 253 teachers.

Table 11.2 CS-Teaching Experience of Diary Study teacher sample

Table 11.1 shows over half the teachers taking part in the Diary Study had 11 or more years of teaching experience. Experience of teaching Computer Studies (Table 11.2) was more limited, half the teacher sample having five years or less teaching experience in the subject.

Industrial Experience	N_T	(%)	N_L	(%)	*CSS (%)
None	48	79	534	76	79
0 - 2 years	5	8	63	9	9
3 - 5 years	5	8	77	11	)
6 -10 years	1	2	7	1	) 12
11+ years	2	3	21	3	)

Legend: N_T = Number of teachers N_L = Number of lessons
* CSS Comparative data from Checklist Study sample of 253 teachers.

Table 11.3 Industrial Experience of Diary Study teacher sample

Academic Qualification in Computing	N_T	(%)	N_L	(%)	*CSS(%)
CS degree or HNC/HND	8	13	100	15	13
College qualification	19	31	217	31	22
None	34	56	375	54	65

Legend: N_T = Number of teachers N_L = Number of lessons
* CSS Comparative data from Checklist Study sample of 253 teachers.

Table 11.4: Academic qualification of Diary Study Teacher Sample

Teacher Training Qualification in CS	N_T	(%)	N_L	(%)	*CSS(%)
FT INSET One term +	3	5	39	6	6
PT INSET with cert	7	11	75	11	13
PT INSET no cert.	30	49	338	48	45
No INSET	21	37	240	35	37

Legend: N_T = Number of teachers N_L = Number of lessons
* CSS Comparative data from Checklist Study sample of 253 teachers.

Table 11.5: Teacher Training Qualification of Diary Study Teacher Sample

Chi^2 tests on the Diary-Study and Checklist-Study samples showed they had the same distributions of Total teaching experience (Table 11.1), CS Teaching Experience (Table 11.2), Industrial Experience (Table 11.3), Academic Qualifications (Table 11.4), and Teacher Training (Table 11.5). It is concluded that the 61 teachers who took part in the Diary Study had the same characteristics as the sample of 253 teachers whose teaching activities have been described previously.

In all five tables shown above there is a close correspondence between the percentage of teachers in any category and the percentage of lessons in the category showing that no group had been more or less willing to use the LDRF. Because the focus of the study is on the lesson, all analyses will be given in lesson units.

The pupil sample

Table 11.6 summarises the data for the sample of 1842 pupils according to gender, year-group and class size. The data show a 25% increase in the number of girls in Year 4 classes as compared to Year 5 classes.

	Year 4			Year 5			Totals		
	M	F	T	M	F	T	M	F	T
Num pupils	474	310	784	691	367	1058	1165	677	1842
Num classes			39			57			96
Mean p/class	12.1	8.0	20.1	12.2	6.4	18.6	12.1	7.1	19.2
% girls			40			35			37
Num lessons		276(40%)			416(60%)			692(100%)	
% lessons by male teacher			83			77			79

Table 11.6: Descriptive statistics for pupil sample

The cover-sheet attached to each set of seven LDRFs asked teachers to give "a broad description of the ability level of the pupils (e.g. "mostly CSE with about 4 pupils obtaining Grade 5 only")". Responses were classified into nine Ability Groupings. These groupings and the number of lessons given to each are shown in Table 11.7. A chi^2 test confirmed that there was no significant difference between the ability distributions in Years 4 and 5. The data show that over half the pupils were in Ability Groupings 1 - 4 inclusive. This suggests some schools have a policy of encouraging above average pupils to take Computer Studies or, perhaps, of restricting it to the more able pupils.

	Ability Grouping Description	Year 4 N	Year 4 %	Year 5 N	Year 5 %	Total N	Total %
1	Very good O-level	0	0	16	4	16	2
2	All O-level	54	20	37	9	91	13
3	Mostly O-level	75	27	78	19	153	22
4	Equal O-level and CSE	41	15	69	17	110	16
5	Mostly CSE, some O-level	33	12	65	15	98	14
6	CSE	26	9	87	21	113	16
7	CSE with some weaker p	0	0	32	8	32	5
8	Non-examination, a few CSE	7	2	7	2	14	2
9	Full-range mixed ability	40	15	25	6	65	9

Number (%) of lessons

Table 11.7 Description of Ability Grouping categories used to describe the pupil sample with number and percentage of lessons taught to each.

The timing of the study

The LDRFs were completed between October 1985 and February 1986. The number of lessons reported in each month were as shown in Table 11.8. The collection of data extended over five months and included both fourth year and fifth year classes. The extended collection period was helpful because it helped the survey to sample as much of the course as possible. Because, however, the sampling period did not include the final intensive examination-revision lessons of Year 5, the data almost certainly underestimate the number and percentage of lessons devoted to tests and the completing of projects during the total course.

1985 October	1985 November	1985 December	1986 January	1986 February
49	450	93	47	53

Table 11.8 Timing of the Lesson Reports

The context of Computer Studies teaching

On each LDRF teachers were asked to indicate the type of room used and the length of the lesson. The data are shown in Tables 11.9 and 11.10.

	Room Description	Lessons Recorded N	%
A.	Purpose built & equipped	107	15.5
B.	Adapted, dedicated micros ready for use	392	56.6
C.	Not dedicated, micros have to be set up	47	6.8
D.	No micro facilities for pupils	146	21.1

Table 11.9: Type of room-facilities used for CS lessons

The data show that over 70% of lessons took place in a room that had been purpose-built or specially adapted for work with microcomputers and that over half the reported lessons lasted for exactly 70 minutes.

Duration /min	Lessons recorded N	%
35 - 65	152	22
70	398	58
75 - 120	142	20

Table 11.10: Duration of CS lessons

Analysis of results by Year-Group

(A copy of the LDRF is included in the Appendix.)

Lesson-type

The LDRF listed nine Lesson-types from which the teacher was asked to choose the one type that best described the lesson being recorded. A tenth category "Other - Please describe" was also included on the LDRF. This was used for less than 1% of the lessons. Teachers' descriptions of these lessons were used to allocate them to one of the nine listed Lesson-types.

Table 11.11 shows teachers' choice of the nine lesson types arranged by Year-group. The data show that some types of lesson are comparatively rare. Five types of lesson shown in the Table as numbers 3, 5, 6, 8 and 9 together account for less than 20% of all lessons. Of the remaining four types, accounting for 80% of all lessons, three show different frequencies of use between Years 4 and 5. There is more Teacher-introduced programming (LSTYPE = 2) in Year 4 but rather more Pupil programming (LSTYPE = 4) in Year 5. As might be expected, the use of Tests and revision exercises (LSTYPE = 7) is more frequent with fifth year pupils.

No.	Lesson-type description	Year 4		Year 5		Sig chi^2
		N_L	%	N_L	%	
1	Teacher talk, p.written work	96	35	136	33	NS
2	Teacher talk, p.programming	85	31	70	17	0.001
3	T. talk, p. do non programming PW	17	6	10	2	0.02
4	Pupils program	36	13	80	19	0.05
5	Pupils do non-programming PW	19	7	16	4	NS
6	Class discussion	4	1	17	4	--
7	Revision or test	14	5	44	11	0.02
8	Worked examples, h'work corrections	1	1	23	6	--
9	Video,visit etc	3	1	20	5	--
	Number of lessons	276		416		

Table 11.11: Lesson-type data arranged by Year-group

Homework

HWK No.	Homework Description	Year 4		Year 5		Sig chi^2
		N_L	%	N_L	%	
1	None	101	37	107	26	0.01
2	Program writing	59	21	93	22	NS
3	Qns. from BB or book	30	11	45	11	NS
4	Answers to oral qns	10	4	8	2	NS
5	Read from textbook	3	1	8	2	NS
6	Write notes/defns.	8	3	11	3	NS
7	Open enquiry/search	13	5	23	6	NS
8	Revise/learn for test	17	6	78	19	0.001
9	Finish classwork	32	12	29	7	NS
	Total no. of lessons	273		402		

Table 11.12: Homework type data arranged by Year-group

Table 11.12 shows the type of homework set to Computer Studies classes in Years 4 and 5. Some differences between the homework exercises used with the two year-groups are shown by the data. The category None is more common in Year 4 whilst Revision is more common in Year 5. Teachers' use of other types of homework activity show no significant variation between fourth and fifth year groups.

Resources

Information about teachers' and pupils' use of resources in Computer Studies lessons is summarised in Table 11.13. The data show that the use of resources other than books and charts varies only a little between Years 4

No.	Resource description	Year 4		Year 5		Sig.
		N_L	%	N_L	%	chi^2
TR01	B-board or OHP	165	60	221	53	NS
TR02	Charts & diagrams	44	16	41	10	0.05
TR03	Micro & large screen	51	19	87	21	NS
TR04	Other comp. h'ware	21	8	44	11	NS
TR05	Models & slides	2	1	6	1	--
TR06	Textbook	48	17	114	27	0.01
TR07	Software package	32	12	39	9	NS
TR08	Microelectronics	11	4	1	0	--
TR09	Video or film	5	2	15	4	NS
TR10	Pub.teaching mats.	13	5	29	7	NS
	Total reports	392		597		
PR01	Microcomputer	150	54	194	47	NS
PR02	Teacher handout	112	41	155	37	NS
PR03	Textbook	72	26	151	36	0.02
PR04	Robot, buggy etc	0	0	8	2	--
PR05	Microelectronics	8	3	3	1	--
PR06	Ref.book Or library	13	5	50	12	0.01
PR07	Software package	48	17	70	17	NS
	Total reports	403		631		

Table 11.13: Use of teacher resources (TR) and pupil resources (PR) arranged by Year-group

and 5. Both teachers and pupils make more use of textbooks in Year 5. The data shown in Table 11.13 also indicate some resources are used infrequently; these include microelectronics modules, robots, models, videos and published materials other than books.

Lesson activities

Teachers' use of the 14 teaching and learning activities listed on the LDRF are summarised in Table 11.14. Data in the table show how each activity was used in the first (F), middle (M) and final (L) third of the reported lessons. A chi^2 test was used to examine the data for differences in the frequency of use and also in the pattern of use between Years 4 and 5.

No.	Lesson Activity Description	Year 4 F	Year 4 M	Year 4 L	Year 4 NU	Year 5 F	Year 5 M	Year 5 L	Year 5 NU	Freq. Sig.	Patt. Sig.
01	T. poses problems	61	47	41	178	99	45	55	279	NS	NS
02	T. demonstrates	95	37	16	163	98	78	41	274	NS	0.05
03	T. explains new mat's	133	83	56	104	162	91	59	225	0.001	NS
04	T. revises old mat's	118	37	15	145	175	80	70	214	NS	0.001
05	T. uses A-V aid	53	26	21	210	56	38	14	339	NS	NS
06	T. reviews/marks hwk	34	8	60	191	45	24	69	314	NS	NS
07	P. do written work	31	70	82	179	54	98	111	269	NS	NS
08	P. read,make notes	31	41	42	210	63	63	62	311	NS	NS
09	P. copy notes bb/dict	70	54	35	171	76	77	53	291	0.05	NS
10	P. use micros	76	126	146	125	129	166	197	215	NS	NS
11	P. program with p&p	26	56	52	203	76	92	83	307	NS	NS
12	Class debate/discuss	29	23	14	235	35	42	45	342	NS	NS
13	P. non-program PW	26	31	34	241	30	39	43	369	NS	NS
14	P. do project work	31	40	43	233	108	118	132	284	0.001	NS
Total number of lessons					276				416		

Legend: F, M, L show use in first, middle and last third of the lesson.
NU = Not used in this number of lessons.
Freq.sig. shows significance of chi^2 test on frequency of use,
Patt.sig. shows significance of chi^2 on distribution of use

Table 11.14: Use of lesson activities between and within lessons in Year-groups 4 and 5.

The frequency tests show only three Lesson-activities were used differently in the two years of the course. These activities are LA03 (Teacher explanation of new material), LA09 (Copying notes), and LA14 (Project work). The first two activities were relatively more common in Year 4 whilst Project work was more common in Year 5. These three differences suggest that lessons rely on teacher direction in Year 4 but allow pupils more time for completion of projects in Year 5. Two Lesson-activities, LA02 (Teacher demonstrating), and LA04 (Teacher revising), show a time-change in the pattern of use. Both these activities feature in the first part of the lesson in Year 4 but were more uniformly spread throughout lessons in Year 5.

Analysis by teacher variables

This section examines how the data on Lesson-type and use of resources were related to six teacher variables.

Lesson-type

Before applying the tests some regrouping of the data was made to avoid rows or columns with low totals. Table 11.15 shows the results of tests carried out on the CS-Teaching Experience and CS-Teaching Qualification data. The Kolgomorov-Smirnov (K-S) test was applied to the Teaching Experience data. When used with ordinal data, the K-S test is more powerful than the chi-square test (Siegel, 1956, p.47ff). The chi-square test was applied to the Teaching Qualification data because this lacks proven ordinal character. Tables 11.15 and 11.16 show that only two teacher variables, Experience of CS-teaching and Teacher training in CS, were significantly associated with the teacher's choice of lesson-type.

Lesson Type*	Total Teaching Experience (years)				Sig.	CS-Academic Qualification			Sig χ^2
	0-2	3-5	6-10	11+	(K-S)	Degree HNC/HND	College qualif.	None	
01	13	34	50	135	NS	29	61	142	NS
02	10	13	47	85	NS	20	64	71	NS
03&05	1	9	17	35	NS	9	19	34	NS
04	2	16	25	73	NS	19	38	59	NS
07&08	4	11	20	47	NS	12	29	41	NS

	Gender			Industrial Experience		
	Male	Female	Sig χ^2	<1 year	>1 year	Sig χ^2
01	178	54	NS	189	43	NS
02	121	34	NS	121	34	NS
03&05	54	8	NS	45	17	NS
04	97	19	NS	89	27	NS
07&08	60	22	NS	62	20	NS

(*) See Table 11.11 for description of Lesson-types

Table 11.15 Lesson Type by four teacher variables

Table 11.15 shows that the associations between Lesson type and the four teacher variables of gender, industrial experience, academic qualification in CS, and total teaching experience were all non-significant.

Lesson Type*	CS-Teaching experience (years)				Sig.	CS-Teaching Qualification (INSET)				Sig.
	0-2	3-5	6-10	11+	(K-S)	FT cert	PT cert	PT no cert	None	chi^2
01	35	107	51	39	NS	8	28	98	98	0.01
02	23	70	45	17	NS	20	27	77	31	0.001
03&05	9	38	12	3	0.01	2	1	41	18	0.02
04	11	48	37	20	NS	4	10	59	43	NS
07&08	6	46	14	16	NS	5	7	43	27	NS

* See Table 11.11 for description of lesson types

Table 11.16: Lesson Type by two teacher variables

The data shown in Table 11.16 indicate that increased experience of CS-teaching is associated with decreased use of non-programming practical work (LSTYPE = 3&5). The same table shows teachers with no training or only uncertificated training prefer Lesson-types 1 and 3&5 that do not include pupil practical-work, whilst teachers with fulltime training showed a preference for Lesson-type No. 2 that includes pupil practical work. It is likely that these two effects are inter-related. Newer teachers, i.e. those with less CS-teaching experience, will be more likely to have received training in CS-teaching and to feel more competent in the use of computer hardware.

Resources

The relationships of six teacher variables to the use of resources within CS-lessons are shown in Table 11.17. As in the previous table use of computer hardware (TR04) is preferred by teachers with a period of fulltime teacher training and is less common with teachers who have long teaching experience. The data show that both teaching experience variables were negatively associated with the use of a number of both teacher and pupil resources. The exception to this general pattern was a positive association between Teaching experience and the use of Teacher handouts. It is noticed that female teachers make more use of teacher resources. The validity of this finding is supported by agreement with the data in Table 8.10 showing that female teachers had higher use of several resource-based Teaching Activities except microelectronics.

