Chapter 2

Analysis of entrance qualifications and experience of the students

2.1 Introduction

The main objective of the research presented in this thesis is to compare two groups of students who have been taught the same material, and who go through the same assessment procedures, but who are taught using two different paradigms. The first, control, group is taught using traditional methods, including 2 hour lecture, 3 hour lab and 1 hour tutorial. The second, experimental, group is taught using the studio teaching method. The courses studied by both groups of students were the two semester-long courses in introductory electronic engineering for first year students in the Department of Manufacturing and Engineering and Engineering Management (MEEM) at CityU, Hong Kong. These courses were taken by all students taking the Bachelor of Engineering degree programmes in Manufacturing Engineering and Mechatronic Engineering, between 1996 and 2001. The students in each programme were accepted into the two programmes with similar entrance requirements. Those accepted included students who came straight from school or college with a mixture of Hong Kong Examination Authority (HKEA) A level or AS level awards, as well as students from the Vocational Training College/Institutes (VTC) with various technical awards, such as Higher Diploma. The mix of students from these different backgrounds varied with each cohort, ranging from around only 60% of students entering with A or AS levels in the first cohort, to 100% in the last two cohorts.

The two groups will be referred to as the Non-ITS, or non-Teaching Studio, group - the control group, and ITS, or Teaching Studio, group - the experimental group, respectively.

2.2 Entrance qualifications

Before any comparison of grades and added knowledge/understanding can be calculated for the two groups, we must be able to quantify any differences, if any, between the entrance qualifications. The first comparison is the entry qualifications of the students. As noted above, in the first two cohorts there were significant numbers of non-A level entrants - mainly from Vocational Training Colleges/ Institutes. To be consistent these were eliminated from this analysis, as were any repeat students. As will be seen later, this elimination made no significant difference to the performance of the cohorts when it came to any assessments made. Detailed analysis of the entrance requirements - A level or AS level, for example - is shown in Appendix 2. This is restricted to t-tests only. These results are discussed in Section 2.5 below. However, detailed statistical analysis will be carried out on the output measures - i.e. the results of the assessments, in the next chapter.

For Cohort 1 the grades were reported by the students in answer to a questionnaire administered by the instructor, and this did not ask for the specific subject, and all grades could therefore not be confirmed against objective data. For Cohort 2 onwards the grades were supplied by the university registry, and were letter (coarse) grades only. As with A level grades in the UK, the Hong Kong

Examination Authority (HKEA) gives grades from A to E for the Hong Kong A Level Examination (HKALE). From Cohort 3 onwards the university registry supplied both “coarse” grades as well as “fine” grades, which range from 1 to 10, 1 being the highest. Thus coarse grade A can be either fine grade 1 or 2. The fine grade system allowed finer discrimination between students for this exercise as the vast majority - >95% - scored either D or E on the coarse grade scale.

Coarse grades were converted into fine grades using the average equivalent i.e. grade A was given a fine grade of 1.5, and so on. This assumption was valid as an analysis of the fine grade distribution for each coarse grade showed that they were roughly equal for all cohorts.

As the fine grade system is an inverted scale, the grades were subtracted from 11, so that fine grade 10 had a value of 1, and fine grade 5 had a value of 6, for example. This made the scale roughly equivalent to the normal score for A level letter grading, i.e. A = 10, B = 8 etc. but with higher discrimination. AS levels were scored at half the value of A level, again in accordance with normal practice.[1]

The number of students entering the courses with HKEA awards and VTC awards varied by cohort. Table 2.1 shows the percentage of students in each category for each cohort. Note again, that the data for the first cohort was self-reported, and its accuracy cannot be determined.

Cohort	96-97		97-98		98-99		99-00		00-01		01-02	
	Non ITS	ITS	Non ITS	ITS	Non ITS	ITS	Non ITS	ITS	Non ITS	ITS	Non ITS	ITS
A level	54	26	47	32	29	33	32	35	42	29	31	31
VTC	51	10	11	6	18	6	10	0	0	0	0	0
no	105	36	58	38	47	39	42	35	42	29	31	31
% a level	51.42857	72.22	81.03	84.21	61.70	84.62	76.19	100.00	100.00	100.00	100.00	100.00

Table 2.1 Percentage of HKEA and VTC award students in each cohort.

This is represented graphically in Figure 2.1 below.

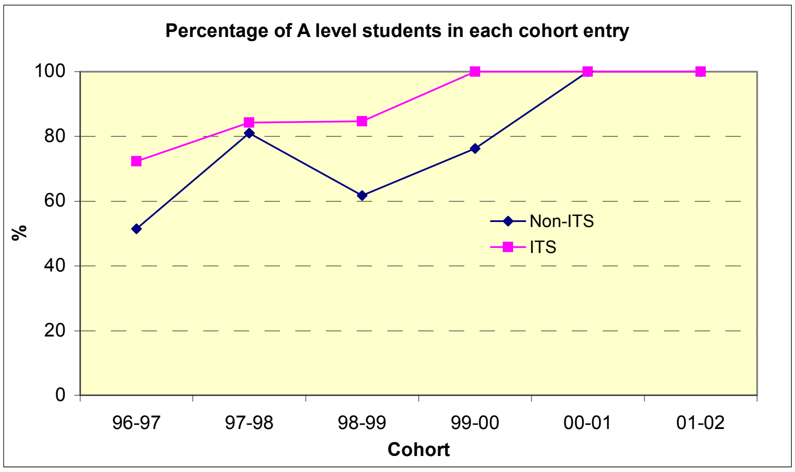

Figure 2.1 Percentage of A level students in each cohort

The first analysis of the A level scores was to compare the average score for each cohort for each

[1] To simplify things, where a score containing both A level and A/S level results is used, it is just referred to as the A level score. If there is reason to differentiate. then the separate scores will be given.

group. This was done in two ways. First, the total score for all examinations was calculated, then the score for only the technical subjects.

Figure 2.2 below shows the total score average for each cohort for the two groups. The top two curves are for all subjects, including Use of English (UoE) and Chinese Language and Culture (CLC) AS level.; the lower two for technical subjects only.

The trendline for each curve was calculated, and also the correlation between the two. An analysis of the results indicated that there was no significant difference between the two groups for both the total and technical subjects only -see Table 2.2. Detailed analysis of the results are given in Appendix 2. Here we will consider correlation coefficient only. The high correlation between the two groups may also be an indication that the pattern of the variation in scores is similar, as can be seen from Figure 2.3. The solid line indicates exact matching of qualifications.