No.	Resource Description	Chi² test of Resource-use by teacher variables Sex	CSQE	CSQA	IndExp	CS-Exp	T-Exp
TR01	B'board or OHP	NS	0.001(+)	NS	0.01(+)	NS	NS
TR02	Charts/diagrams	NS	NS	NS	NS	NS	NS
TR03	Micro & screen	NS	NS	NS	NS	NS	NS
TR04	Comp.Hardware	0.05(F)	0.001(+)	NS	0.05(+)	0.001(-)	0.001(-)
TR05	Models/slides	--	--	--	--	--	--
TR06	Textbook	0.01(F)	0.05(+)	0.05(-)	NS	NS	NS
TR07	Software	0.001(F)	0.05(-)	NS	NS	0.01(-)	0.01(-)
TR08	Microelectronics	NS	NS	NS	NS	--	--
TR09	Video/Film	NS	NS	NS	NS	NS	NS
TR10	Pub.Materials	0.01(F)	NS	NS	NS	0.05(-)	0.05(-)
PR01	Microcomputer	NS	NS	NS	NS	NS	NS
PR02	Teacher handout	0.05(M)	NS	NS	NS	NS	0.01(+)
PR03	Textbook	NS	NS	0.05(-)	NS	NS	0.01(-)
PR04	Robot or Buggy	NS	--	--	--	--	--
PR05	Microelectronics	NS	--	--	--	--	--
PR06	Reference books	NS	0.05(-)	0.05(+)	NS	0.001(-)	0.001(-)
PR07	Software	NS	0.01(-)	NS	NS	NS	0.05(-)

Legend: (F), (M), (+), (-) indicate increased resource use is associated with this direction of the teacher variable
CSQE, (CSQA) CS qualification educational (academic),
CS-Exp = CS teaching experience

Table 11.17: Use of teacher and pupil resources by teacher variables

Teacher Lesson-satisfaction

For each lesson, teachers were asked to rate their own level of satisfaction with the lesson on a five-point scale. The level of Lesson-satisfaction was analysed in terms of the resources used and the Lesson-type.

	Level of Teacher Lesson-satisfaction				
	High or very high (1)	Slightly above average (2)	Average (3)	Rather below average (4)	Low (Dissatisfied) (5)
N_L	137	259	236	44	5
%	20	38	34	6	<1

Table 11.18: Summary of Teachers' Level of Lesson Satisfaction

Table 11.18 shows the level of teachers' Lesson-satisfaction was generally high. Satisfaction was above average (Ratings 1 and 2) in 57% of lessons and below average (Ratings 4 and 5) in 7% of lessons.

No.	Lesson-type Description	Level of Teacher Lesson-satisfaction* 1	2	3	4&5	Total	Sig. (K-S)
1	Teacher talk, p. written work	38	90	84	18	230	NS
2	Teacher talk, p. programming	39	67	45	4	155	0.05
5&3	T. talk, p. do non-prog. PW	18	27	11	6	62	0.01
4	Pupil programming	26	42	39	5	112	NS
7&8	Revision,test, worked examples	7	15	41	10	73	0.001

(*) See Table 11.18 for description of Satisfaction Level codes

Table 11.19 Level of Teacher Satisfaction by Lesson-type

The data in Table 11.19 suggest teachers are most satisfied with lessons that include both teacher talk and pupil programming. The use of tests and revision exercises is associated with average and less than average Lesson-satisfaction.

	Teacher-resource	Level of Teacher Satisfaction(*) 1		2		3		4&5		Sig
	(£)	0	1	0	1	0	1	0	1	K-S
TR01	Blackboard, OHP	69	68	100	159	100	136	28	21	NS
TR02	Charts & diagrams	115	22	230	29	206	30	46	3	NS
TR03	Micro & large screen	93	44	201	58	206	30	43	6	.001
TR04	Other comp.h'ware	120	17	235	24	216	20	45	4	NS
TR05	Models & slides	137	0	252	7	235	1	49	0	NS
TR06	Textbook	116	21	198	61	165	71	40	9	.05
TR07	Software package(s)	114	23	228	31	223	13	46	3	.01
TR08	Microelectronics	132	5	255	4	233	3	49	0	NS
TR09	Video, film	132	5	251	8	229	7	49	0	NS
TR10	Published materials	129	8	240	19	225	11	45	4	NS

(*) See Table 11.18 for description of Satisfaction Level codes
(£) 0 and 1 categories indicate numbers of Non-uses (0)
and Uses (1) of the activity associated with column satisfaction level

Table 11.20: Level of Teacher Lesson-satisfaction by Teacher-resource use

The data for Resource-use and Teacher Lesson-satisfaction given in Table 11.20 show Lesson-satisfaction is higher when the teacher uses either a micro and demonstration screen or software materials. The use of the textbook is associated with average Lesson-satisfaction. All other uses of teacher resources are without significant relationships to the level of Lesson-satisfaction. The data also re-emphasise the low frequency of use of some resources.

	Pupil-resource	Level of Teacher Satisfaction(*) 1		2		3		4&5		Sig
		0	1	0	1	0	1	0	1	K-S
PR01	Microcomputer	57	80	121	138	131	105	28	21	NS
PR02	Teacher handout	90	47	145	114	153	83	27	22	NS
PR03	Textbook	104	33	180	79	139	97	36	13	. 05
PR04	Robot, Buggy, etc	135	2	253	6	236	0	49	0	NS
PR05	Microelectronics	131	6	255	4	235	1	49	0	NS
PR06	Ref. books,library	122	15	234	25	222	14	40	9	NS
PR07	Software package	106	31	212	47	208	28	38	11	NS

(*) See Table 11.18 for description of Satisfaction Level codes

Table 11.21: Level of Teacher satisfaction by Pupil-resource use

Teacher Lesson-satisfaction was also analysed according to the use of pupil-controlled resources. Results in Table 11.21 show teachers associate average and below average Lesson-satisfaction with the use of textbooks. Although teachers expressed a higher level of Lesson-satisfaction with a Lesson-type that included pupil-programming (see Table 11.19), pupils' use of the microcomputer shows no significant relationship in Table 11.21. It is also noticed that although teachers' use of software has a significant association with Lesson-satisfaction in Table 11.20, there is no matching level of significance for pupils' use of software.

Analysis by pupil ability

The ability of each class was judged on an 8-point scale with a further category of "Full-range mixed ability". The data are shown in Table 11.7. Prior to the analyses reported in this section, the top two ability ranges were combined as were the two lowest ranges. The lessons given to the mixed ability classes, under 10% of the total, were omitted from the analyses because it did not seem appropriate to combine them with any of the more homogeneous groups.

Lesson type

The data for the distribution of Lesson-type by pupil ability are shown in Table 11.22. The data show an increased emphasis on revision activities for pupils of moderate and lower ability.

		Pupil Ability Grouping						Sig.
No.	Lesson type	1&2	3	4	5	6	7&8	K-S
01	T.talks,p.write	36	63	28	31	42	17	NS
02	T.talks,p.program	29	33	30	21	21	3	NS
03&05	Non-program PW	10	17	3	7	3	11	NS
04	Programming	16	25	25	21	13	6	NS
07&08	Revision/Test	4	13	13	14	21	8	0.01

Ability codes: 1=Good O-level, 2= All O-level, 3=Mostly O-level,
4= O+CSE, 5=Good CSE, 6=CSE, 7=Weak CSE, 8=Non-exam.

Table 11.22: Lesson type by pupil ability

Resources

The use of teacher-based resources according to pupil ability is shown in Table 11.23. Teachers' use of all types of resources including blackboard, textbook, micro and large (demonstration) screen, hardware and software is seen to be uniformly distributed across the ability groups.

		Pupil Ability Grouping (*)						Sig.
	Teacher-resource	1&2	3	4	5	6	7&8	K-S
TR01	Blackboard, OHP	71	76	67	39	68	23	NS
TR02	Charts & diagrams	15	28	5	3	22	7	NS
TR03	Micro & large screen	20	32	14	22	25	6	NS
TR04	Other comp.h'ware	12	22	9	9	4	6	NS
TR05	Models & slides	4	0	1	1	2	0	NS
TR06	Textbook	25	46	35	21	17	16	NS
TR07	Software package(s)	14	15	13	13	9	4	NS
TR08	Microelectronics	3	1	0	3	1	0	NS
TR09	Video, film	2	4	2	6	4	0	NS
TR10	Published materials	8	13	4	5	5	6	NS

(*) See Table 11.22 or text for Ability Grouping codes

Table 11.23: Use of Teacher-resources by class Ability Grouping

Table 11.24 shows the use of pupil-resources in classes of different ability levels. The data show that the use of all types of pupil controlled resource is independent of pupil ability.

	Pupil-resource	1&2	3	4	5	6	7&8	Sig. K-S
		Ability Grouping (*)						
PR01	Microcomputer	59	72	64	50	45	19	NS
PR02	Teacher handout	44	61	37	29	47	28	NS
PR03	Textbook	31	49	53	32	22	25	NS
PR04	Robot, Buggy, etc	4	2	0	1	0	0	NS
PR05	Microelectronics	3	0	0	3	1	0	NS
PR06	Ref. books, library	16	5	12	18	3	7	NS
PR07	Software package	25	24	20	19	12	14	NS

(*) See Table 11.22 or text for Ability Grouping codes

Table 11.24: Use of Pupil-resources by Ability Grouping

Homework

The distribution of homework type was also tested against pupil-ability as shown in Table 11.25. The infrequently used categories of 4, 5, and 6 (see Table 11.12) were omitted from the analysis. These three categories together accounted for less than 10% of the responses. The K-S tests confirm that some homework types are not uniformly distributed across the ability range. Whilst higher ability pupils are likely to be set written questions, pupils in the lower ability classes are more likely to be given homework of the revising/learning kind . The data show that higher ability pupils do **not** receive a higher proportion of open or enquiry type of homework.

No	.Homework Type	1&2	3	4	5	6	7&8	Sig. K-S
		Pupil ability groupings(*)						
1	None	25	43	38	29	26	23	NS
2	Programming	30	33	22	19	27	4	NS
3	Written exercises	17	21	9	6	12	1	0.05
7	Open enquiry	3	10	6	9	4	0	NS
8	Revise/learn	14	19	6	13	27	9	0.05
9	Finish classwork	5	13	11	14	7	1	NS

(*) See Table 11.22 or text for Ability group codes.

Table 11.25: Frequencies of Homework type by pupil ability

Analysis by Room Type

Table 11.26 shows the cross-tabulation of Lesson-type according to Room-type. The Table shows that teachers use Lesson Types 1 and (7 & 8) less in 'good' rooms of the A and B categories and relatively more often in the C and D rooms. The table confirms the absence (or near absence) of pupil programming (Lesson types 2 & 4) and other practical activities (Lesson Types 3 & 5) in C and D rooms. These not surprising results add support to the reliability of the data.

No.	Lesson-type Description	Room-type* A	B	C	D	Total
1	Teacher talk, p. written work	26	102	14	90	232
2	Teacher talk, p. programming	31	105	14	5	155
5&3	T. talk, p. do non-prog. PW	12	36	6	8	62
4	Pupil programming	28	80	6	2	116
7&8	Revision, test, worked examples	8	42	3	29	82
	Column totals	105	365	43	134	647

(*) See Table 11.9 for description of Room-type categories

Table 11.26: Cross-tabulation of Lesson-type by Room-type

Discussion

The results of the Diary Study demonstrate that the LDRF collected significant and reliable information about the teaching of Computer Studies to 16 year old pupils (Aim 1). Teachers found the LDRF categories suitable for describing their lessons as all the categories were used and the use of the "Other" category was small. The significant differences found between lessons:

- given to pupils in the two years of the course,
- given by teachers of differing experience and training, and
- given to pupils of differing ability

are sufficient to establish the discriminant validity of the LDRF. Its concurrent validity was established before use through the involvement of experienced teachers in its development. The reliability of the instrument is confirmed by the general agreement between findings from the sets of Lesson-type, Resource-use and Lesson-activities data. In other circumstances additional information about the LDRF might have been obtained from a comparison of the teachers' reports with LDRFs completed by a classroom observer but such studies could not be undertaken because of industrial difficulties in schools.

Although the correlations between some teacher variables and lessons must be interpreted with some caution because of the small number of teachers in some categories, from the data it seems likely that there are differences between the types of lessons given by trained and untrained teachers (Aim 2). One of the strongest findings in the analyses according to teacher-variables was of a negative correlation between teaching experience and the use of resources, except Teacher handouts. This shows that more recently qualified teachers were more likely to use resources both for themselves and their pupils. One of the most encouraging findings of the survey allied to this was that a period of fulltime training does produce changes in teachers' use of resources. It appears that teacher variables of gender, industrial experience and academic qualifications are unimportant in determining teaching patterns.

For classes of different ability, no significant differences were found in the use of resources, only one significant difference was found on Lesson-type and two differences in the type of homework given (Aim 3). In lessons the less-able pupils are more likely to be engaged in written work. For homework the higher ability pupils are likely to be given written work whilst lower ability pupils are more likely to receive learning homework.

The survey has shown that one-third of classes receive no homework assignment this being most evident in Year 4. When homework is set it is most likely to be Program writing (Years 4 and 5), or Finish work started in the lesson (Year 4) or Revise/learn (Year 5). Homework featured as a significant correlate of student learning in two studies described in

Chapter 3 (Fraser, 1987; Paschal et al, 1984) and a recent report by HMI (DES, 1987) said of homework

> "its function must be to generate a variety of worthwhile learning experiences additional to those provided in school...designed to take account of the different ages, abilities and needs of the pupils...exploit the environment outside the school and to develop the skills of discovery, of investigation and of independent learning." (p.42-43)

In Computer Studies the importance of homework as a correlate of learning has not been fully exploited and the recommendations of HMI have been only partially met.

There was no consistent pattern of differences between classes of different ability on measures of lesson-type, use of resources or homework activities. The absence of significant relationships between pupil ability and lesson characteristics may be due in part to the relative homogeneity of CS classes. The data have shown most CS-pupils are of above average ability and a high percentage of CS-classes contain O-level pupils only. Teachers may decide this level of uniformity makes it unnecessary to arrange alternative activities for pupils of different abilities.

Teachers were most satisfied with lessons based on teacher demonstration and the use of software and least satisfied with lessons based on the use of textbooks, tests and allied activities. These results show that teachers prefer to use lesson-types and resources that allow joint teacher-pupil participation. The finding that Computer Studies lessons are based on a narrow range of lesson-structures and use a limited range of activities and resources is a major finding of the survey. It appears that resources such as videos, robots and models, and microelectronics modules have very low frequencies of use. Any follow-up study should seek to discover whether teachers are unaware of these resources, are unable to obtain them, or have decided against their use.

Computer studies syllabuses and examinations may be blamed by some teachers for restricting opportunities to use a wider range of teaching and learning activities. It is probably examination pressures that cause teachers to emphasise the teaching of programming in Year 4 and the preparation of a student-project and the use of revision-tests in Year 5. The greater frequency of Revision-type homework in Year 5 is also consistent with teaching that is focused on meeting examination requirements.

Summary

A one sheet per lesson instrument the LDRF was used to collect data about the teaching of Computer Studies to pupils age 14-16 years. The LDRF collected data about the location and duration of the lesson, the style of lesson, the use of resources, homework assignments and the time-distribution of lesson activities. Background information was also collected giving the composition and ability of the class and six teacher variables.It was shown that the 61 teachers who completed the LDRFs were an equivalent sample to the 253 teachers who completed the Activities Checklist.

A review of the Room, Duration, Pupil and Teacher data gives a description of the typical Computer Studies classroom. Teachers' responses showed that 70% of CS-lessons are given in rooms specially built or adpated for work with microcomputers and last for 70 minutes. Computer Studies classes typically contain from 18 - 20 pupils about one-third of whom are girls. The ability of Computer Studies pupils is above average, more than 50% of classes contain all or some pupils of O-level standard.

It was found that four types of lesson were in common use; (1) Teacher talk combined with pupil written exercises, (2) Teacher talk combined with pupil programming, (3) Pupil programming, and (4) Revision exercises and tests. Although 14 lesson activities were listed on the LDRF, only three showed a high frequency of use. These were <u>Teacher explaining new material</u> (53%), <u>Pupils using microcomputers</u> (50%), and <u>Teacher revising old material</u> (48%). The principal resources used in Computer Studies lessons were found to be blackboard, microcomputer, teacher handout and textbook. The finding that teachers and pupils made only infrequent use of

other resources such as videos, microelectronics and models, is one finding of the survey. The Lesson-type chosen by teachers was found to be related to their Experience of CS-teaching and their CS-teaching Qualification. Other teacher variables of gender, qualifications and experience were unrelated to choice of Lesson-type but did influence the use of some resources. Teachers expressed most personal satisfaction with lessons and resource use that allowed teacher-pupil interaction and least satisfaction with lessons using textbooks.

Differences were found between the types of lessons given to pupils in the first and second years of the course. These showed a greater amount of teacher-talk in the first year and of pupil individual work in the second. Differences between first and second year classes in the use of teacher-controlled and pupil-controlled resources were generally confined to the use of textbooks and reference books. The analysis of within lesson activities showed more teacher explanation of new material and pupil note-making in the first year. This is an expected result that adds additional validity to the study.

Differences between the type of homework assignments set in the two years were found to be confined to two of the nine homework-types. The frequency of Revision rose from about 6% in Year 4 to almost 20% in Year 5. The frequency of No-homework fell from 37% in Year 4 to 26% in Year 5. The discovery that over the two years of the course about one-third of lessons had no associated homework assignment is an additional finding of the survey.