	Correlation coefficient
Total score	0.95
Technical subjects score	0.98

Table 2.2 Correlation coefficients for all cohorts

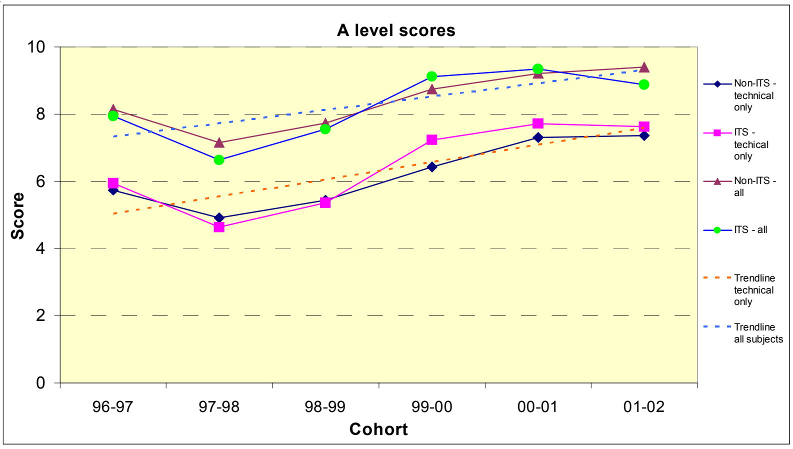

Figure 2.2 Average number of exam pass numbers for those passing both CLC and UoE - excluding CLC and UoE

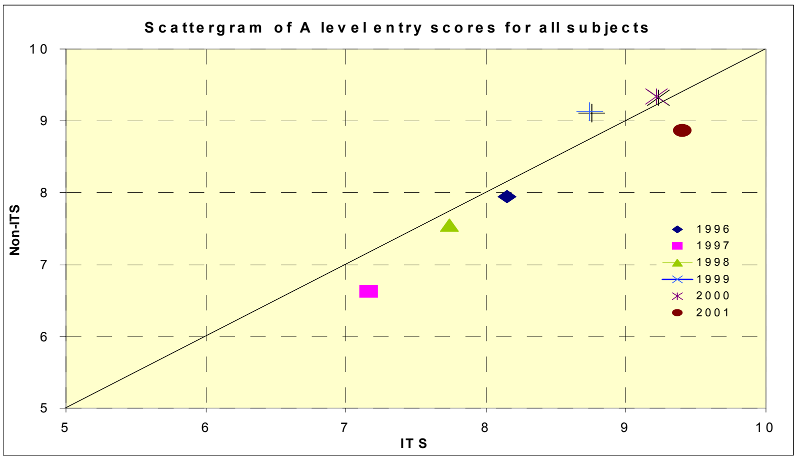

Figure 2.3 shows a scattergram of the scores for both groups for all subjects.

A comparison was then made between the A level scores of the two groups compared to those of A level examination entrants in general [HKEA, 1997, 1998, 1999, 2000, 2001, 2002]. This was to determine the relative quality of students entering the two courses, and their rough position in the overall performance of Hong Kong A level results. Table 2.3 shows the average number of A and AS level examinations taken by all entrants for each of the years considered. These are based on exam pass numbers for those passing both Chinese Language and Culture (CLC) and Use of English (UoE) AS level but do not include those passes. Detailed data, taken from the HKEA annual reports are given in Appendix 3.

These are total numbers of exam entrants, not just school entrants, as some of the students on the two courses also come from a non-school background but with A levels not vocational qualifications. The number of subjects taken is indicated for the two courses being considered is shown as a comparison for each year. These results can be plotted as a scattergram, as shown in Figure 2.4.

Year	HKALE average		Studied courses average		
	A level	AS level		A level	AS level
1996	1.97	0.39	Non-ITS	2.27	0.96
			ITS	2.12	1.69
1997	1.97	0.39	Non-ITS	2.32	0.19
			ITS	2.22	0.16
1998	1.97	0.39	Non-ITS	2.62	0.24
			ITS	2.47	0.19
1999	1.95	0.65	Non-ITS	2.46	0.31
			ITS	2.34	0.26
2000	1.95	0.40	Non-ITS	2.23	0.47
			ITS	2.28	0.52
2001	1.97	0.41	Non-ITS	2.19	0.42
			ITS	2.35	0.35

Table 2.3 Average number of exam pass numbers for those passing both Chinese Language and Civilisation (CLC) and Use of English (UoE) AS level

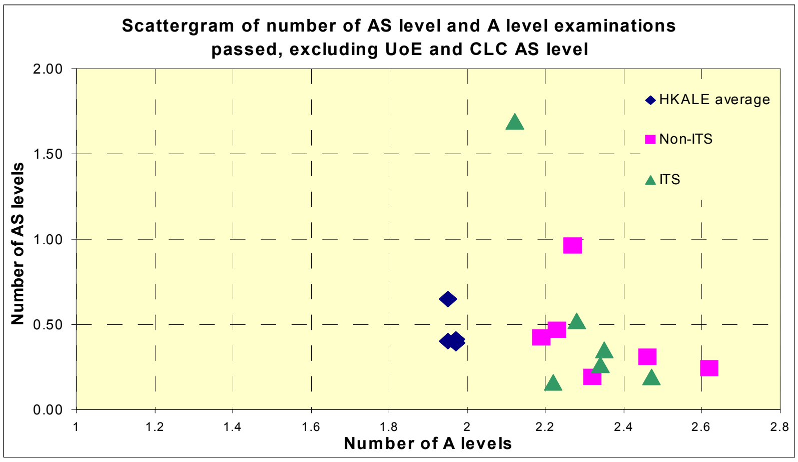

Figure 2.4 Scattergram of number of AS level and A level examinations passed, excluding CLC and UoE

These results can be plotted as a scattergram, as shown in Figure 2.4. It is clear from Table 2.3, Figure 2.4 and Figure 2.5, that entrants to both courses under consideration passed more examinations than the average, although the average grade was much lower than average. At the same time there was no significant difference in the number of examinations passed by both groups.

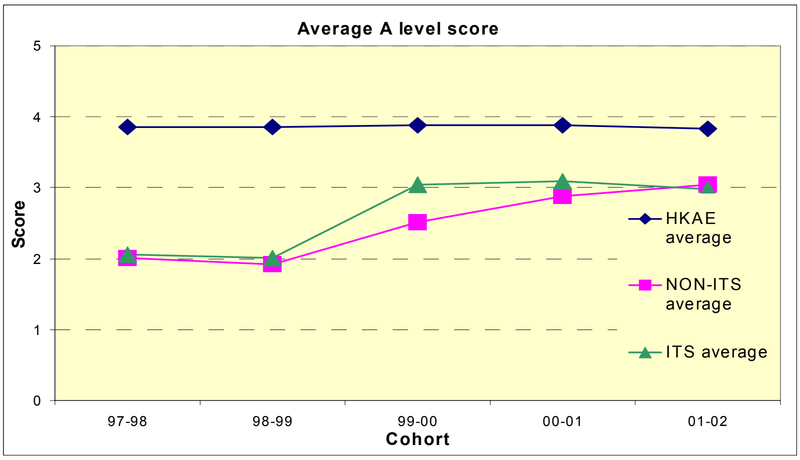

Figure 2.5 Average score of students compared to HKALE average

Again, the average score for each group was calculated across all cohorts. The correlation is shown in Table 2.4 below.

	No A levels passed	No AS levels passed	Average A level score
Correlation coefficient	0.63	0.98	0.91

Table 2.4 Correlation coefficient between two groups for various factors

2.2.1 Technical subjects

A further analysis of the entrance grades for each technical subject is given in Figure 2.6a and 2.6b. This is for Pure Maths, Chemistry and Physics A level only, as these were the subjects taken by the majority of students. Also shown are the average grades for each subject for all students taking HKALE examinations in these subjects. Appendix 4 shows the grade distribution for each year, against the HKALE average for each subject analysed.

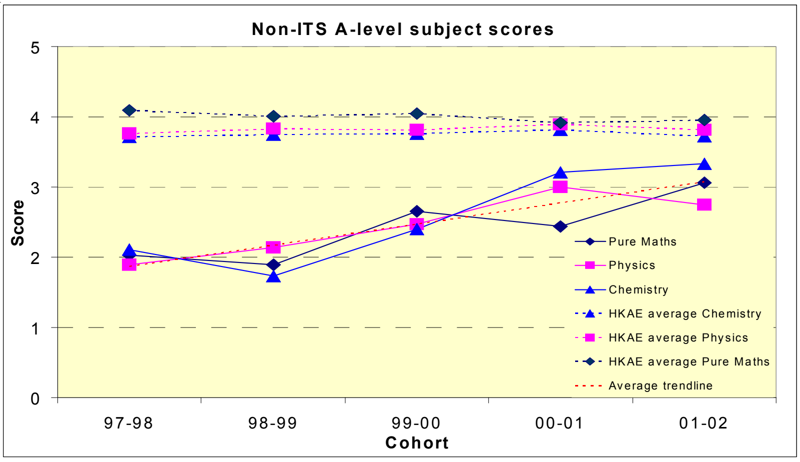

Figure 2.6a Technical A level subject scores for Non-ITS group

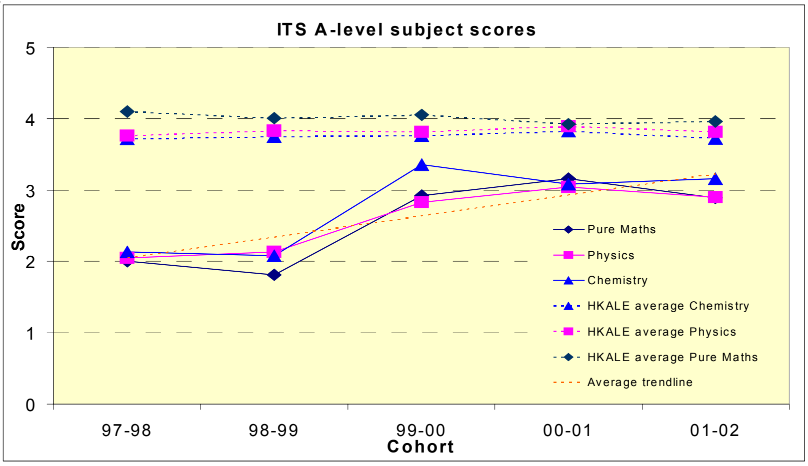

Figure 2.6b Technical A level subject scores for ITS group

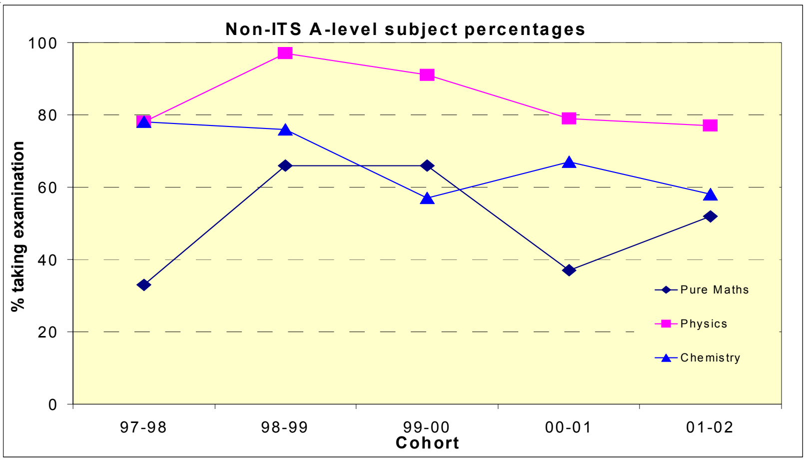

Figure 2.7a Percentage of students taking main technical subjects for Non-ITS group

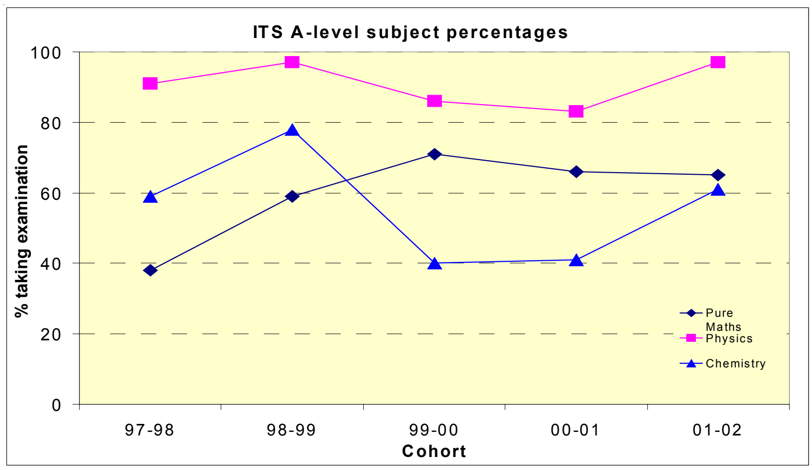

Figure 2.7b Percentage of students taking main technical subjects for ITS group

Figures 2.7a and 2.7b show the percentage of students in each group taking the three main technical subjects. From these it can be seen that there maybe a tendency for the ITS group to have a greater proportion of students that took Maths at A level, compared to the non-ITS group, although the varying data over the whole period makes any detailed comparisons difficult.