Some effects associated with Pupil Ability were found in the data relating to Lesson-type and Homework. The use of Teacher-resources and Pupil-resources did not vary significantly with pupil ability.

CHAPTER 12

SUMMARY, DISCUSSION AND SUGGESTIONS FOR FURTHER RESEARCH

Summary

It is convenient to set out the main findings of the study in terms of the 12 objectives listed in Chapter 5. It will be seen that all these objectives have been achieved.

Objective 1.

To describe the characteristics of a sample of pupils engaged in Computer Studies.

The sample of 2320 pupils included 747 (32%) girls. About half the sample probably had access to a computer at home although this was little used except for games and programming by boys (Table 9.3). Only a minority of pupils had significant experience of CAL (Table 9.4). Data from the Diary Study pupil sample showed that Computer Studies classes contain a high percentage of pupils of above average ability.

Objective 2.

To identify scales or instruments suitable for the measurement of attitudes toward computers held by Computer Studies pupils.

The CARAQ instrument with an additional scale was confirmed as suitable for measuring the attitudes towards computers of pupils taking Computer Studies as an examination subject. The values of reliabilities and mean interscale correlations obtained for the CARAQ scales were closely similar to results obtained in the author's 1984 study (Table 9.6). The instrument used to assess Computer Anxiety was reliable (Table 9.12) and discriminated between sub-groups of the sample (see under Objective 3, below). Two reliable scales measuring pupils' attitudes to a Job using a Computer were derived from a semantic differential questionnaire (Table 9.15).

Objective 3.

To seek relationships between pupil characteristics and attitudes to computers in the sample of Computer Studies pupils.

Gender, home-use of a computer for programming and educational games and Science group membership were found to be associated with more favourable attitudes on all CARAQ scales although the 0.05 level of significance was not reached on the scales THREAT and FUTURE by girls' Homeuse of a computer. CAL-experience was associated with improved scores on the SCHOOL scale for boys and the scales EMPLOY, CAREER and SCHOOL for girls (Table 9.7). Membership of the Arts-group was associated with more favourable attitudes on the scales EMPLOY, SOCIAL, CAREER and LEISURE (Table 10.1).

Boys had a significantly lower level of Computer Anxiety than girls and in general high-levels of Homeuse of a computer for games or programming were associated with lower Anxiety. For girls CAL experience reduced the level of Computer Anxiety (Table 9.13).

One of the two Jobscales showed a significant gender effect (Table 9.16), in which boys gave a computer-based job a higher score on the evaluative scale.

Objective 4.

To describe the characteristics of a sample of Computer Studies teachers

It was estimated that about 42% of eligible teachers returned the Teacher Booklet. Of the survey sample of 253 teachers one-quarter was female. Only 13% of the sample had a degree or near-equivalent academic qualification in Computer Science and only about one teacher in 16 had received full-time training in the teaching of CS (Tables 8.6 and 8.7). Nearly 80% of the sample also taught mathematics (Table 8.5), the data suggested that most CS teachers had previously had some years of teaching another subject. About 20% of the sample had had some industrial experience of using computers.

Objective 5.

To identify and measure variables that correspond to stable characteristics of teachers' behaviours in Computer Studies lessons.

The 19 Activity Scales derived from the Checklist had moderate values of alpha reliability, were statistically distinct (Table 8.10), and were shown by factor analysis to belong to a common construct. These derived variables were used to identify five Teaching Styles. One of these Styles (Style 1) which was adopted by almost 40% of the teacher sample showed fewest departures from "average" teaching, it was characterised by higher than average use of computer software and lower than average use of worksheets and routine exercises (Table 8.12). Styles 2 and 3 were described as "positive" because they were distinguished by the greater use of physical resources, two "negative" Styles were characterised by almost total lack of use of teaching resources other than blackboard and textbook. Male teachers preferred Style 1 whilst teachers with a qualification in computing or teacher training in the subject were most common in Styles 1 and 2 (Table 8.15). Teachers whose other subject was mathematics seemed to avoid the most positive Style (Style 2) and prefer the two negative Styles.

Three canonical discriminant functions (CDFs) derived from the Activity scales may be useful measures of teacher characteristics. Each of the teacher variables of length of teaching experience, industrial experience, academic and training qualifications, teaching subject and gender was associated with just one of the CDFs (Table 8.15). This shows that each teacher variable is associated with an identifiable group of teaching activities.

Responses to the semantic differential questionnaire showed teachers' attitudes to their job could be expressed in terms of two components of demand and evaluation (Table 8.18). These attitude-component scales were found to be reliable (Table 8.20) and independent of teacher variables (Table 8.21).

Objective 6.

To seek relationships between the behaviour variables of Computer Studies teachers and pupils' attitudes toward computers.

Teacher gender was not included in any of the regression equations predicting pupils' attitude scores (Table 10.2). Oneway analysis of variance showed that the global construct of Teaching Style was not associated with pupils' attitudes (Table 10.14). The Activity scale scores were moderately good predictors of the pupils' CARAQ scores with R^2 values from the regression equations ranging up to 22%. The Activities of Microelectronics, Student involvement, Teachers concern for resources, and Teacher taking interest in pupils' career and leisure activities were found to evoke more favourable attitudes (Table 10.6)

No significant correlation was found between any of the 19 teaching Activities and pupils' level of Computer Anxiety (Table 10.12). Teacher gender and other teacher characteristics measured by the CDFs also had no significant correlation with pupils' Anxiety scores (Table 10.11).

Teachers' Jobscores were strongly and positively associated with pupils' views of a computer-based job or career (Table 10.16).

Objective 7.

To identify scales or instruments to measure pupils' perceptions of the Computer Studies classsroom environment.

Nine established scales and one new scale were used to measure pupils' perceptions of the classroom environment. The values of scale reliabilites and interscale correlations found for students of Computer Studies were similar to those reported for science students (Table 9.9). Further analyses suggested four scales of the ICEQ instrument were not wholly suitable for use in Computer Studies classrooms.

Objective 8.

To seek relationships between pupil characteristics and perceptions of the Computer Studies classroom environment.

A few significant relationships were found between pupil characteristics and their perceptions of the classroom environment. When grouped by gender, boys' scores were greater on the RESOURCES and TASK ORIENTATION scales. Homeuse of a microcomputer produced a significant increase on the INVOLVEMENT scale for both boys and girls as well as on the PARTICIPATION scale for boys and on the INVESTIGATION and INNOVATION scales for girls. Experience of CAL significantly increased pupils' perception of the levels of PERSONALISATION and INVESTIGATION in Computer Studies lessons and also increased boys' perceptions of the levels of PARTICIPATION and INNOVATION. Science group membership had no significant influence on pupils'perceptions of the Computer Studies classroom environment (Table 9.10).

Objective 9.

To seek relationships between the behaviour variables of Computer Studies teachers and pupils' perceptions of the Computer Studies classroom environment.

Although some of the multiple correlations between pupils' perceptions of the classroom environment and the 19 Teaching Activities are quite low, some interesting points arise (Table 10.8). The Activity Use of non-micro AV aids increases pupils' perceptions of INNOVATION, TASK-ORIENTATION and ORDER & ORGANISATION in Computer Studies lessons which suggest that pupils feel they are being "well-taught". The use of additional hardware such as Network and wordprocessor is positively correlated with pupils' perceptions of RESOURCES. The perception of INNOVATION is increased by New teaching ideas, Network and wordprocessor and the use of Worksheets. The perception of PERSONALISATION is increased by Use of software and also by Teacher-interest in pupils. When pupils Seek their own information about computers the increased perception of INDEPENDENCE is accompanied by a decrease in the perceptions of TASK ORIENTATION and INVOLVEMENT. Pupils appreciate Activities of Pupil-differentiation and Pupil-directed exercises through an increased perception of classroom DIFFERENTIATION. Oneway analysis of variance showed that Teaching Style was not significantly associated with pupils' classroom environment perceptions (Table 10.19).

Objective 10.

To seek relationships between pupils' perceptions of the Computer Studies classroom environment and their attitudes toward computers.

The 14 CE dimensions were moderately good predictors of pupils' attitudes toward computers. The value of R^2 for the eight attitude scales was in the range 0.10 to 0.29 (Table 10.10). One or both of the classroom environment dimensions of INVOLVEMENT and ORDER & ORGANISATION were included in the regression equation of the eight attitude scales. The scales of CAREER and LEISURE were most strongly related to classroom perceptions while LEISURE was negatively correlated wuith TASK ORIENTATION. Only the scale INVOLVEMENT had a significant correlation with Computer Anxiety. A higher level of INVOLVEMENT was associated with a lower level of Anxiety (Table 10.13).

Objective 11.

To determine the lesson styles, activities and resources used by teachers and 14-16 year old pupils in Computer Studies lessons.

Over half the CS lessons reported in the Diary Study lasted for 70 minutes. The majority of lessons were given in a room specially equipped for Computer Studies. The mean class size was 19 pupils (12B, 7G). Computer Studies classes were reported to contain a lower proportion of pupils of average and below average ability (Table 11.17).

Over 80% of lessons used one of the three lesson structures of Teacher talk and pupil written work, Teacher talk and pupil programming and Pupil programming in Year 4 (Table 11.11). These structures were also the most common in Year 5 although the frequency of Revision examples and Tests increased sharply. Quite often, after a teacher introduction in the first third of the lesson, pupils spent the remainder of the lesson either doing written exercises or programming at the keyboard. Both teachers and pupils used a limited range of non-hardware resources (Table 11.13). Lessons varied little in type, use of resources or homework with pupil ability possibly because teachers thought any variation unnecessary with relatively homogeneous classes (Tables 11.22 to 11.25). Only three types of homework were common in each year of the course, Program writing and Answering questions were common in both Years 4 and 5, Finish classwork was common in Year 4 and Revise in Year 5 (Table 11.12).

Objective 12.

To determine whether lesson styles and resource use in Computer Studies lessons are related to characteristics of the teacher, pupil and classroom environment.

One of the most noticeable feature of Computer Studies lessons was their uniformity. Lesson-Type varied only with teacher variables of teacher training and teaching experience in Computer Studies (Tables 11.15, 11.16). The use of resources followed a similar pattern, the variables of CS Teaching Experience and CS Teacher Training Qualification showed the strongest influence on the use of a wide range of resources (Table 11.17).

Discussion

Computer Studies in the school curriculum

The significance of the descriptions of Computer Studies teaching activities, pupils' attitudes and the context of lessons obtained in the survey has to be judged against the potential benefits of this subject for pupils. In other words, "Why do schools teach Computer Studies?". Views of Universities and of the Alvey Committee quoted in Chapter 1 agree that the cognitive content of current courses of CS is of little or even negative value to pupils going into Higher Education. Thus a "specialist knowledge" or "introduction to further studies" argument cannot be used to justify the place of Computer Studies in the school curriculum. The value of the cognitive content of Computer Studies to students leaving school at age 16 is also doubtful. In Chapter 1 it was noted that the skills of BASIC programming and of handling the limited range of school equipment are judged of little value by employers. In their view the interests of students would be better served by more attention to the basic skills of literacy, numeracy and communication. Thus the "vocational skills" argument cannot be used to justify the teaching of Computer Studies. In the concluding section of his survey report, Wellington (1987) says:

> "The requirements of employers are rarely stated in specific terms and are almost never phrased in the language of skills....employers' requirements and selection criteria are usually couched in terms of attitudes, aptitudes, awareness" (Wellington, 1987, p.81)

These requirements suggest the place of Computer Studies in the school curriculum may be justified if it

1. helps pupils to develop favourable attitudes to computers and their use, and
2. helps pupils to become aware of the range of computer equipment, techniques and applications to be found in industry and commerce.

Some points from this study

Data from this and other studies suggest that pupils have little experience of computer assisted learning. If there is also no provision within a school for granting pupils individual access to computers to pursue self-chosen activities, Computer Studies lessons may be equated with pupils' total school computer experience. It is therefore important to ensure that Computer Studies lessons do develop computer awareness and favourable attitudes toward computers. The results of this study have provided information about the attitudinal effects of lesson activities and other variables.

One of the principal findings has been the strong association between home-use of a computer and pupils' attitudes and perceptions. The existence of a link between home-use and attitudes in the general population is well-known and is understandable. Neverthless it is still somewhat surprising to find that there is a strong association between home-use and attitudes in a sample of pupils taking Computer Studies at school. All the pupils in the sample had received between 50 and 60 weeks of Computer Studies lessons averaging 140 minutes per week. The results show that this extensive school study of computers did **not** mask the attitudinal effects of home-use.

For those pupils who do not have the advantage of a home computer, open access to school computer facilities could improve attitudes and reduce Computer Anxiety. It might also be useful in reducing a marked gender effect which was shown on all attitude scales. Even after the period of Computer Studies experience, girls had significantly less favourable attitudes. In Chapter 2 it was noted that in a Swedish study, a 12 month course in "datalara" did not remove gender differences.

The five Teaching Styles had no significant differential effect on pupils' attitudes although it might have been expected that the positive styles would lead to different outcomes from the negative styles. One reason for the absence of a Teaching Style effect in this study may be connected with another major finding of the survey which was that the format, structure and resources employed in Computer Studies lessons vary over a limited range. The emphasis on programming and the limited range of concrete materials are all consistent with a course perceived in terms of an examination based on "Project plus written paper" which could have masked the effect of teacher style on pupil attitudes. If, as it seems reasonable to suppose, passing the examination rather than developing attitudes and awareness is the teachers' major aim, the pervading ethos might be similar in all Computer Studies lessons. Thus all Teaching Styles could have the same minimal effect on pupils.

Trends and implications

An increasing number of schools are providing courses of "computer awareness" or "information technology" for all pupils and are reducing, or ceasing altogether, the amount of CS taught in favour of using resources for computer assisted learning across the curriculum (Wellington, 1987). In Chapter 1 it was noted that the networking of a school's micro-computers, often associated with the teaching of Computer Studies, was negatively associated with use of CAL across the curriculum. If schools feel pressed to increase their commitment to CAL and to the use of information technology throughout the school, they may decide it is preferable to distribute their computer hardware more widely. This policy would make it more difficult to also teach Computer Studies. In The National Curriculum 5-16 (DES, 1987) Computer Studies is not one of the ten core subjects.

Given current criticisms of this subject and the likely pressures on the school timetable, the writer thinks it most unlikely that Computer Studies as an examination subject will survive if the National Curriculum proposals are implemented. In future, pupils may be expected to acquire their knowledge of computers and micro-electronics through the core subject "Technology" which will be taught to all pupils from 7 to 16.

The employers questioned by Wellington wished school leavers to be aware of computers and information technology and to have favourable attitudes toward their use. There is no reason to suppose these aims should be different for the teaching of "technology for all" in a new curriculum. The content and teaching methods of the new subject should be chosen to meet these aims.

Results from the present survey can provide helpful pointers to designers and teachers of these new courses. The results indicate that teacher training has an effect on classroom practices. The importance of teacher training in the use of alternative classroom activities and the use of resources will increase as less-specialised and more wide-ranging courses are put into the curriculum of younger pupils.

Suggested courses should be framed in ways that requires pupils to experience a wide range of both hardware (equipment) and software (programs). It has been shown that one feature of the present CS courses was their concentration on a narrow range of resources. The finding that use of micro-electronics modules, videos, visits etc. together account for less than 10% of all lessons is a clear indication that current courses do not help pupils to become "aware" of computers and microelectronics technology and their applications. The survey has shown that teacher training can encourage teachers to employ a wide range of teaching tactics and teaching resources which in turn lead to pupils acquiring more favourable attitudes. Research showing the favourable effect of new science curricula and interaction on students' attitudes was reported in Chapter 3 and similarities between science and Computer Studies research studies make it reasonable to suppose a similar effect may be found if new syllabuses of "computer awareness technology" are introduced.

In the new courses pupils should not be required to prepare any long project for assessment or other purpose. The excessive amount of class-time required for pupils to produce this piece of work was possibly one reason why teachers were unable to use a range of lesson structures that would reflect their own skills, personality and interests.

The tasks or exercises for computer solution used in teaching the new subject should be seen as relevant by the pupils. They should be the sort of tasks that pupils might themselves tackle with their home computer. The basis for this suggestion is the observation that home activities have favourable associations with attitudes. These favourable associations include a lower level of Computer Anxiety. Therefore school activities that are similar to these activities and take place in the same environment may also promote favourable attitudes.

The importance of the environment in which computer activities take place is demonstrated by other evidence from the survey. More favourable attitudes on the CARAQ scales were favoured by classroom environments the students perceived as high in INVOLVEMENT and ORDER & ORGANISATION. As explained earlier, it is possible to interpret these findings as students seeking a "home" environment within the classroom.