2.2.2 Language subjects

An analysis of the language capabilities of the two groups studied is shown in Figs 2.8 a and 2.8b. These show that average AS level score for the two main compulsory language subjects, Use of English and Chinese Communication and Culture. The average score for all HKALE entrants who passed these subjects is also shown, as is a composite score made by summing the two individual scores. The full details of the actual distribution is given in Appendix 4.

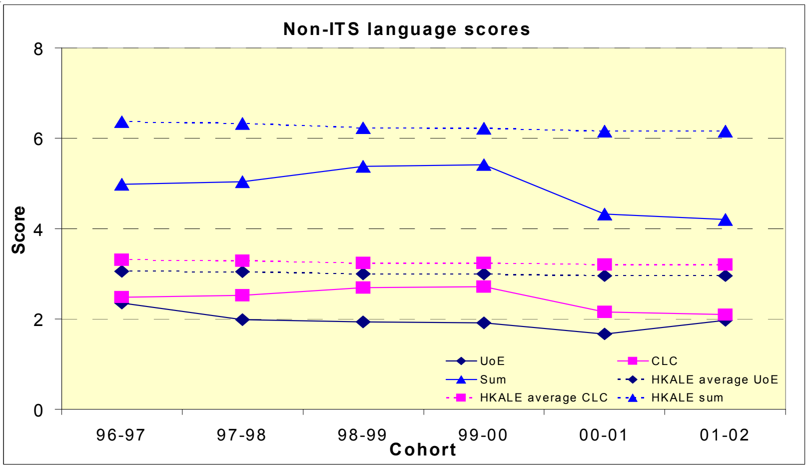

Figure 2.8a. Average scores in UoE, CLC and the sum of both for non-ITS group

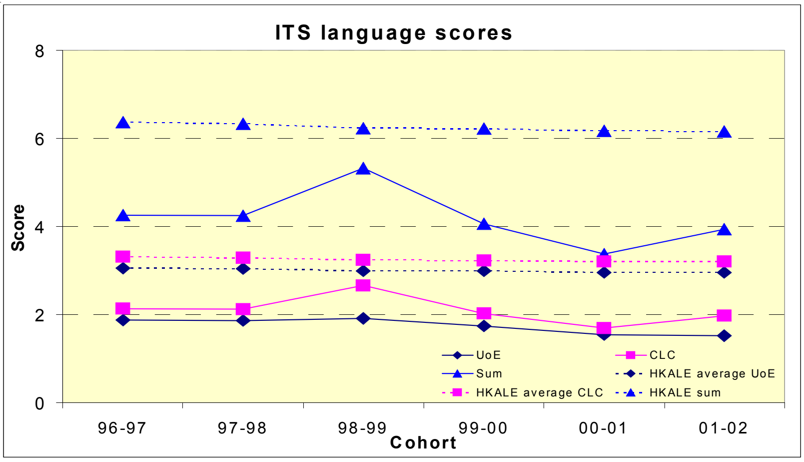

Figure 2.8b Average scores in UoE, CLC and the sum of both for ITS group

2.3 Survey questionnaire

At the beginning of Semester A, for each cohort, a questionnaire was given to both groups by the instructor. This included questions about the ownership and awareness of IT and computers, as well as a 50 question section asking technical questions. This questionnaire is shown in Appendix 1, and the results in Appendix 5. These will be looked at in greater details later in the chapter. However, some results will be referred to below, to relate attitudes towards learning in English and these will be related to the UoE results.

2.4 Language preferences

As part of the questionnaire/test given to each students on the first week of the courses, Appendix 1, a number of questions related to language preferences. The results from these questions are given in Appendix 5. One of the questions, Question 20, asked in which language the students preferred lectures to be given. The percentage of students preferring English only, Chinese only, or a mixture of the two, are shown in Figures 2.9a and 2.9b.

Further questions, questions 21 and 22, also asked the same for tutorial and laboratory work. To get an approximate indication of the overall preference for the language of instruction, these three questions were combined and the students' responses are shown in Figures 2.10a and 2.10b.

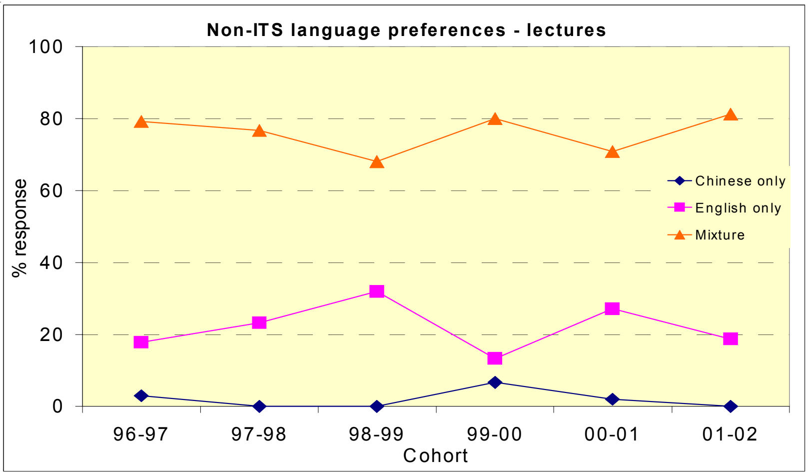

Figure 2.9a Percentage of students preferring various language options for lectures in the Non-ITS group

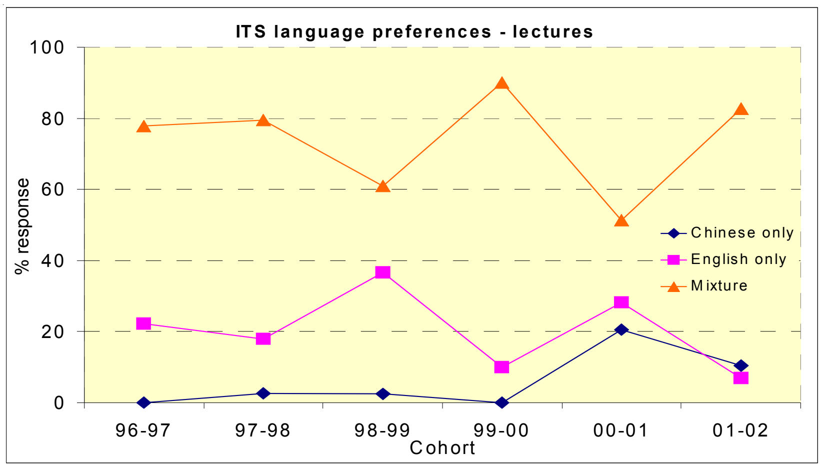

Figure 2.9b Percentage of students preferring various language options for lectures in the ITS group

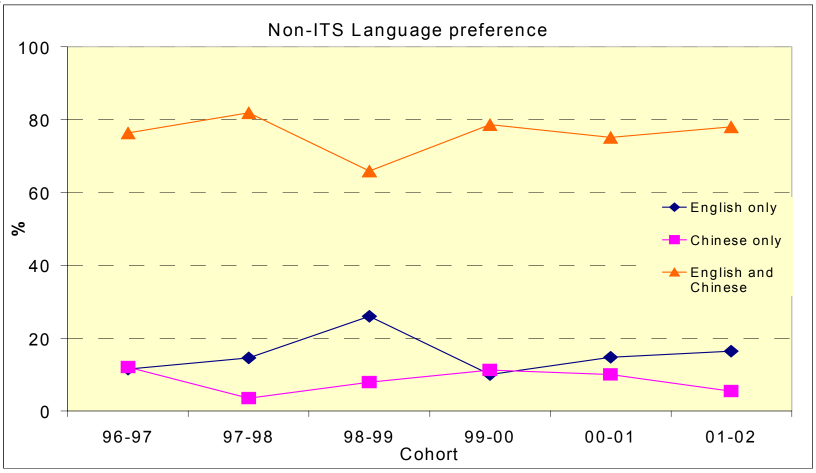

Figure 2.10a Overall language preferences, percentage of students in Non-ITS group

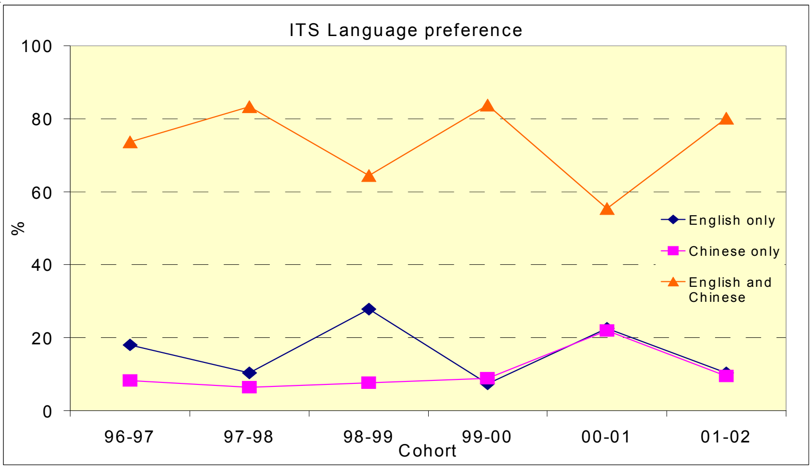

Figure 2.10b Overall language preferences, percentage of students in ITS group

2.5 IT skills and competence

Questions 3 - 6 on the pre-test questionnaire related to the knowledge of various commonly used programs, including word processor, spreadsheet, database and web browser. Students were asked

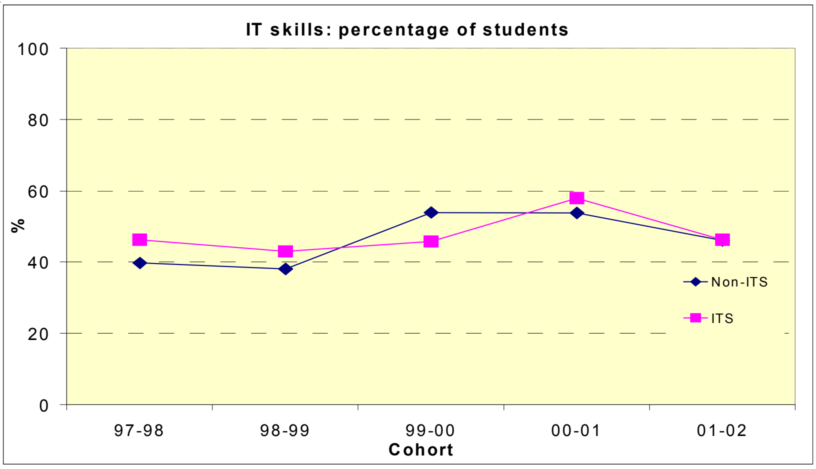

Figure 2.11 Aggregate answers from Questions 3-6, indicating IT skills, percentage of students

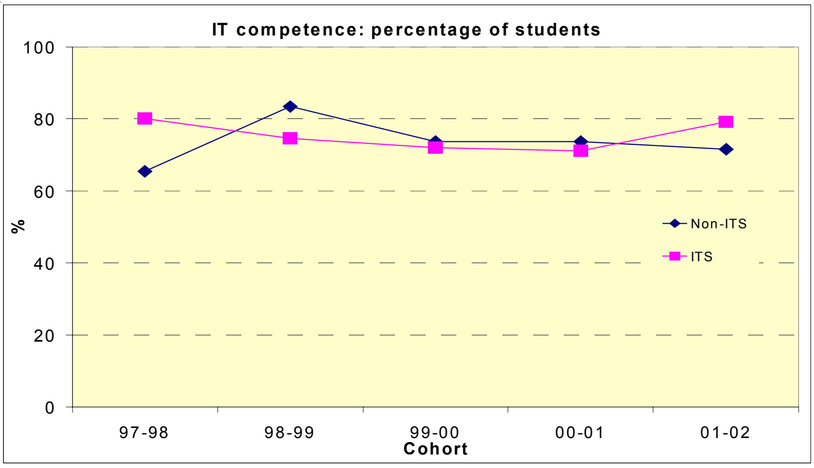

Figure 2.12 Aggregate answers for Questions 1-2 and 7-9, indicating IT competences, percentage of students.

if they were familiar with these programs. Their responses to these 4 questions have been aggregated as shown in Figure 2.11. This shows the percentage of students who say they are familiar with the four programs, and was used as an indicator of IT skills.