Spaull (1987) reports an experiment in which open access to computer equipment provided within a University Hall of residence produced a "home environment" in which the students could gain computing experience. Just as at home, the computers are available "in the room next door" around the clock and there is often someone else nearby, not a teacher or member of staff, who can be approached for help or who can be shown one's latest achievement. Also any problem a student chooses to tackle is their own choice, it is not part of an assignment, there is no time limit, and it can be continued or abandoned just as the student wishes. The provison of a "home-computer room" within a school would help to redress the imbalance against girls and socially-disadvantaged groups of pupils who do not have access to a computer outside school.

Suggestions for further research

It has been suggested that new school courses dealing with computers should have the aims of promoting awareness and favourable attitudes. Awareness of computers may be achieved through use of a much wider range of computer and teaching resources than is presently used in CS lessons. Favourable attitudes may be encouraged if school experiences of computers set out to "mimic" home experiences. These two suggestions (provision and use of a wider range of resources and home-like experiences) for teaching changes could be the subject of action research.

To study the effects of materials, a small number of teachers could first be trained in the classroom use of a wide range of computer-related teaching resources for themselves and the pupils. These would include videos, computer software, microelectronics modules, visits and so on. The teachers would then be asked to teach a non-examination course of computer awareness (or information technology awareness) for, say, one term. It would be feasible to use the CARAQ instrument and Anxiety scale to look for attitude changes associated with pupils' wider experiences.

The second line of research, the provison of "home environment experiences" at school may be more significant. Perhaps a study of the effects of the provision of a "home-computer room" within a few schools would provide useful pointers for a larger scale study.

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APPENDIX

CONTENTS

Activities in Computer Studies Teaching

COMPUTER EDUCATION RESEARCH

HULL UNIVERSITY

1985

COMPUTER EDUCATION RESEARCH

A project supported by ESRC

1985/6

This booklet forms part of a survey of activities in Computer Education in secondary schools. It is designed to obtain information from teachers of Computer Studies about their use and importance-rating of certain lesson activities and some perceptions of their work.

All responses will be treated in strictest confidence. Results will be used to improve teacher education courses in Computer Studies and Information Technology.

All Computer Studies teachers are invited to take a further part in the research study as explained on the inside back cover.

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THE COMPUTER STUDIES ACTIVITIES CHECKLIST

Instructions for checklist completion

The checklist is a list of statements used by teachers to describe their activities in lessons of Computer Studies. In the list, 'pupil' refers to a boy or girl taking Computer Studies for O-level, CSE or 16+ examinations. 'Equipment' identifies all types of computer equipment, peripherals and microelectronics devices. 'Materials' means consumable materials whilst 'resource' refers to books, textbooks and workcards, CAL-packages and software, and all other audio-visual aids.

To describe your job as a Computer Studies teacher you should read each statement and quickly decide whether you normally perform that activity in the course of your school work. The interpretation of normally should be that you deliberately and freely choose to engage in the activity on one or more occasions each year. Do not record any operation that you have been forced to use by unusual or special circumstances.

Write 1 in the box if the activity is part of your normal Computer Studies teaching with pupils age 14-16 years. Write 0 if it is not.

The restriction to a YES (1) or NO (0) response may prove difficult for some activities. The important consideration is whether you choose to perform the operation, if you do then teacher-training courses must allow for it. If you feel unable to give a fair picture of your Computer Studies teaching because some items are not clear or for some other reason, please record your comments on the page provided at the end of the booklet.

SUMMARY OF INSTRUCTIONS

1. All activities refer to Computer Studies for O/CSE/16+ examinations
2. Write 1 in the box of any activity you do perform
3. Write 0 in the box of any activity you do not perform
4. Check that for each page every activity has either a 1 or a 0
5. Comment if you wish at the end of the checklist.

1	Require pupils to make notes from a class textbook	
2	Meet with other teachers to review/discuss CAL materials	
3	Demonstrate thermistor or other sensor connected to input port	
4	Use own computer at home to prepare CS materials and exercises	
5	Use computer program to demonstrate binary/hex arithmetic	
6	Use slides or tape-slide pack in CS teaching	
7	Mark a pupil's work in the presence of the individual pupil	
8	Encourage pupils to use micros in out-of-lesson time to complete classwork or obtain extra practice	
9	Ask pupils to bring examples/problems from other subjects to CS lessons	
10	Demonstrate file-handling or administration package to head, deputies or other senior school staff	
11	Require pupils to copy material from a teacher-produced worksheet	
12	Teach about artificial intelligence as one of the CS topics	
13	Permit pupils to use equipment or materials that you have not previously demonstrated	
14	Use film or video to show applications of computers	
15	Use computer program to show action of logic circuits (gates)	
16	Require pupils to write an extended account ("essay") after viewing a film or video	
17	Write CAL programs for use in your own teaching	
18	Demonstrate PRESTEL as part of a CS lesson	
19	Ask pupils to work through a manual file-handling exercise as an introduction to computer file-handling	
20	Maintain/repair computer equipment oneself	
21	Write or modify CAL programs for teachers in other subjects	
22	Regularly spend class time talking about test or homework answers with individual pupils	
23	Show video to initiate discussion about effects of computer-use	
24	Teach techniques of top-down or structured programming	
25	Use class textbook as source of exercises on non-programming topics ..	
26	Ask pupil to talk to the class about a computer application linked to the work of a parent/relative/friend	

1 Require pupils to work at micros in groups of three or more .... ☐
2 Borrow books or materials from MEP centre or local centre for personal study or information .... ☐
3 Use teletypewriter to show production/reading of paper-tape .... ☐
4 Set an individual pupil extra problems/exercises to help correct a misunderstanding revealed by test or homework .... ☐
5 Engage in fund-raising activities to buy additional microcomputers ... ☐
6 Help other staff to choose or obtain appropriate CAL software .... ☐
7 Provide pupils with a guide to help them make notes from books .... ☐
8 Demonstrate a commercial/business package/program to CS-pupils .... ☐
9 Record TV-programmes for use in CS lessons .... ☐
10 Allow pupils to program directly at the micro keyboard without first making a program listing on paper .... ☐
11 Supply a list of titles from which pupils must choose their projects . ☐
12 Use/demonstrate a link to a mainframe computer .... ☐
13 Within the same class, set different programming exercises to pupils with different levels of programming experience .... ☐
14 Ask pupils to evaluate a piece of software sold for home/school use .. ☐
15 Use CS lessons to improve pupils' prospects on the job-market .... ☐
16 Run an INSET course on CAL within your own school .... ☐
17 Display pupils' CS-work outside the CS teaching room/area .... ☐
18 Give lessons on problem-solving in addition to lessons on programming ☐
19 Require pupils to read selected parts of textbook in CS lesson .... ☐
20 Plan lessons so that time is available for talk with individual pupils ☐
21 Maintain library of books and magazines specifically for pupil use ... ☐
22 Discuss careers in computing with pupils in out of lesson time .... ☐
23 Read computing or technical magazines in the school library .... ☐
24 Demonstrate the use of the input-output ports of the micro .... ☐
25 Require pupils to write notes or essay as a follow-up to a class discussion or debate .... ☐
26 Require pupils to study part of the syllabus by private study only (ie without formal teaching) .... ☐

1 Hold a class discussion of recent computer news or development in place of the lesson planned for that day .... ☐
2 Use wallcharts showing parts or peripherals of microcomputers .... ☐
3 Issue a class textbook for an extended period .... ☐
4 In school time, write or amend programs for school administration .... ☐
5 Use a demonstration board of logic gates .... ☐
6 Set pupils exercise based on use of a file-handling package .... ☐
7 Use pupils' questions as ideas for subsequent lessons .... ☐
8 Demonstrate control of a lamp/motor via the output port of a micro ... ☐
9 Help/advise staff about microcomputer hardware for CAL use .... ☐
10 Require pupils to use a commercial-office software package (eg a spreadsheet) .... ☐
11 Incorporate the teaching of study-skills within CS lessons .... ☐
12 Use simulated computer system to teach programming or other concepts . ☐
13 Demonstrate BBC-Buggy or other robot-like device .... ☐
14 Ask pupils to bring computer-items from newspapers and magazines for teaching use in CS lessons .... ☐
15 Specify the length or content of pupils' projects .... ☐
16 Require pupils to choose and write their own ideas about some aspect of the social effects of computer use .... ☐
17 Use an objective test to assess programming or keyboard skills .... ☐
18 Allow pupils to use a wordprocessor to prepare the documentation for their CS project .... ☐
19 Suggest pupils devise their own problems for programming exercises ... ☐
20 Require pupils to use sensors (eg for light, temperature) as part of CS practical work .... ☐
21 Use ECONET (or equivalent) network for CS teaching .... ☐
22 Talk generally about a topic whilst pupils make notes .... ☐
23 Take positive action to encourage girls to choose CS .... ☐
24 Offer extreme or exaggerated view to stimulate pupils' comments .... ☐
25 Ask pupils to bring their own software for use in CS lessons .... ☐
26 Use pupils' programming ideas as a starting point for further lesson(s) on programming .... ☐

1. Devise special projects for less-able pupils in CS-classes ....
2. Demonstrate teletext as part of CS lesson ....
3. Obtain materials from MEP centre or local centre for demonstration ...
4. Use a "cardboard computer" or other physical model to aid the teaching of programming concepts ....
5. Ask pupil to talk to the class about his/her project ....
6. Consult LEA Adviser about financial problems of resources for CS .....
7. Set exercises requiring extended answers throughout whole course .....
8. Require pupils to answer a worksheet in conjunction with a video .....
9. Demonstrate bar-code reader ....
10. Use wallcharts showing parts or peripherals of mainframe computers ...
11. Attend local (non-residential) INSET course ....
12. Give screen demonstration of turtle graphics (LOGO) ....
13. Ask pupils to talk about their views on the social effects of comps...
14. Consult LEA Adviser about the teaching of a particular CS topic ......
15. Run a programming course for staff in your school ....
16. Require pupils to study one or more computer applications by private work and use of library books ....
17. Require pupils to carry out experiments with microelectronics "modules" or circuits ....
18. Discuss careers in computing during CS lesson-time ....
19. Tell pupils they should try to arrange a personal visit to a computer installation with the help of a parent/relative/friend ......
20. Use a wordprocessor for the preparation of handouts and worksheets ...
21. Teach some pupils extra "theory work" outside normal lessons ....
22. Act as examiner/moderator for CSE/O/16+ examination board ....
23. Locate source of cheap or free materials for CS teaching ....
24. Require pupils to make their own notes during class siscussions ......
25. Display rules relating to safe/allowed use of microcomputers etc .....
26. Display pupils' work on the walls of the CS teaching area ....

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1. Belong to a professional computing group (BCS, CEG, MUSE,...) ....
2. Demonstrate lightpen, graphpad or other alternative input device ......
3. Set aside part of the lesson just to answer pupils' questions ....
4. Contact University/College staff about CS teaching or facilities ......
5. Require pupils to type-in a listing from book or magazine ....
6. Require pupils to use a wordprocessor as part of a CS lesson ....
7. Ask local employers what computer-skills they require of employees ....
8. Implement teaching idea from journal or educational text ....
9. Include computer-control as a topic within CS teaching ....
10. Give pupils worksheets for non-programming topics ....
11. Discuss a pupil's program with the whole class ....
12. Encourage pupils to write to firms/institutions to seek information about computers and computer applications ....
13. Teach some practical microelectronics as part of CS ....
14. Use a simulation of teletext for demonstration or pupil work ....
15. For CS teaching, make use of a database containing the school records of pupils in the class ....
16. Set programming problems based on the known interests of individual members of the class ....
17. Allow pupils to go to school library during a CS lesson ....
18. Construct an interface or "control-box" for CS teaching/demonstration .
19. Help class/group to enter for a computer competition ....
20. Set pupils an exercise based on use of a simple database (eg Quest) ...
21. Tell pupils their essay answers should include material they have discovered for themselves ....
22. Assist school office staff with administrative use of the computer ....
23. Require pupils to tackle "debugging" in a logical and serious manner as an integral part of programming ....
24. Talk to pupils about their leisure time use of home micros ....
25. Use diagrams or articles from computer magazines for wall display .....
26. Encourage pupils to seek an "unusual" solution to programming exs......

1. Attend an INSET course on microelectronics .... ☐
2. Use different sets of programming exercises for fast and slow pupils in the same class .... ☐
3. Read a pupil's work to the rest of the class .... ☐
4. Devote part of each day (or nearly every day) to care of school network, administration programs or software resources .... ☐
5. Tell pupils to make a personal study of a computer application linked to the work of a parent/relative/friend .... ☐
6. Check programs used at computer club sessions have some educational value .... ☐
7. Require pupils to use reference books to find data for class exercises ☐
8. Require pupils to make notes on applications from the class textbook .. ☐
9. Split class into two or more groups doing different non-programming work in the same room .... ☐
10. Use more than one type of micro with a class or group .... ☐
11. At home, write programs for school administration .... ☐
12. Demonstrate a stock-control simulation program .... ☐
13. Allow pupils a free choice of which programs to record in their notes ☐
14. Make or repair microelectronics equipment for another teacher/dept..... ☐
15. Set test requiring extended answers each term or more often .... ☐
16. Collaborate with other teacher(s) to teach Information Technology ..... ☐
17. Set programming problem based on topic from another school subject .... ☐
18. Arrange some lessons so that half the class uses micros for programs whilst the other pupils do non-programming work .... ☐
19. Require pupils to use a BBC-Buggy or other robot for practical work ... ☐
20. Make personal visit to computer installation to obtain ideas or information for CS teaching .... ☐
21. Implement a teaching idea from another teacher or an INSET course ..... ☐
22. Use newspaper/magazine article as source of lesson material .... ☐
23. Keep in touch with past pupils studying or working with computers ..... ☐
24. Require pupils to make brief notes from longer teacher handout .... ☐
25. Demonstrate file-handling by means of a commercial program .... ☐
26. Require pupils to consult more than one book to answer set exercise ... ☐

1. Vacate CS-area in favour of teacher wishing to use CAL .... ☐
2. Allow pupil to work on project or individual study instead of doing class exercises .... ☐
3. Demonstrate an education program as an example of computer application ☐
4. Require pupils to use non-keyboard input device(s) for practical work ☐
5. Demonstrate wordprocessor in CS-lesson .... ☐
6. Show commercial program to help teach screen-layout programming ...... ☐
7. Require pupils to collect data to make up personal datafile .... ☐
8. Arrange for class or group to produce cooperative work .... ☐
9. Call on pupil with special knowledge or interest in a topic to make a greater contribution to class discussion .... ☐
10. Teach one or more topics solely by class debate .... ☐
11. Give help with computer administration of school records etc .... ☐
12. Seek help from another teacher about the teaching of a CS topic ...... ☐
13. Require pupils to program on more than one type of micro .... ☐
14. Require pupils to use a simulation of a computer application .... ☐
15. Ask pupils' opinions of work set/done in CS lessons .... ☐
16. See pupil after school to explain errors in test or homework .... ☐
17. Use CAL-type material and large screen to teach non-programming topic . ☐
18. Set exercises to develop pupils' keyboard (ie typing) skills .... ☐
19. Require pupils to make their own notes about film/video .... ☐
20. Request pupil to ask a parent/relative to give help with arranging a class visit to a computer installation .... ☐
21. Read educational computing journal to look for teaching ideas .... ☐
22. Explain to class/group how to use information sources for projects .... ☐
23. Compile alternative non-programming worksheets for use at different ability levels in the same class .... ☐
24. Use program written by pupil for CS teaching .... ☐
25. Personally construct microelectronics equipment for CS teaching ...... ☐
26. Run a Computer Awareness (non-programming) course for other staff .... ☐

1 Encourage pupils to attend outside lecture/exhibition on computing ...	
2 Allow pupils a completely free choice of which application to study ..	
3 Use diagrams/articles from computer magazine as part of pupil handout	
4 Invite headteacher to attend CS lesson or computer club session	
5 Demonstrate assembly language or machine-code programming	
6 Ask pupils to bring items of hardware for use in CS lessons	
7 Talk to pupils about TV-programmes on computers outside lesson time ..	
8 Make use of videogame in CS teaching	
9 Encourage pupils with a home micro to work ahead of other pupils	
10 Ask pupil to demonstrate program he/she has written to the whole class	
11 Issue more than one set of textbooks during the course	
12 Arrange the class so that some pupils write programs into notebooks whilst others use the micros for programming exercises	
13 Require pupils to write LOGO (turtle graphics) program	
14 Demonstrate electronic mail-box communication (eg Micronet)	
15 Require pupils to make notes on article from newspaper/magazine	
16 Ask pupil to talk to class about computer visit or other experience ..	
17 Discuss own personal computer interests with pupils after lessons	
18 Use micro to process data collected by pupils with another teacher ...	
19 Preview audio-visual materials prior to use in CS lesson	
20 Provide pupils with a "Teach-yourself programming" text or program ...	
21 Invite computer user to visit school to talk to pupils	
22 Consult/discuss with other teachers about the teaching of problem-solving skills	
23 Demonstrate computer-aided-design (CAD) program or simulation	
24 Point out the job-relevance of CS topics and skills	

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BACKGROUND INFORMATION

This is to help us assess the extent to which different training and other experiences may affect the choice of teaching activities.