Questions 1-2, and 7-9, assess the students' attitudes to using computers in their learning. Question 10 asks how many hours a week they use the computer. A usage of greater than 10 hours a week was counted as indicating that the student was familiar with the computer. The answers from these five questions were aggregated to indicate a measure of IT competence. This is shown in Figure 2.12.

2.6 Equivalence

The objective of the analysis above is to assess the equivalence of the two groups at entrance to the courses under study. From Figure 2.2, it can be seen that the A level scores have been rising each year (Except for the first cohort, where the objectives of the data is in doubt, anyway). This would seem to indicate that the courses studied have been attracting better students. However, the scores from the technical section of the pre-test, shown in Figure 2.13 show that the average ability of each class has been declining over the same period. This would seem to indicate some form of grade inflation in the entrance qualifications. This will be discussed in greater detail in the next chapter.

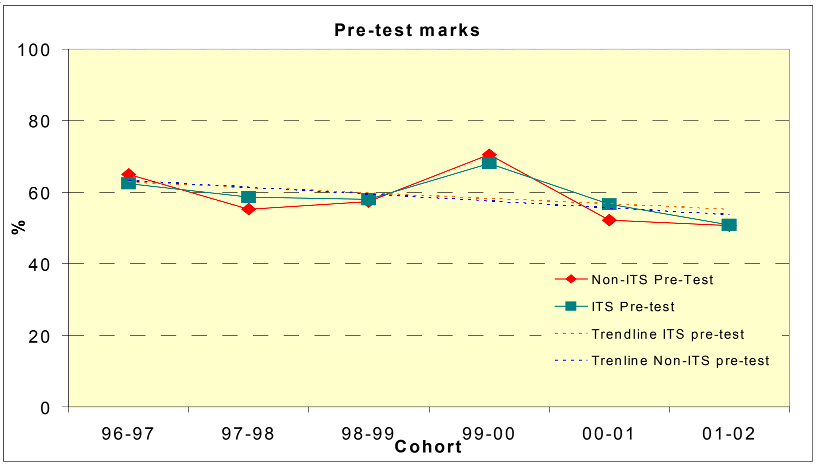

Figure 2.13 Pre-test scores - technical section

At the same time it can be seen from Table 2.2 that there was close correlation between the A level scores of both groups. This is shown diagrammatically in Figure 2.3. This close correlation is also indicated when the number of subjects passed at AS and A level are considered. Figure 2.4 shows a significant clustering of points on the scattergram of number of AS levels against A levels passed. (Reference to Appendix 2 at this point, will show that the actual relationships between this data is quite complex, and further work will need to be carried out to determine exact relationships).

However, as can be seen from Figures 2.6a and 2.6b and the detailed figures in Appendix 3, it is clear that students in the earlier cohorts were in the bottom quartile of students passing the three main technical subjects at A level, but that recent cohorts are now in the third quartile. It is also clear from these figures that there is again close correlation between the scores of both groups, as shown in Table 2.5 below. This gives correlation coefficients of 0.95 for Physics, 0.8 for Chemistry and 0.75 for Maths.

One area where there is difference between the two groups studied is in the percentage of the class taking various A level technical subjects. This varies over the period studied, as can be seen from Figures 2.6a and 2.6b. As mentioned above, it would be complicated to analyse the correlation between the two groups because of this variation, but by inspection it can be seen that the ITS group has a higher percentage of students with Physics, with a slight advantage in Chemistry and Maths.

The data for the non-technical subjects can also be used to determine the correlation between the groups. This is also shown in Table 2.5 below; the correlation coefficient is 0.55 for UoE and 0.69 for CLC.

The graphs for language preference are also difficult to analyse. For the language preference in lectures, there are correlation coefficients of 0.43 for English and 0.47 for mix of English and Chinese. The responses to Chinese only are too few to correlate. Similar figures for the overall language preference are 0.63 for English only, and 0.3 for a mixture.

A level	**r**
Physics	0.95
Maths	0.75
Chemistry	0.8
UoE	0.55
CLC	0.69
IT skills	0.93
IT competences	0.9
Language Preferences	
Lecture	
English	0.43
Mixed English and Chinese	0.47
Overall	
English	0.63
Mixed English and Chinese	0.3
Pre-test	0.88

Table 2.5. Correlation between groups for various analyses

The data from the two graphs showing IT skills, Figure 2.11, and competence, Figure 2.12, have correlation coefficients of 0.93 and 0.90 respectively.

One point of interest to note is that there is a 'peak' in the 'sum' score for the 1998-99 ITS cohort shown in Figure 2.8b. This corresponds to the higher preference for English shown in Figure 2.10b. However, the slight increase in the corresponding score for the 2001-2 ITS cohort does not translate into a higher preference for English - in fact exactly the opposite!

The correlation coefficient for the pre-test scores shown in Figure 2.13 is 0.88. Finally, a t-test was carried out on the three sets of A level scores combined, as shown in Appendix 2. This showed that the p-value of the analysis of all the scores was 0.78; that for the technical subjects only was 0.77, and that for language subjects only was 0.04.

From the above we can conclude that both groups studied are equivalent at intake, except for the language abilities, as shown by the AS level results. Therefore the splitting of the students into a control group and experimental group based on self-chosen criteria i.e. the degree course to be taken, is valid for comparative purposes.

2.7 Further analysis of the pre-test data

Assuming that it is possible to consider the two groups homogeneous, a more detailed analysis of the students' responses to the questions in the pretest leads to a better understanding of students' experience with, and attitudes to, computers and IT in general. This will be especially useful when considering whether such experience and attitudes affects student learning in an environment which is based around that technology.

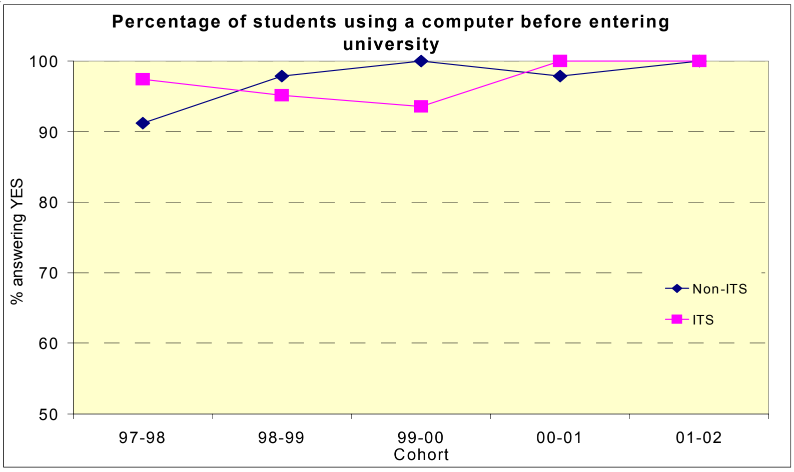

Figure 2.14 Percentage of students having used computers before entering university

The first question asked whether the student had used a computer before. The results are show in Figure 2.14.

As can be seen, and expected, the number of students having used a computer has now reached

100%. What is surprising is that just 5 years ago 6% of students had not used a computer before entering an engineering programme.

Question 2 asked whether the student felt comfortable using a computer. Although the response to this question was predicated on the interpretation of ‘comfortable’, it was never the less one of a number of questions, which when combined together, gave a good indication of the student’s attitude. The results are shown in Figure 2.15.

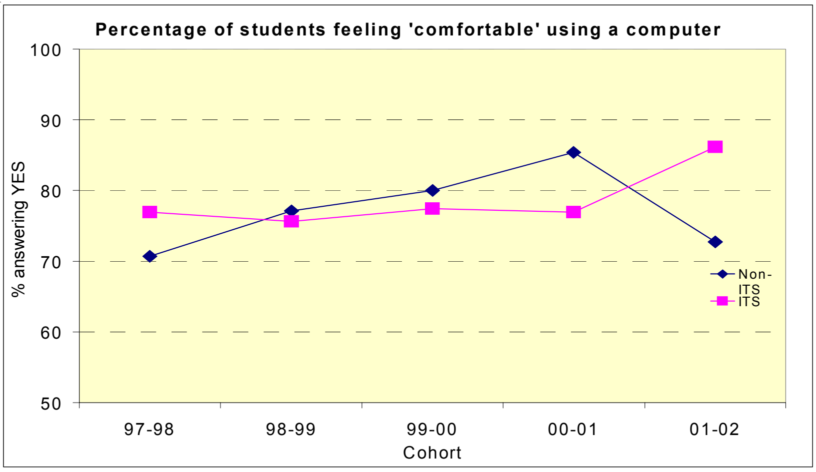

Figure 2.15 Percentage of students feeling ‘comfortable’ using a computer

It can be seen that the response has peaked, at 85% for the non-ITS group, but dropped for the last cohort, whereas the ITS group has continued to rise. Again, this is surprising considering that these are engineering students who will be spending considerable time using computers, not only in their courses, but also in their eventual jobs.

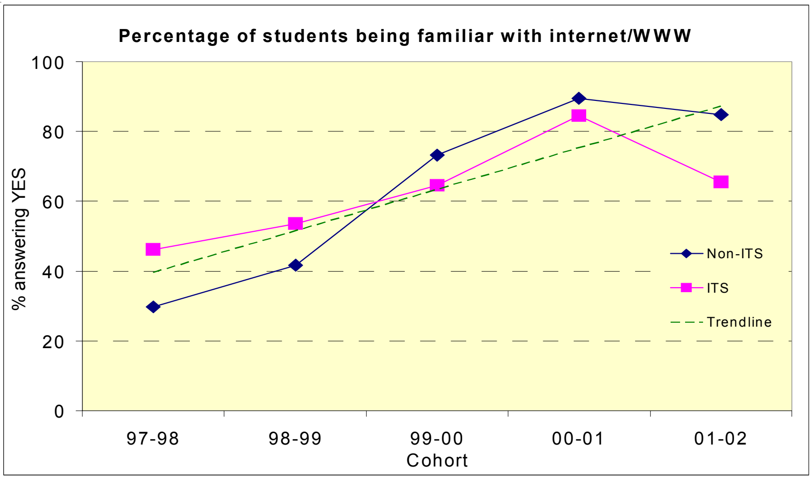

Figure 2.16 Percentage of students being familiar with the internet/WWW

The next questions considered the students’ technical skills at using, or at least being familiar with, the most common computer applications. Question 3 concerned the use of the Internet/WWW. The responses are shown in Figure 2.16. The combined trendline shows that over the past 5 years familiarity with the web has risen substantially, although the 01-02 cohort shows a drop-off that is not expected.

Although their ownership, use of computers, and computer skills had risen steadily, their willingness to use computers as part of their course looks as though it is decreasing. However, the two courses studied were consistent in their responses, which indicated that this feeling was prevalent independent of the programme. One explanation could be that at the beginning of the survey period ownership of computers was low, although not significantly so, whereas web access, for example, has increased significantly. The decrease in willingness to use the computer/web/internet for studying seems to have dropped by about the same amount as the increase in ownership, indicating that at the beginning of the survey those using computers were more willing to use them. As ownership has increased as well as access to the web, the change in use has also affected the students attitudes. It now seems that the computer has become more of a social tool than one for study.

Figure 2.17 shows the aggregated results of all the questions concerning what might be called 'IT skills'. These questions asked about knowledge or experience of using word processors, spreadsheets and databases, and also includes the results of the question above concerning the Internet/WWW. A slight bias has been introduced to weight the results towards the more familiar applications, such as word processing, and against more uncommon ones, like databases. The results are shown in Figure 2.17. 100% would approximate to a good familiarity with all the common applications.

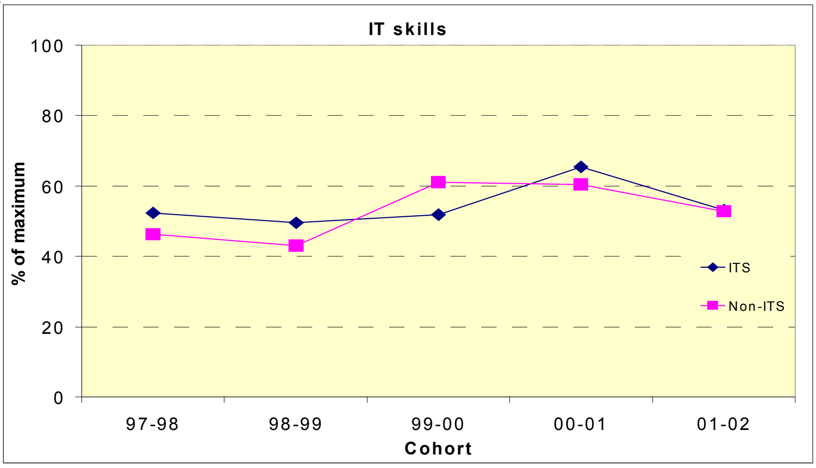

Figure 2.17 IT skills

Again, a saturation point seems to have been reached, with students averaging around 60% skill level on entry compared to those who would be considered adequately skilled.