1. Sex

Female		Male	

2. How long have you been teaching?

Less than 2 years	
3 - 5 years	
6 - 10 years	
11 or more years	

3. Have you worked with a computer in industry/commerce?

NO		YES, for ___ years	

4. What are your Computer Science qualifications?

Academic

CS degree, joint degree or HNC/HND in CS	
College or Open Univ. qualification in CS	
No academic qual. in CS	

Educational

FT INSET, 1 term+	
PT INSET for an award or certificate	
PT INSET, no award or certificate	
No INSET training	

Have you any other qualification in CS (academic or education)? (Name/describe) ....

5. What are your other principal teaching subjects?

Mathematics	
Science	
Technical/craft	
Humanities	
Mod Lang /English	

6. For how long have you taught Computer Studies?

Less than 2 years	
3 - 5 years	
6 - 10 years	
11 or more years	

7. Your present school is: girls/boys/mixed: age range ....

ACTIVITY IMPORTANCE RATING

In this section your are to describe the teaching of Computer Studies as you think it should be carried out. You can do this by indicating the relative importance of some CS teaching activities.

The activities to be considered are shown in the Rating Matrix on the opposite page. Please give your view of each of the 17 types of teaching activity in terms of its relative importance in CS teaching. Rate each activity as Above Average, Average, or Below Average in importance. If there is any activity which you consider completely unimportant or of no value, show this in the end column of the table.

Try to place approximately equal numbers of activities (ie about 6) in each of the three categories of relative importance.

Please rate ALL activities.

ACTIVITY IMPORTANCE RATING MATRIX

	Relative Importance (About 6 Act's per column)			Act's of no value in CS teaching
	Above Average	Average	Below Average	
Organise and supervise the work of groups and individuals in the class				
Encourage pupils to provide resources for teaching/learning				
Use computer software for teaching				
Maintain informal contact with pupils both in and out of lessons				
Seek external help/advice for CS teaching or information				
Utilise the full potential of the micro as a teaching aid				
Write programs for administration and other teachers				
Incorporate microelectronics theory and practical into CS lessons				
Make full use of available textbooks				
Set pupils clearly and precisely specified tasks and exercises				
Allow pupils to work freely to develop their own ideas				
Make use of non-computer based teaching resources				
Make use of technical/electronic aids				
Allow pupils to participate in and to choose the teaching activities				
Link CS teaching to ideas and practices of industry and commerce				
Actively seek new teaching ideas				
Provide pupils with individualised learning experiences				

THE JOB OF A COMPUTER STUDIES TEACHER

You have used a checklist and an importance-rating grid to describe the teaching of Computer Studies. We would like you now to describe your job in another way.

Listed below are a number of contrasting pairs of words or phrases which might be used to describe the job of CS teachers. Please give your assessment of this task by circling one of the numbers along each scale.

The numbers between the words or phrases allow you to indicate how much you think the job is like either of the pairs. The closer your choice is to one end of the scale the more strongly you feel that end best describes your job. For example, if you feel your job is very closely related to the word at one end of the scale, you should circle the number at that end:

Either

Easy (1) 2 3 4 5 6 7 Difficult

Or

Easy 1 2 3 4 5 6 (7) Difficult

If you feel your job is quite closely related to one end or the other, then circle either 2 or 6. If it is only slightly related to one side, then circle either 3 or 5. If you consider that both ends are equally associated with your job, or that the scale is completely irrelevant, then you should circle 4.

DO: Consider both ends of the scale before deciding
Circle ONE number only for each scale
Answer ALL scales

The job of a Computer Studies teacher

Valuable	1	2	3	4	5	6	7	Worthless
Tense	1	2	3	4	5	6	7	Relaxed
Successful	1	2	3	4	5	6	7	Unsuccessful
Involves much responsibility	1	2	3	4	5	6	7	Involves no responsibility
Interesting	1	2	3	4	5	6	7	Boring
Unfriendly	1	2	3	4	5	6	7	Friendly

The job of a computer studies teacher

Modern	1	2	3	4	5	6	7	Out-of-date
Safe	1	2	3	4	5	6	7	Risky
Comfortable	1	2	3	4	5	6	7	Uncomfortable
Difficult	1	2	3	4	5	6	7	Easy
Varied	1	2	3	4	5	6	7	Repetitive
Authoritative	1	2	3	4	5	6	7	Participative
Well-defined	1	2	3	4	5	6	7	Ill-defined
Needs imagination	1	2	3	4	5	6	7	Needs no imagination
Necessary	1	2	3	4	5	6	7	Not necessary
Unpleasant	1	2	3	4	5	6	7	Pleasant
Requires work as part of a team	1	2	3	4	5	6	7	No team-work is required
Demanding	1	2	3	4	5	6	7	Undemanding

The job of a computer studies teacher

Involves many things	1	2	3	4	5	6	7	Involves one thing
Requires much experience	1	2	3	4	5	6	7	No experience is required
Theoretical	1	2	3	4	5	6	7	Practical
Useful	1	2	3	4	5	6	7	Not useful
Technical	1	2	3	4	5	6	7	Non-technical
Fits in with other subjects	1	2	3	4	5	6	7	Does not fit in with other subjects
Non-specialised	1	2	3	4	5	6	7	Highly specialised
Suitable for everyone	1	2	3	4	5	6	7	Suitable for very few
Active	1	2	3	4	5	6	7	Passive
Healthy	1	2	3	4	5	6	7	Unhealthy
Needs special training	1	2	3	4	5	6	7	Does not require special training

THANK YOU FOR YOUR HELP

The valuable information in this completed booklet could not have been obtained without your cooperation, the time and help you have given are much appreciated.

PLEASE: Use this page to add any comments or suggestions
Read the invitation opposite
Return the completed booklet in the envelope provided.

Do you have a colleague who teaches CS and who might be willing to complete a booklet? Please give his/her name with your return.

AN INVITATION

You are warmly invited to take a further part in the study or to be informed of its findings. If you would like to do so, please indicate your interest and give your name and address below.

I/We should like to receive a report of the findings of the study (due late 1986) ☐

I/We may be (*) willing to keep a record of about 12 Computer Studies lessons. Each lesson-record will require only a few minutes for completion. ☐

I/We may be (*) willing to allow some CS pupils to answer a 30-minute attitude questionnaire. No CS knowledge or skills will be tested. The questionnaire can be used with pupils of all abilities. ☐

(*) A copy of the lesson-record sheet and the pupil questionnaire will be sent for ypur prior approval.

Name(s) ....

....

School Address ....

....

.... Postcode ....

Please send a booklet tp my colleague(s) ....

(at the above address) ....

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POST-LESSON REPORT FORM

Date .... Lesson duration .... (mins) Room Type (A,B,C,D) ......

Lesson type Tick ONE that best gives a description of this lesson

Teacher talk/demonstration, little/no PW by pupils ....

Teacher talk/demonstration, pupils do programming PW ....

Teacher talk/demonstration, pupils do non-programming PW ....

Pupils do programming PW .... Pupils do non-programming PW ....

Class debate/discussion .... Revision or pupil exercises ....

Other (describe) ....

Resources used by the teacher Circle ALL those used in this lesson

BB/OHP	Charts/ diagrams	Micro and large screen	Other computer hardware	Model/ slides
Textbook	Software package	Microelectronics modules/robot	Film/ video	Published teaching materials

Resources used by pupils Circle ALL those used in this lesson

Micro	Teacher handout	Textbook	Robot/ buggy etc	Microelectronics modules/circuits
Ref book/ library	Software package	Other (describe)		

Homework set this lesson Circle ONE that best describes the work set

No homework set	Program writing	Written answers to textbook/handout qns	Written answers to oral/bb questions
Reading from textbook	Writing notes/ definitions	Open enquiry or search for info.	Revising or learning

Level of lesson satisfaction Mark ONE estimate for your own, ONE for pupils

The general level of your satisfaction with this lesson is:	High/ very high	Slightly above average	Average	Rather below average	Low (dissatisfied)
Your estimate of pupils' satisfaction with this lesson is	High/ very high	Slightly above average	Average	Rather below average	Low (dissatisfied)

Lesson activities For each activity indicate the period(s) of the lesson when it was used. Tick more than one column if appropriate.

	LESSON PERIOD			
	First third	Second third	Final third	Not used
Teacher poses problem for class solution				
Teacher demonstrates				
Teacher explains new material/idea(s)				
Teacher revises material/ideas already known ..				
T. uses AV aid or non-computer resource				
T. discusses/marks/sets homework				
Pupils do written exercises				
Pupils read or make notes from textbook/H'out				
Pupils make notes from bb or dictation				
Pupils use microcomputers				
Pupils write programs without computers				
Class discusses/debates a problem/issue				
Pupils do non-programming PW				
Pupils do individual or project work				
Other activity (name)				

Description of the lesson

Describe briefly, in chronological order, what happened in this lesson. Mention the concepts/ideas taught, the method of teaching, how activities and materials were organised and any key events whether these were planned or not.

COMPUTER ATTITUDE (CARAQ) SCALES USED IN THE PUPIL QUESTIONNAIRE

All items had a four-point response scale: Strongly Agree, Agree, Disagree, Strongly Disagree. Positive items were scored 1, 2, 4, 5 and omitted items 3.

Satisfaction

1. Finding a solution to a computer problem gives a feeling of mental satisfaction
2. Computer Scientists can be as creative as other scientists
3. Programming a computer to do new tasks can be a real challenge
4. Computer Studies can be as thought provoking as other subjects
5. Programming a computer offers almost unlimited challenges and possibilities
6. Using a powerful computer can be a fascinating experience
7. It is better to be able to appreciate art and music rather than computers and microelectronics
8. Testing a new idea in microelectronics or computing is often exciting
9. Computers are one of mankind's greatest achievements
10. Working with a computer can help to develop a person's thinking power

Future

1. In the future nearly everyone will have something to do with computers
2. In the future computrs will make books almost unnecessary
3. We will soon use microcomputers to help in the home
4. Soon everyone will need to know how a microcomputer works
5. A really big computer can answer any worthwhile question
6. Everyone should know about the uses of computers
7. By the end of the century every home will have a microcomputer
8. The future of this country depends mainly on having good computers
9. Nowadays computers affect the lives of everyone

Social

1. Computers have made us soft, we would be better off without them
2. Computers are helping to make the world a better place
3. Computers cannot help the world to solve its problems
4. All the best jobs use a computer
5. Our present society could not exist without computers
6. Government money spent on computers could be put to better use
7. Computers stop people thinking for themselves
8. Using a computer is an anti-social job
9. Computers have done more harm than good in the world
10. To get a good job you need to know something about computers
11. Robots are threat to modern society

Threat

1. If we build too many computers they may turn against us
2. An out-of-control robot would be a serious menace
3. Computers are a threat to our private lives
4. A faulty computer could start a World war
5. Computers are reducing our appreciation of art and nature
6. The thought of a world that depends on computers frightens me

7. Computers should not keep information about ordinary people
8. Personal privacy is threatened by computer databanks
9. A computerised society would care less about individual people
10. We are letting microcomputers change the world too quickly

Employ

1. A clever man or woman can do any job just as well as a computer
2. We need to use more computers in our factories
3. It is wrong to use computers whilst people are unemployed
4. This country needs to use more robots and computers
5. Robots will make factory work more pleasant
6. Computers do not take away people's jobs
7. Shops and offices should make more use of computers
8. We should reject robots and find other ways of making things
9. Offices should use more people and fewer electronic machines
10. Shops that use a computer are less helpful to their customers
11. Microcomputers do not cause unemployment

Career

1. I would dislike having to work all day with a computer
2. I would like to be a computer specialist when I leave school
3. I think a job in computing is one of the best available
4. I would like to work for a firm that uses computers
5. Working with a computer would be an interesting and worthwhile career
6. Using a computer would be an interesting way to earn a living
7. If possisble I shall choose a job that does not use a computer

Leisure

1. TV-programmes about computers or robots are boring
2. I would very much like to be given a book about computers
3. During the school holidays, I would like to visit a firm using computers
4. I like to read about computers and the uses of computers
5. I would like to see more TV-programmes about computers and robots
6. I do not enjoy reading about robots and the uses of robots
7. I would not give up some of my free time to visit a computer system

School

1. All children should be taught to use a microcomputer at school
2. It is not necessary for a school to have a microcomputer
3. Children should not use school-time to learn about computers
4. Every school should have a computer club
5. School lessons about computers help to train pupils for a good career
6. Schools are spending too much time and money on computers
7. Lessons about comoputers and their uses should be compulsory for all pupils
8. I think every school should have several microcomputers for the pupils to use
9. Schools should use microcomputers to help pupils to learn more easily

CLASSROOM ENVIRONMENT SCALES USED IN THE PUPIL QUESTIONNAIRE

Part 1: The ICEQ Scales

All ICEQ items had a five-point response scale: Almost Never, Seldom, Sometimes, Often, Very Often. These were scored 1, 2, 3, 4, 5 respectively for "positive" items.

Personalisation

1. The teacher considers students' feelings.
2. The teacher talks with each student
3. The teacher takes a personal interest in each student
4. The teacher goes out of his/her way to help each student
5. The teacher is unfriendly to students
6. The teacher helps each student who is having trouble with the work
7. The teacher remains at the front of the class rather than moving about
8. Students are encouraged to be considerate of other people's ideas and feelings
9. The teacher tries to find out what each student wants to learn about
10. The teacher uses tests to find out where each student needs help.

Participation

1. Students discuss their work.
2. The teacher talks rather than listens
3. Most students take part in discussion
4. Students give their opinion during discussion
5. The teacher lectures without students asking or answering questions
6. Students are asked questions
7. Students sit and listen to the teacher
8. Students ideas and suggestions are used during classroom discussions
9. Students ask the teacher questions
10. There is classroom discussion

Independence

1. The teacher decides where students sit
2. Students choose their partnesr for group work
3. Students are told exactly how to do their work
4. Students are told how to behave in the classroom
5. The teacher decides when students are to be tested
6. Students are punished if they behave badly
7. The teacher decides which students should work together
8. Students are told what will happen if they break any rules
9. Students who break the rules get into trouble
10. The teacher decides how much movement and talk there should be in the classroom

Investigation

1. Students find out answers to questions from textbooks rather than from investigations
2. Students draw conclusions from information
3. Students carry out investigations to test ideas
4. Students find out answers to questions and problems from the teacher rather than from investigations
5. Students are asked to think about the evidence behind statements
6. Students carry out investigations to answer questions coming from class discussions
7. Students explain the meaning of statements, graphs, diagrams
8. Students carry out investigations to answer questions which puzzle them
9. Investigations are used to answer the teacher's questions
10. Students solve problems by obtaining information from the library

Differentiation

1. Students work at their own speed
2. All students use the same textbook
3. Allstudents do the same work at the same time
4. Different students do different work
5. Different students use different tests
6. Students who have finished their work wait for the others to catch up
7. Different stuents use different books, equipment and materials
8. Students who work faster than others move on to the next topic
9. The same teaching aid (e.g. blackboard) is used for all students in the class
10. All students are expected to do the same amount of work in the lesson

Part 2: The CES and Resources scales

All scales were of the TRUE/FALSE format. Scoring for positive items was TRUE = 2, OMIT = 1, FALSE = 0.

Resources

1. There is ussually sufficient equipment and materials in CS lessons
2. The Computer Studies equipment is reliable and easy to use
3. Students have to waste time waiting for their turn to use a micro
4. It is often necessary to move or find microcomputer equipment in CS lessons
5. Because some equipment has to be shared, students don't get much work done in CS
6. The school is well equipped for CS
7. The CS equipment is usually set up and ready for use
8. In CS we are able to see and use many sorts of computer and electronics equipment
9. Most pupils have enough time to use the micro in CS lessons
10. There are sufficient books to help with CS projects

Involvement

1. Students put a lot of effort into what they do in CS lessons
2. Students are often "clock-watching" in CS lessons
3. Most students really pay attention to what the teacher says in CS lessons
4. In CS lessons, very few students take part in class discussions or activities
5. A lot of students just "doodle" or waste time in CS lessons
6. As part of a CS lesson, students talk about their project to the rest of the class
7. A lot of students seem only half awake in Computer Studies
8. Students sometimes do extra Computer Studies work on their own
9. Students really enjoy Computer Studies lessons

Task Orientation

1. In Computer Studies, almost all the time is spent in lesson activities
2. Students are expected to stick closely to the work set in CS lessons
3. Getting the proper amount of work done is important in CS
4. Students don't do much work in CS lessons
5. In CS we usually get through the planned lesson
6. If a student misses a couple of CS lessons, it is difficult fo him or her to catch up
7. In CS lessons we often talk about things not connected with computers or electronics
8. CS lessons seem more aplace to chat or play games than they are to learn something
9. In CS the teacher sticks to classwork and doesn't get sidetracked to talk about other things

Order & Organisation

1. Computer Studies lessons are well organised
2. Students are almost always well behaved in Computer Studies
3. CS classes are often very noisy
4. In CS lessons, the teacher hardly ever has to call the class to order
5. Computer Studies activities are usually clear so everyone knows exactly what to do
6. CS lessons hardly ever start on time
7. The teacher often has to tell students to calm down in CS
8. Students don't fool around in Computer Studies lessons
9. In CS lessons, students don't shout out whilst the teacher is talking

Innovation

1. New ideas are always being tried out in CS lessons
2. What students do in CS is very different on different days
3. New and different ways of teaching are not tried very often in CS classes
4. The CS teacher likes pupils to think up unusual problems
5. In CS the students have very little say about how the lessons are spent or arranged
6. The CS teacher often suggests unusual projects for pupils
7. Students are set the same kind of homework after almost every CS lesson

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THE TEACHER ACTIVITY SCALES

Activity Descriptions

(Short descriptions of the 19 Teaching Activities derived from the 206 item checklist)

ACT01 General teaching via textbooks, pupil programming on micros
ACT02 General teaching via tests, making notes, class discussion
ACT03 Differentiation of pupil work via individual exercises, materials
ACT04 Teacher concern for pupils'career and leisure interests both during and after lessons
ACT05 Use of pupil-centred and pupil-directed study exercises
ACT06 Obtain and use new teaching ideas from other teachers, INSET courses, journals
ACT07 Use of wallcharts, TV and videos, other non-computer audio-visual-aids
ACT08 Concern for and use of microcomputer network, wordprocessors
ACT09 Microelectronics: demonstration and pupil use, course attendance
ACT10 Use of computer hardware and other peripherals for teaching
ACT11 Use of worksheet-based exercises, routine keyboard exercises
ACT12 Pupil participation in lessons
ACT13 Pupils encouraged to find out about computers for themselves
ACT14 Teacher concern for provision of hardware resources and up-to-date information
ACT15 Teacher demonstration and pupil use of software packages
ACT16 Teacher involvement with computer-based school administration
ACT17 Use of micro for data handling, use of commercial materials
ACT18 Concern for computing as a professional study, courses for other staff
ACT19 Use of simulation materials, demonstration of LOGO, CAD, teletext

Lists of the Teaching Behaviours (Checklist items) within each Activity are given on the following pages. The number preceding each item shows its position in the checklist. Items marked * were deleted from the Activity before calculation of the Scale statistics.

Activity No.1

Label: General teaching via textbooks, pupil programming on micros

1 Require pupils to make notes for class textbook
138 Require pupils to make notes on applications from class textbook
45 Require pupils to read selected parts of textbook in CS lesson
*12 Teach about artificial intelligence as one of CS topics
67 Specify the length or content of pupils' projects
103 Display rules relating to safe/allowed use of microcomputers etc
55 Issue a class textbook for an extended period
*192 Issue more than one textbook during the course
*13 Permit pupils to use equipment/materials you have not previously demonstrated
*36 Allow pupils to program directly at the keyboard without first making a program listing on paper
27 Require pupils to work at micros in groups of three or more
140 Use more than one type of micro with a class or group
169 Require pupils to program on more than one type of micro

Activity No. 2

Label: General teaching via tests, making notes, class discussion

6 Use slides or tape-slidepack for CS-teaching
76 Offer extreme or exaggerated view to stimulate pupils' comments
23 Show video to initiate discussion about computer use
185 Use diagrams/articles from computer magazine as part of pupil handout
16 Require pupils to write an extended account ("essay") after viewing a film or video
175 Require pupils to make their own notes about film/video
51 Require pupils to write notes or an essay as a follow-up to a class discussion or debate
66 Ask pupils to bring computer-items from newspapers and magazines for teaching use in CS-lessons
53 Hold class discussion of recent computer news or development in place of the lesson planned for that day
85 Set exercises requiring extended answers throughout whole course
145 Set test requiring extended answers each term or more often
74 Talk generally about a topic whilst pupils make own notes
102 Require pupils to make own notes during class discussions

Activity No. 3

Label: Differentiation of pupil work via individual exercises, materials

7 Mark a pupil's work in the presence of the individual pupil
71 Suggest pupils devise their own problems for programming exercises
39 Within the same class, set different programming execises to pupils with different levels of programming experience
132 Use different sets of programming exercises for fast and slow pupils in the same class
30 Set an individual pupil extra problems/exercises to help correct a misunderstanding revealed by test or homework
120 Set programming problems based on the known interests of individual members of the class
59 Use pupils' questions as ideas for subsequent lessons
78 Use pupils'programming ideas as a starting point for further lesson(s) on programming
46 Plan lessons so that time is available for talk with individual pupils
171 Ask pupils' opinions of work set/done in CS lessons
191 Encourage pupils with a home micro to work ahead of other pupils

Activity No.4

Label: Teacher concern for pupils' career and leisure interests both during and after lessons

48 Discuss careers in computing with pupils in out of lesson time
206 Point out the job-relevance of CS topics and skills
96 Discuss careers in computing during CS lesson time
91 Ask pupils to tak about their views on the social effects of computers
128 Talk to pupils about their leisure time use of home micros

continued....

172 See pupil after school to explain errors in test/homework
189 Talk to pupils about TV-programmes on computers outside lessons
199 Discuss own personal computer interest with pupils after lessons
68 Require pupils to choose and write their own ideas about some aspect of the social effects of computer use

Activity No. 5

Label: Use of pupil-centred and pupil-directed study exercises

94 Require pupils to study one or more computer applications by private work and use of library books
125 Tell pupils their essay answers should include material they have discovered for themselves
178 Explain to class how to use information for projects
137 Require pupils to use reference books to find data for class exercises
156 Require pupils to consult more than one book to answer set exercise
148 Arrange some lessons so that half the class uses micros for programs whilst the other pupils do non-programming work
194 Arrange the class so that some pupils write programs into notebooks whilst others use micros for programming exercises
158 Allow pupil to work on project or individual study instead of doing class exercises
168 Seek help from another teacher about the teaching of a CS topic

Activity No.6

Label: Obtain and use new teaching ideas from other teachers, INSET courses, journals

2 Meet with other teachers to review/discuss CAL materials
146 Collaborate with other teachers to teach Information Technology
32 Help other staff to choose or obtain appropriate CAL software
61 Help/advise staff about microcomputer hardware for CAL use
183 Encourage pupils to attend outside lecture/exhibition on computing
112 Implement teaching idea from journal, or educational text
151 Implement teaching idea from another teacher or INSET course
159 Demonstrate an education program as an example of computer use
89 Attend local (non-residential) INSET course
101 Locate source of cheap or free materials for CS teaching

Activity No.7

Label: Use of wallcharts, TV and videos, other non-computer audio-visual aids

*8 Encourage pupils to use micros in out-of-lesson time to complete classwork or to obtain extra practice
14 Use film or video to show applications of computers
*25 Use class textbook as sourcxe of exercises on non-programming topics
*127 Require pupils to teackle "debugging" in a logical and serious manner as an integral part of programming
*24 Teach techniques of top-down or structured programming
114 Give pupils worksheets for non-programming topics

continued....

54 Use wallcharts showing peripherals or parts of microcomputers
88 Use wallcharts of peripherals or parts of mainframe computers
35 Record TV-programme for use in CS-lesson
201 Preview audio-visual materials prior to use in CS lesson
129 Use diagram or article from computer magazine for wall display
152 Use newspaper/magazine article as source of lesson material
177 Read educational computing journal to look for teaching ideas

Activity No. 8

Label: Concern for and use of microcomputer network, wordprocessors

20 Maintain/repair computer equipment oneself
134 Devote part of each day (or nearly every day) to care of school network, administration programs and/or software resources
47 Maintain library of books and magazines specifically for pupil use
*79 Devise special projects for less-able pupils in CS-classes
187 Demonstrate assembly language or machine-code programming
157 Vacate CS-area in favour of teacher wishing to use CAL
34 Demonstrate a commercial/business package/program to CS pupils
98 Use a wordprocessor for the preparation of handouts/worksheets
161 Demonstrate wordprocessor in CS-lesson
70 Allow pupils to use wordprocessor to prepare the documentation for their CS-project
110 Require pupils to use a wordprocessor as part of a CS-lesson

Activity No. 9

Label: Microelectronics: demonstration and pupil use; course attendance

3 Demonstrate thermistor or other sensor connected to input port
72 Require pupils to use sensors (eg for heat, light) as part of CS practical work
60 Demonstrate control of lamp/motor via the output port of micro
160 Require pupils to use non-keyboard input device(s) for PW
65 Demonstrate BBC-Buggy or other robot-like device
149 Require pupils to use BBC-Buggy or robot for practical work
122 Construct an interface or "control-box" for CS teaching/demonstration
181 Personally construct microelectronics equipment for CS teaching
144 Make or repair microelectronics equipment for another teacher
131 Attend an INSET course on microelectronics

Activity No. 10

Label: Use of computer hardware and other peripherals for teaching

18 Demonstrate PRESTEL as part of a CS lesson
196 Demonstrate electronic mail-box communication
87 Demonstrate bar-code reader
29 Use teletypewriter to show production/reading of paper tape
38 Use/demonstrate link to a mainframe computer
77 Ask pupil to bring their own software for use in CS lessons
188 Ask pupils to bring items of hardware for use in CS lessons

continued

43 Display pupils' CS-work outside the CS teaching room/area
*111 Ask local employers what computer skills they require of employees
*92 Consult LEA Adviser about the teaching of a particular CS topic
108 Contact University/College staff about CS teaching or facilities
57 Use demonstration board of logic gates
95 Require pupils to carry out experiments with microelectronics modules or circuits
117 Teach some practical microelectronics as part of CS
82 Use a "cardboard computer" or other physical model to aid the teaching of programming concepts
133 Read a pupil's work to the rest of the class
*109 Require pupils to type-in a listing from book or magazine
*100 Act as examiner/moderator for CSE/O/16+ examination board

Activity No. 11

Label: Use of worksheet-based exercises, routine keyboard exercises

11 Require pupils to copy material from teacher-produced sheet
154 Require pupils to make brief notes from longer teacher handout
41 Use CS lessons to improve pupils' prospects on the job-market
190 Make use of videogame(s) in CS teaching
69 Use an objective test to assess programming or keyboard skills
174 Set exercises to develop pupils' keyboard (typing) skills
86 Require pupils to answer worksheet in conjunction with a video
197 Require pupils to make notes on article from paper/magazine
139 Split class into two or more groups doing different non-programming work in the same room
179 Compile alternative non-programming worksheets for use at different ability levels in the same class
143 Allow pupils a free choice of which programs to record in notes
202 Provide pupils with "Teach yourself programming" text or program

Activity No. 12

Label: Pupil participation in lessons

22 Regularly spend class time talking about test or homework answers with individual pupils
107 Set aside part of the lesson just to answer pupils' questions
166 Teach one or more topics solely by class debate
*37 Supply a list of titles from which pupils must choose their projects
*52 Require pupils to study part of the syllabus by private study only (i.e. without formal teaching)
26 Ask a pupil to talk to the class about a computer application linked to the work of a parent/relative/friend
83 Ask pupil to talk to the class about his/her project
192 Ask pupil to demonstrate program he/she has written to the whole class
198 Ask pupil to talk to the class about computer visit or other experience
115 Discuss a pupil's program with the whole class
176 Request a pupil to ask parent/relative to give help with arranging a class visit to a computer installation
180 Use program written by a pupil for CS teaching
203 Invite computer user to visit school to talk to pupils

Activity No. 13

Label: Pupils encouraged to find out about computers for themselves

97 Tell pupils they should try to arrange a personal visit to a computer installation with the help of a parent/relative/friend
135 Tell pupils to make a personal study of a computer application linked to the work of a parent/relative/friend
130 Encourage pupils to seek and "unusual" solution to programming exercises
184 Allow pupils free choice of which application to study
33 Provide pupils with a guide to help them make notes from books
63 Incorporate the teaching of study skills within CS lessons
116 Encourage pupils to write to firms/institutions to seek information about computers and computer applications
165 Call on pupil with special knowledge or interest in a topic to make a greater contribution to class discussion
164 Arrange for class or group to produce cooperative work
204 Consult or discuss with other teachers about the teaching of problem-solving skills
121 Allow pupils to go to school library during a CS lesson

Activity No.14

Label: Teacher concern for provision of hardware resources and up-to-date information.

4 Use own computer at home to prepare CS materials and exercises
44 Give lessons on problem-solving in addition to lessons on programming
17 Write CAL program for use in own teaching
21 Write or modify CAL programs for teachers in other subjects
9 Ask pupils to bring examples/problems from other subjects to CS-lessons
147 Set programming problem based on topic from other school subject
84 Consult LEA Adviser about financial problems of resources for CS
150 Make personal visit to compouter installation to obtain ideas or information for CS teaching
31 Engage in fund-raising activities to buy additional microcomputers
99 Teach some pupils "theory work" outside normal lessons
75 Take positive action to encourage girls to choose CS
104 Display pupils' work on the walls of the CS teaching area
49 Read computing or technical magazine in the school library
136 Check programs used in computer club sessions have some educational value

Activity No. 15

Label: Teacher demonstration and pupil use of software packages

50 Demonstrate the use of input-output ports of the micro
113 Include computer control as a topic within CS teaching
106 Demonstrate lightpen, graphpad or other input device
142 Demonstrate a stock-control program
170 Require pupils to use a simulation of a computer application
58 Set pupils exercise based on use of a file-handling package
124 Set pupils exercise based on use of a simple database (eg Quest)
163 Require pupils to collect data to make up a personal datafile
62 Require pupils to use a commercial/office software package (eg a spreadsheet)
155 Demonstrate file-handling by means of a commercial program

Activity No.16

Label: Teacher involvement with computer-based school administration

10 Demonstrate file-handling or administration package to head, deputies or senior staff
167 Give help with computer administration of school records etc
126 Assist school office staff with administrative use of the computer
56 In school time, write or amend programs for school admin.
141 At home, write or amend programs for school administration

Activity 17

Label: Use of micro for data handling, use of commercial materials

5 Use computer program to demonstrate binary.hex arithmetic
15 Use computer program to show action of logic circuits (gates)
40 Ask pupils to evaluate a piece of software sold for home use
200 Use micro to process data collected by pupils with another teacher
119 For CS teaching, nake use of a database containing schoolrecords of pupils in the class
19 Ask pupils to work through a manual file-handling exercises as an introduction to computer file-handling
162 Show commercial program to help with screen-layout programming
186 Invite headteacher to attend CS lesson or computer club session
28 Borrow books or materials from MEP centre or local centre for personal study or information
81 Obtain software materials from MEP centre for demonstration

Activity No. 18

Label: Concern for computing as a professional study, courses for other staff

42 Run an INSET course on CAL within your own school
182 Run a Computer Awareness course (non-programming) for staff
93 Run a programming course for staff in you school
73 Use ECONET (or equivalent) network for CS teaching
105 Belong to a professional group (BCS, CEG, MUSE,...)
123 Help class/group to enter for a computer competition
153 Keep in touch with past pupils studying or working with computers

Activity No. 19

Label: Use of siumulation materials, demonstration of LOGO, CAD, teletex, etc

64 Use simulated computer system to teach programming or other concepts
173 Use CAL-type material and large screen to teach non-programming topic
80 Demonstrate teletext as part of CS lesson
118 Use a simulation of teletext for demonstration or pupil work
205 Demonstrate computer-aided-design (CAD) program or simulation
90 Give screen demonstration of turtle graphics (LOGO)
195 Require pupils to write LOGO (turtle graphics) program

T-TESTS ON TEACHER ACTIVITIES BY TEACHER CHARACTERISTICS

T-tests on Teacher-Activities by Teacher Gender (M-F), Industrial Experience (Indexp), Total teaching experience (TTexp), Computer Studies teaching experience (CSTexp), Computer Studies qualification Academic (CSQA) and CStudies qualification Educational (CSQE).

Scale No.	Activity-scale description (abbreviated)	T-test probability values Gender M/F 191/59	Indexp Yes/No 54/199	TTexp <6/6+ 46/201	CSTexp <6/6+ 90/163	CSQA Yes/No 90/163	CSQE Yes/No 46/207
1	General teaching via books and pupil programming	066	451	447	258	497	121
2	General teaching via tests, notes from books, videos	048	163	961	177	262	624
3	Differentiation of pupil work	791	120	269	787	822	334
4	Teacher interest in pupils' career and leisure interests	043	053	261	698	094	813
5	Use of pupil-centred & pupil directed exercises	719	871	850	445	190	751
6	Use of new teaching ideas	393	207	783	868	008	003
7	Use of wallcharts, other non-computer AV aids	826	933	568	065	020	233
8	Concern for and use of network, wordprocessors	286	011	474	491	003	027
9	Microelectronics; demon. & pupil use, course attendance	000	012	034	782	069	121
10	Use of computer hardware, peripherals for teaching	926	181	883	422	094	024
11	Use of worksheet, routine keyboard exercises	022	092	090	437	663	674
12	Pupils talk, demonstrate provide resources	176	374	774	676	802	710
13	Pupils to find out about computers themselves	257	502	784	803	945	517
14	Teacher concern for h'ware resources and information	571	098	551	416	006	082
15	Teacher and pupil-use of software packages	420	002	520	635	035	163
16	Teacher in computer-based administration	001	283	285	019	317	374
17	Data handling,use of commercial packages	140	193	166	624	157	135
18	Concern for academic study, courses for staff	106	506	008	003	000	293
19	Use of simulations LOGO, CAD, teletext etc	761	015	462	678	018	040

Note: A positive correlation favours males , greater experience or qualification.

BREAKDOWN OF ACTIVITY SCORES BY IMPORTANCE MATRIX ITEM RATINGS

The value quoted is the significance of F, the ratio of the mean squares between groups to the mean square within groups. Since N = 253 and each Matrix item had (usually) three classes of response, the numbers of degrees of freedom were 2 and 250.

Act.	Importance Rating Matrix Item Numbers																
No.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
01	247	666	256	179	981	110	465	351	000	715	250	395	419	782	035	240	496
02	441	001	155	113	527	066	096	104	278	453	328	396	725	784	059	473	798
03	599	534	707	550	104	490	060	050	513	027	003	034	020	594	522	956	004
04	243	002	151	683	161	284	098	137	038	666	144	708	410	859	574	730	549
05	068	002	230	894	426	886	204	989	492	350	004	357	050	212	241	883	125
06	188	223	034	009	031	062	376	021	060	042	546	372	177	831	225	507	089
07	159	153	017	817	520	016	381	087	611	425	359	503	241	716	532	900	798
08	294	512	264	364	737	244	130	295	001	059	321	322	656	552	118	122	080
09	244	022	459	534	571	081	035	000	013	560	047	568	000	021	476	170	476
10	885	019	788	304	413	018	004	001	010	068	096	965	048	804	882	461	152
11	732	022	086	160	784	013	096	086	490	260	487	191	010	506	410	752	575
12	536	000	509	920	247	535	184	605	000	368	230	645	426	394	262	472	159
13	787	006	311	302	272	661	177	640	106	389	005	253	016	084	614	918	004
14	534	001	823	422	188	818	053	573	018	267	010	454	059	378	536	770	039
15	424	096	001	141	763	309	732	001	007	774	414	148	056	073	527	564	130
16	869	627	320	302	190	560	000	076	260	429	552	425	508	019	853	420	964
17	874	038	119	471	680	085	014	009	072	839	344	662	142	472	290	160	189
18	319	366	371	841	017	315	067	053	061	151	430	506	262	680	923	144	173
19	110	275	001	142	846	111	507	002	069	282	343	091	128	674	434	606	193

RESULTS OF T-TESTS ON COMPUTER ATTITUDES BY PUPIL VARIABLES

Tests by gender

Variable	Group	N	Mean	SD	T/Prob.
Satisfaction	Boys	778	21.8985	6.278	-6.46
	Girls	357	24.4285	6.051	0.000
Employment	Boys	778	31.4627	7.808	-6.86
	Girls	357	34.8627	7.728	0.000
Threat	Boys	778	27.7121	7.397	-5.78
	Girls	357	30.4482	7.406	0.000
Future	Boys	778	24.2185	5.686	-1.97
	Girls	357	24.9356	5.701	0.049
Social	Boys	778	31.0566	7.184	-5.28
	Girls	357	33.3697	6.687	0.000
Career	Boys	778	19.2044	7.011	-6.18
	Girls	357	21.8571	6.577	0.000
Leisure	Boys	778	18.4460	6.736	-9.97
	Girls	357	22.5910	6.395	0.000
School	Boys	778	19.3997	5.617	-2.09
	Girls	357	20.1849	5.982	0.037

Tests by Homeuse for Boys

Variable	Group	N	Mean	SD	T/Prob.
Satisfaction	High	625	20.9568	5.696	-7.80
	Low	153	20.7451	7.054	0.000
Employment	High	625	30.6960	7.553	-5.42
	Low	153	34.5948	8.070	0.000
Threat	High	625	27.0512	7.375	-5.34
	Low	153	30.4118	6.879	0.000
Future	High	625	23.8645	5.488	-3.45
	Low	153	25.7386	6.223	0.001
Social	High	625	30.3152	6.944	-5.73
	Low	153	34.0850	7.376	0.000
Career	High	625	18.0704	6.763	-10.3
	Low	153	23.8366	6.051	0.000
Leisure	High	625	17.4480	6.293	-8.32
	Low	153	22.5229	6.965	0.000
School	High	625	18.6496	5.079	-6.68
	Low	153	22.4641	6.601	0.000

Tests by Homeuse for Girls

Variable	Group	N	Mean	SD	T/Prob.
Satisfaction	High	179	23.0615	5.789	-4.38
	Low	178	25.7978	6.014	0.000
Employment	High	179	33.5922	7.671	-3.15
	Low	178	36.1404	7.594	0.002

continued.......

Variable	Group	N	Mean	SD	T/Prob.
Threat	High	179	29.7542	7.992	-1.78
	Low	178	31.1461	6.716	0.076
Future	High	179	24.6145	5.840	-1.07
	Low	178	25.2584	5.555	0.287
Social	High	179	32.3464	6.658	-2.93
	Low	178	34.3989	6.575	0.004
Career	High	179	20.6983	6.399	-3.39
	Low	178	23.0225	6.566	0.001
Leisure	High	179	21.4525	6.295	-3.42
	Low	178	23.7360	6.307	0.001
School	High	179	19.0279	5.218	-3.73
	Low	178	21.3483	6.471	0.000
			Tests by CAL for Boys		
Satisfaction	High	258	21.4535	5.574	-1.47
	Low	520	22.1192	6.594	0.141
Employment	High	258	31.0969	7.480	-0.94
	Low	520	31.6642	7.966	0.348
Threat	High	258	27.9225	7.510	0.558
	Low	520	27.6077	7.346	0.580
Future	High	258	24.1977	5.631	-0.07
	Low	520	24.2288	5.718	0.942
Social	High	258	30.9109	6.785	-0.41
	Low	520	31.1288	7.379	0.682
Career	High	258	19.0310	6.701	-0.05
	Low	520	19.2904	7.164	0.620
Leisure	High	258	18.0891	6.678	-1.05
	Low	520	18.6231	6.764	0.296
School	High	258	18.6589	5.086	-2.72
	Low	520	19.7673	5.832	0.007
			Tests by CAL for Girls		
Satisfaction	High	107	24.0935	6.034	-0.68
	Low	250	24.5680	6.064	0.497
Employment	High	107	32.9346	7.130	-3.24
	Low	250	35.6880	7.840	0.001
Threat	High	107	29.5327	7.206	-1.55
	Low	250	30.8400	7.470	0.155
Future	High	107	24.1682	5.235	-1.75
	Low	250	25.2640	5.868	0.082
Social	High	107	32.8224	6.470	-1.03
	Low	250	33.6040	6.777	0.304
Career	High	107	20.4206	6.289	-2.78
	Low	250	22.4720	6.615	0.006
Leisure	High	107	21.7009	5.609	-1.85
	Low	250	22.9720	6.678	0.066
School	High	107	19.1869	5.669	-2.13
	Low	250	20.6120	6.072	0.034

Scheffe Tests of Computer Attitude scales by Science Group

Variable	SC-Grp	Means	Mean	Squares	DF	F/Prob/Result.
Satisfaction	3	21.1088	BG	981.4882	2	25.6403
	2	22.2445	WG	38.2791	1160	0.000
	1	24.4378				3 > 2 > 1
Employment	3	30.5306	BG	2090.5815	2	35.375
	2	31.7695	WG	59.0977	1160	0.0000
	1	35.2405				3 > 2 > 1
Threat	3	27.0102	BG	1325.1183	2	24.2722
	2	28.0020	WG	54.5940	1160	0.0000
	1	30.7622				3>1 2>1
Future	3	24.0802	BG	111.0878	2	3.4275
	2	24.6190	WG	32.4190	1160	0.0328
	1	25.0730				2 > 1
Social	3	30.3810	BG	2340.1805	2	24.0895
	2	31.1303	WG	48.5725	1160	0.0000
	1	33.8297				3>1 2>1
Career	3	18.0102	BG	1563.2327	2	33.9033
	2	19.5892	WG	46.1085	1160	0.0000
	1	22.2541				3 > 2 > 1
Leisure	3	17.3027	BG	2167.9275	2	49.4062
	2	19.2425	WG	43.8797	1160	0.0000
	1	22.3216				3 > 2 > 1
School	3	18.9694	BG	450.6655	2	13.9621
	2	19.0621	WG	32.2778	1160	0.0000
	1	20.9162				3>1 2>1

RESULTS OF T-TESTS ON CLASSROOM ENVIRONMENT SCORES BY PUPIL VARIABLES

Tests by gender

Variable	Group	N	Mean	SD	T/Prob.
Resources	Boys	795	19.8138	4.786	-2.13
	Girls	390	20.4308	4.648	0.034
Involvement	Boys	795	17.4855	4.914	1.51
	Girls	390	17.0308	4.868	0.132
Task-Orientation	Boys	795	20.3648	3.864	-2.32
	Girls	390	20.9000	3.631	0.020
Order & Orgnstion	Boys	795	18.5447	5.587	0.39
	Girls	390	18.4113	5.541	0.696
Innovation	Boys	795	12.3233	3.095	-0.29
	Girls	390	12.3795	3.142	0.771
Personalisation	Boys	795	29.4616	6.791	-1.50
	Girls	390	30.0923	6.781	0.133
Participation	Boys	795	30.2541	6.295	0.87
	Girls	390	29.9154	6.352	0.387
Independence	Boys	795	31.3208	6.015	1.08
	Girls	390	30.9205	5.961	0.279
Investigation	Boys	795	25.5451	5.840	0.89
	Girls	390	25.1281	5.971	0.374
Differentiation	Boys	795	23.9824	6.495	0.82
	Girls	390	23.6564	6.378	0.411

Tests by Homeuse for Boys

Variable	Group	N	Mean	SD	T/Prob.
Resources	High	621	19.9066	4.785	1.03
	Low	174	19.4828	4.791	0.303
Involvement	High	621	17.7424	4.901	2.81
	Low	174	16.5690	4.866	0.005
Task-Orientation	High	621	20.4686	3.783	1.37
	Low	174	19.9943	4.096	0.171
Order & Orgnstion	High	621	18.7005	5.609	1.51
	Low	174	17.9885	5.588	0.133
Innovation	High	621	12.4187	3.166	1.76
	Low	174	11.9828	2.811	0.081
Personalisation	High	621	29.6361	6.792	1.37
	Low	174	28.8391	6.768	0.173
Participation	High	621	30.5894	6.375	2.99
	Low	174	29.0575	5.863	0.003
Independence	High	621	31.2576	6.037	-0.56
	Low	174	31.5460	5.949	0.574
Investigation	High	621	25.6441	5.959	1.84
	Low	174	24.7559	5.354	0.066
Differentiation	High	621	23.7890	6.527	-1.61
	Low	174	24.6724	6.348	0.107

Tests by Homeuse for Girls

Variable	Group	N	Mean	SD	T/Prob.
Resources	High	193	20.6995	4.951	1.13
	Low	197	20.1675	4.327	0.260
Involvement	High	193	17.5544	4.933	2.11
	Low	197	16.5178	4.761	0.035
Task-Orientation	High	193	21.1710	3.483	1.46
	Low	197	20.6345	3.760	0.145
Order & Orgnstion	High	193	18.7824	5.484	1.31
	Low	197	18.0457	5.585	0.190
Innovation	High	193	12.7513	3.172	2.32
	Low	197	12.0152	3.078	0.021
Personalisation	High	193	30.7150	6.802	1.80
	Low	197	29.4882	6.721	0.073
Participation	High	193	30.4456	5.948	1.64
	Low	197	29.3959	6.699	0.102
Independence	High	193	30.5181	6.066	-1.32
	Low	197	31.3147	5.845	0.188
Investigation	High	193	26.1451	5.869	3.37
	Low	197	24.1320	5.915	0.001
Differentiation	High	193	23.5337	6.401	-0.38
	Low	197	23.7766	6.369	0.707

Tests by CAL for Boys

Variable	Group	N	Mean	SD	T/Prob.
Resources	High	259	20.2046	4.481	1.65
	Low	536	19.6250	4.920	0.099
Involvement	High	259	17.7992	4.865	1.26
	Low	536	17.3340	4.936	0.209
Task-Orientation	High	259	20.4093	3.577	0.23
	Low	536	20.3433	3.998	0.815
Order & Orgnstion	High	259	18.5251	5.319	-0.07
	Low	536	18.5541	5.716	0.944
Innovation	High	259	12.7066	3.130	2.42
	Low	536	12.1381	3.064	0.016
Personalisation	High	259	30.5097	6.298	3.15
	Low	536	28.9552	6.966	0.002
Participation	High	259	31.0000	5.848	2.41
	Low	536	29.8937	6.475	0.016
Independence	High	259	31.0309	6.066	-0.94
	Low	536	31.4608	5.991	0.347
Investigation	High	259	26.2703	5.591	2.81
	Low	536	25.0597	5.921	0.005
Differentiation	High	259	24.4981	6.414	1.57
	Low	536	23.7332	6.525	0.117

Tests by CAL for Girls

Variable	Group	N	Mean	SD	T/Prob.
Resources	High	123	20.3171	4.916	-0.32
	Low	267	20.4831	4.528	0.751
Involvement	High	123	17.1707	4.998	0.38
	Low	267	16.9603	4.816	0.705
Task-Orientation	High	123	21.1789	3.497	1.05
	Low	267	20.7715	3.691	0.295
Order & Orgnstion	High	123	18.3821	5.615	-0.07
	Low	267	18.4232	5.516	0.946
Innovation	High	123	12.7236	3.173	1.46
	Low	267	12.2210	3.122	0.145
Personalisation	High	123	31.5854	6.646	3.00
	Low	267	29.4045	6.744	0.003
Participation	High	123	30.8130	6.410	1.89
	Low	267	29.5019	6.294	0.060
Independence	High	123	31.2764	5.940	0.80
	Low	267	30.7566	5.975	0.424
Investigation	High	123	26.1789	6.104	2.34
	Low	267	24.6442	5.856	0.020
Differentiation	High	123	23.3577	6.658	-0.61
	Low	267	23.7940	6.252	0.541

Scheffe Test of Classroom Environment scales by Science Group

Variable	Mean	Squares	DF	F/Prob	Result.
Resources	BG	33.4793	2	1.4809	NSD
	WG	22.6076	1195	0.2279	
Involvement	BG	36.0044	2	1.5077	NSD
	WG	23.8804	1195	0.2218	
Task-Orientation	BG	19.8463	2	1.3809	NSD
	WG	14.3723	1195	0.2518	
Order & Organ.	BG	85.9312	2	2.7745	NSD
	WG	30.9721	1195	0.0628	
Innovation	BG	6.8392	2	0.7130	NSD
	WG	9.6283	1195	0.4917	
Personalisation	BG	16.8327	2	0.3640	NSD
	WG	46.2440	1195	0.6950	
Participation	BG	5.4870	2	0.1372	NSD
	WG	39.8492	1195	0.8714	
Independence	BG	65.6105	2	1.7979	NSD
	WG	36.4937	1195	0.1661	
Investigation	BG	29.4087	2	0.8508	NSD
	WG	34.5668	1195	0.4273	
Differentiation	BG	0.0772	2	0.0018	NSD
	WG	41.7182	1195	0.9982	

CORRELATIONS BETWEEN PUPIL ATTITUDE AND CLASSROOM ENVIRONMENT VARIABLES

	PERS	PART	INDP	INVS	DIFF	RESS	INVL	TSKO	OROG	INNV
PERS	1000	687	179	656	304	304	665	221	434	498
PART	687	1000	285	570	122	281	693	124	279	505
INDP	179	285	1000	-011	175	188	175	-196	130	231
INVS	656	570	-011	1000	231	377	599	341	463	496
DIFF	304	122	175	231	1000	002	076	-253	-064	343
RESS	304	281	188	377	002	1000	292	153	378	274
INVL	665	693	175	599	076	292	1000	547	673	375
TSKO	221	124	-196	341	-253	153	547	1000	634	017
OROG	434	279	130	463	-064	378	673	634	1000	115
INNV	498	505	231	496	343	274	375	017	115	1000
SATF	287	249	200	329	007	205	416	327	454	122
EMPL	053	109	139	144	-083	-049	143	193	266	005
THRT	079	046	-081	238	-096	030	173	265	334	-132
FUTR	248	259	121	281	-081	050	311	171	190	-168
SOCL	209	225	094	311	-126	045	303	291	351	101
CARR	273	287	172	312	042	081	510	316	473	100
LEIS	240	230	222	269	067	157	417	172	405	119
SCHL	382	297	162	361	-052	189	436	214	352	129

	SATF	EMPL	THRT	FUTR	SOCL	CARR	LEIS	SCHL
SATF	1000	486	260	483	482	625	720	652
EMPL	486	1000	542	327	635	496	456	284
THRT	260	542	1000	-023	529	336	189	197
FUTR	483	327	-023	1000	384	485	472	625
SOCL	482	635	529	384	1000	501	401	430
CARR	625	496	336	485	501	1000	743	581
LEIS	720	456	189	472	401	743	1000	559
SCHL	652	284	197	625	430	581	559	1000

Decimal points omitted. Based on 102 Class Sets

Scales are: Personalisation, Participation, Independence, Investigation, Differentiation, Resources, Involvement, Task-Orientation, Order & Organisation, Innovation, Satisfaction, Employment, Threat, Future, Social, Career, Leisure, School.

REGRESSSION ANALYSIS RESULTS

Computer Attitude variables

Using Pupil and Teacher variables as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F	Multiple R & R-squared
Satisfaction	BHUSE1	-0.053080	2.746	0.0978	0.39032
	CANF1	0.082287	7.802	0.0053	0.015235
	CANF2	-0.049777	2.866	0.0908	
	SCGP	0.135154	16.726	0.0000	
	CANF3	0.069778	5.644	0.0177	
	BHUSE3	0.124113	14.944	0.0001	
	BCAL3	-0.120049	15.530	0.0001	
	BCAL5	0.062712	4.170	0.0414	
	PSEX	0.091076	7.388	0.0067	
	BHUSE4	0.209122	36.944	0.0000	
Employ	BTCAL	0.060913	3.852	0.0500	0.38171
	SCGP	0.127130	14.251	0.0002	0.14570
	BHUSE3	0.104328	10.461	0.0013	
	BCAL3	-0.095092	9.410	0.0022	
	PSEX	0.099183	9.017	0.0027	
	BHUSE4	0.194735	35.803	0.0000	
	ARTSGP	0.083686	7.710	0.0056	
Threat	CANF2	-0.053136	2.991	0.0841	0.25357
	SCGP	0.106921	9.680	0.0019	0.06430
	BHUSE3	0.080210	5.716	0.0170	
	PSEX	0.086594	6.366	0.0118	
	BHUSE4	0.096450	8.063	0.0046	
Future	OFFPR	0.055434	3.186	0.0746	0.19464
	SCGP	0.052980	2.823	0.0932	0.03789
	BHUSE3	0.076482	5.060	0.0247	
	BHUSE4	0.126702	13.669	0.0002	
Social	SCGP	0.138872	20.079	0.0000	0.32782
	BHUSE3	0.126286	14.746	0.0001	0.10747
	BCAL3	-0.071064	5.615	0.0180	
	ARTSGP	0.055483	3.287	0.0701	
	BHUSE4	0.176692	28.535	0.0000	
Career	BHUSE1	-0.063956	4.073	0.0438	0.41948
	SCGP	0.093242	7.836	0.0052	0.17596
	BHUSE3	0.171095	28.167	0.0000	
	BCAL3	-0.091812	9.355	0.0023	
	BHUSE2	0.070067	4.976	0.0259	
	BCAL5	0.072169	5.680	0.0173	
	ARTSGP	0.086769	8.572	0.0035	
	PSEX	0.095435	8.315	0.0040	
	BHUSE4	0.209541	36.806	0.0000	

Leisure	OFFPR	0.053937	2.931	0.0872	0.49139
	BHUSE1	-0.107237	12.408	0.0004	0.24147
	CANF1	0.067473	5.827	0.0160	
	SCGP	0.100638	9.850	0.0017	
	BHUSE3	0.180590	33.859	0.0000	
	BCAL3	-0.085970	9.467	0.0021	
	BHUSE2	0.104170	11.958	0.0006	
	ARTSGP	0.052804	2.726	0.0990	
	PSEX	0.177477	30.445	0.0000	
	BCAL2	0.051881	3.329	0.0684	
	BHUSE4	0.221842	44.542	0.0000	
School	BTCAL	0.067795	5.061	0.0247	0.31820
	CANF1	0.057338	3.644	0.0566	0.10125
	SCGP	0.081595	7.168	0.0075	
	BHUSE3	0.112916	11.765	0.0006	
	BHUSE4	0.206310	38.513	0.0000	

Classroom Environment variables

Using Pupil and Teacher variables as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F.	Multiple R & R-squared
Resources	SCGP	-0.074182	5.841	0.0158	0.23607
	CANF2	-0.181507	3.598	0.000	0.05573
	BHUSE1	0.055010	3.226	0.0728	
	BCAL3	0.073359	5.804	0.0162	
	TSEX	0.062084	3.937	0.0475	
Involvement	SCGP	0.079653	6.640	0.0101	0.25251
	CANF1	0.091576	9.021	0.0027	0.06376
	BHUSE2	0.120758	13.0852	0.0002	
	CANF3	0.054768	3.223	0.0729	
	BHUSE3	0.080193	5.647	0.0177	
	BCAL5	0.056240	3.295	0.0698	
	BCAL1	-0.073415	5.684	0.0173	
	BHUSE4	0.057547	2.801	0.0945	
Task-Orientation	CANF1	0.078256	6.123	0.0135	0.18947
	BHUSE2	0.080997	6.415	0.0115	0.03590
	BHUSE3	0.069422	4.662	0.0311	
	TSEX	-0.137489	18.890	0.0000	
	PSEX	-0.063152	4.167	0.0415	
Ord & Organisation	CANF1	0.159491	26.916	0.0000	0.23777
	CANF2	-0.063920	4.369	0.0368	0.05654
	BHUSE2	0.066584	4.321	0.0379	
	CANF3	0.061773	4.024	0.0451	
	BCAL1	-0.104245	11.323	0.008	
	BHUSE4	0.082287	6.551	0.0106	
	BCAL2	0.065320	4.392	0.0364	

Innovation	CANF1	0.079002	6.527	0.0108	0.17978
	BHUSE2	0.108090	12.674	0.0004	0.03232
	CANF3	0.060100	3.776	0.0523	
	BHUSE3	0.085811	7.188	0.0075	
	BCAL1	0.075455	5.931	0.0150	
Personalisation	BTCAL	0.084263	6.769	0.0094	0.26145
	CANF1	0.108090	12.674	0.0004	0.06835
	CANF2	0.101851	11.241	0.0008	
	BHUSE2	0.053573	2.886	0.0879	
	CANF3	0.068302	5.011	0.0254	
	BHUSE3	0.150575	22.641	0.0000	
	BCAL4	0.054118	2.814	0.0937	
Participation	CANF2	0.066177	4.453	0.0351	0.23846
	BHUSE2	0.103811	10.165	0.0015	0.05686
	CANF3	0.054275	3.187	0.0745	
	BHUSE3	0.092532	7.429	0.0065	
	TSEX	0.062077	3.933	0.0476	
	BCAL5	0.054886	3.231	0.0726	
	BHUSE4	0.083660	5.987	0.0146	
Independence	SCGP	0.0633530	4.272	0.0390	0.25035
	CANF1	0.063778	4.101	0.0431	0.06267
	CANF2	0.065871	4.380	0.0366	
	CANF3	-0.078950	6.659	0.0100	
	BHUSE3	-0.101045	9.187	0.0025	
	TSEX	0.162325	25.283	0.0000	
	BCAL4	0.076574	6.219	0.0128	
	BCAL1	-0.071455	5.376	0.0206	
	BHUSE4	0.061885	3.385	0.0661	
Investigation	BTCAL	0.062033	3.548	0.0599	0.29891
	CANF1	0.124216	16.012	0.0001	0.08222
	BHUSE2	0.131610	16.917	0.0000	
	CANF3	0.085495	8.017	0.0047	
	BHUSE3	0.097118	8.509	0.0036	
	TSEX	-0.086970	7.926	0.0050	
	BCAL5	0.063529	3.775	0.0523	
	BHUSE4	0.073631	4.785	0.0289	
Differentiation	SCGP	-0.056566	2.831	0.0928	0.24464
	CANF2	0.153561	24.166	0.0000	0.05985
	CANF3	0.093498	9.484	0.0021	
	TSEX	0.168700	29.127	0.0000	
	BCAL5	0.054003	3.084	0.0793	
	PSEX	0.058811	3.022	0.0825	
	BHUSE4	-0.070409	5.091	0.0243	

Classroom Environment variables

Using Pupil and Teacher gender* as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F.	Multiple R & R-squared
Resources	SCGP	-0.056005	3.051	0.0810	0.16832
	OFFPR	0.061585	3.748	0.0531	0.02833
	BHUSE1	0.072249	5.442	0.0198	
	BCAL3	0.070957	5.272	0.0219	
	TSEX	0.103896	11.311	0.0008	
Involvement	SCGP	0.089653	8.487	0.0037	0.22573
	BHUSE2	0.135463	18.130	0.0000	0.05095
	BHUSE3	0.097380	9.369	0.0023	
	BCAL5	0.061334	3.889	0.0489	
	BCAL1	-0.069837	5.138	0.0236	
Task-Orientation	BHUSE2	0.082204	6.576	0.0105	0.17361
	BHUSE3	0.067838	4.431	0.0355	0.03014
	TSEX	-0.118790	14.890	0.0001	
	PSEX	-0.066579	4.618	0.0319	
Ord & Organisation	BHUSE2	0.072546	4.991	0.0257	0.15552
	BCAL1	-0.096555	9.725	0.0019	0.02419
	BHUSE4	0.089098	7.547	0.0061	
Innovation	OFFPR	0.094839	9.491	0.0021	0.17964
	BHUSE2	0.070270	4.793	0.0288	0.03227
	BHUSE3	0.090278	7.937	0.0049	
	BCAL1	0.074839	5.894	0.0154	
Personalisation	OFFPR	0.064440	4.386	0.0365	0.21243
	BHUSE2	0.060077	3.558	0.0596	0.04513
	BHUSE3	0.144398	20.483	0.0000	
	BTCAL	0.059957	8.489	0.0937	
Participation	BHUSE2	0.110990	11.606	0.0007	0.21790
	BHUSE3	0.089184	6.901	0.0087	0.04748
	BCAL5	0.051987	2.885	0.0897	
	BHUSE4	0.077501	5.119	0.0239	
Independence	SCGP	0.052055	2.783	0.0956	0.21744
	BHUSE3	-0.107344	10.267	0.0014	0.04728
	TSEX	0.162384	28.022	0.0000	
	BCAL4	0.077738	6.321	0.0121	
	BCAL5	-0.052090	2.799	0.0947	
	BHUSE4	0.063488	3.522	0.0608	
Investigation	BCAL1	0.052398	2.947	0.0863	0.26624
	BHUSE2	0.133075	16.952	0.0000	0.07088
	BHUSE3	0.096117	8.207	0.0043	
	TSEX	-0.054240	3.222	0.0730	
	BCAL5	0.085982	7.925	0.0050	
	BHUSE4	0.073531	4.705	0.0303	

Differentiation	OFFPR	0.053861	3.025	0.0828	0.15848
	TSEX	0.129874	17.758	0.0000	0.02512
	BHUSE4	-0.068613	4.910	0.0269	

(*) The three CDFs were not included in these analyses.

Computer Attitude variables

Using Teacher Activities as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F	Multiple R & R-squared
Satisfaction	ACT09	0.216235	2.252	0.0266	0.31481
	ACT04	0.220608	2.063	0.0417	0.09910
	ACT11	-0.220533	2.061	0.0420	
Employ	ACT12	0.282668	2.316	0.0227	0.39249
	ACT01	-0.183674	1.863	0.0655	0.15405
	ACT03	-0.290505	2.486	0.0147	
	ACT17	-0.280109	2.268	0.0256	
	ACT14	0.234709	1.706	0.0913	
Threat	ACT19	-0.216494	2.200	0.0302	0.39662
	ACT09	0.393307	3.906	0.0002	0.15731
	ACT05	-0.210343	2.109	0.0375	
Future	ACT05	-0.273414	2.548	0.0124	0.46533
	ACT04	0.445369	3.967	0.0001	0.21653
	ACT02	-0.244930	2.298	0.0248	
	ACT14	0.215296	1.917	0.0582	
Social	ACT09	0.255070	2.561	0.0119	0.27014
	ACT05	-0.167749	1.684	0.0952	0.07297
Career	None				
Leisure	None				
School	ACT18	0.205276	2.097	0.0385	0.20528 0.04214

Classroom Environment variables

Using Teacher Activities as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F	Multiple R & R-squared
Resources	ACT12	-0.302778	3.214	0.0018	0.39768
	ACT08	0.327059	3.472	0.0008	0.15815
Involvement	ACT05	0.2444874	2.220	0.0287	0.29451
	ACT07	0.177183	1.724	0.0878	0.08673
	ACT13	-0.211041	1.882	0.0629	
Task-Orientation	ACT07	0.264380	2.591	0.0110	0.26916
	ACT13	-0.181525	1.779	0.0783	0.07245
Order & Organ.	ACT07	0.261029	2.704	0.0081	0.26103
					0.06814
Innovation	ACT16	-0.262977	2.345	0.0211	0.43440
	ACT11	0.196594	1.689	0.0944	0.18871
	ACT08	0.266938	2.326	0.0221	
	ACT02	-0.255883	2.159	0.0334	
	ACT06	0.261700	2.180	0.0317	
Personalisation	ACT19	-0.252375	2.182	0.0315	0.32358
	ACT04	0.220910	2.220	0.0287	0.10470
	ACT15	0.251780	2.184	0.0314	
Participation	None				
Independence	ACT18	0.212660	2.098	0.0385	0.35298
	ACT15	-0.207851	2.039	0.0442	0.10626
	ACT13	0.202929	1.971	0.0515	
Investigation	ACT10	0.251872	2.603	0.0107	0.25187
					0.06344
Differentiation	ACT01	-0.197595	2.141	0.0348	0.46128
	ACT05	0.320298	3.056	0.0029	0.21278
	ACT03	0.287219	2.659	0.0092	
	ACT17	-0.263861	2.569	0.0117	

Computer Attitude variables

Using Classroom Environment perceptions as predictors

Criterion Variable	Retained Variables	Beta	F-value	Sig. F	Multiple R & R-squared
Satisfaction	Order & Organ.	0.454455	5.102	0.0000	0.45456
					0.20653
Threat	Innovation	-0.293973	2.767	0.0068	0.42923
	Order & Organ.	0.242388	2.328	0.0220	0.18424
	Investigation	0.271306	2.278	0.0249	
Employ	Resources	-0.175111	1.697	0.0928	0.31124
	Order & Organ.	0.331988	3.217	0.0017	0.09687
Future	Involvement	0.310699	3.269	0.0015	0.31070
					0.09653
Social	Differentiation	-0.168809	1.757	0.0821	0.42103
	Order & Organ.	0.226161	2.144	0.0345	0.11726
	Investigation	0.245785	2.271	0.0253	
Career	Order & Organ	0.237886	2.079	0.0402	0.53909
	Involvement	0.349481	3.054	0.0029	0.29061
Leisure	Task Orientation	-0.203850	1.735	0.0859	0.47575
	Order & Organ.	0.326436	2.455	0.0590	0.22634
	Involvement	0.309254	2.517	0.0135	
School	Involvement	0.436438	4.851	0.0000	0.43644
					0.19048

FORUM/SEMINAR ON RESEARCH STUDIES IN COMPUTER/IT EDUCATION

(Part of the Information Technology and Education Programme)

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