Figure 2.18 shows those responding positively to a question that asked if they use a computer to do their homework. Surprisingly, the trend has been falling, with around 20% using computers for homework in 01-02. However, as will be seen below, over 95% of students owned a computer by that time.

The next set of questions focused on the students' reactions to computer use. Figure 2.19 shows the percentage of those who felt that using computers help them learn, and Figure 2.20, the percentage of those who enjoyed using computers.

The answers to these two questions seem to indicate that whilst most students considered computers a useful learning tool fewer students didn't really like using them for doing so, and this seems confirmed by the responses to the question on homework, Figure 2.18, where a small minority, around 20%, actually used them for such a purpose.

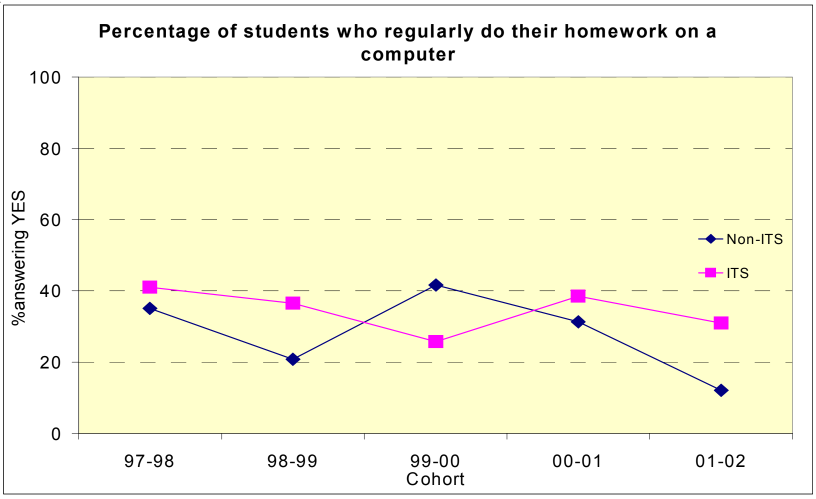

Figure 2.18 Percentage of students who use a computer to do their homework

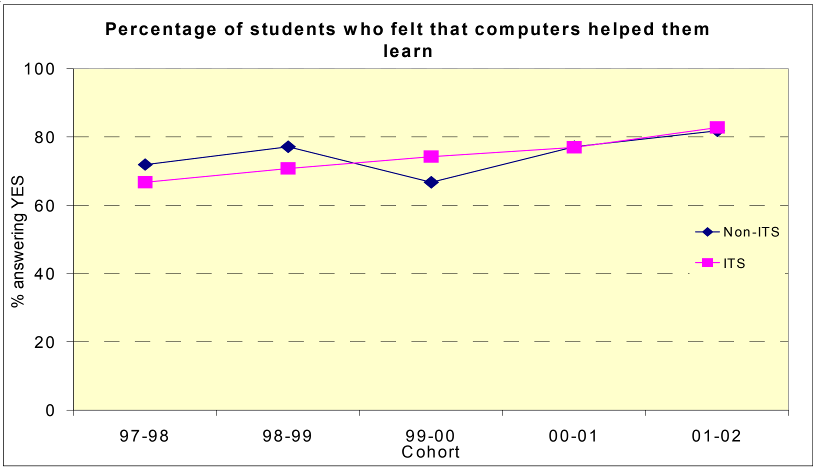

Figure 2.19 Percentage of students who felt that computers helped them learn

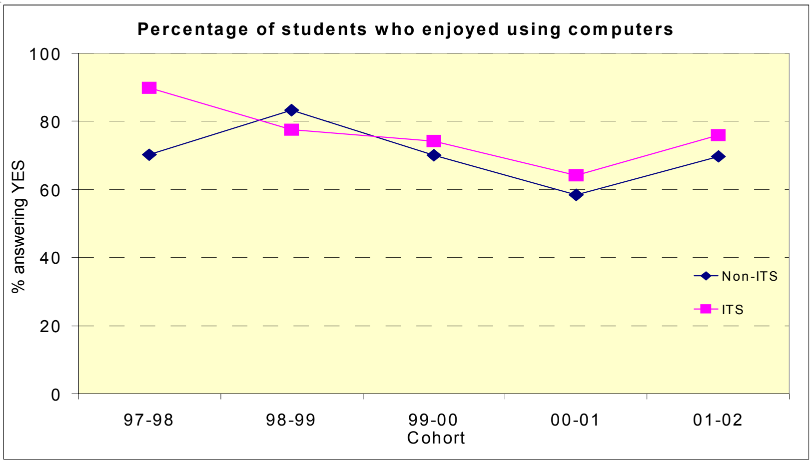

Figure 2.20 Percentage of students who enjoyed using computers

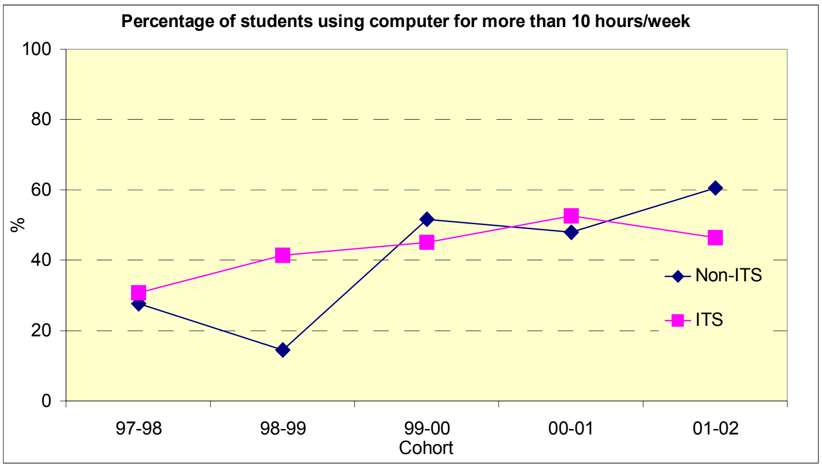

Figure 2.21 Percentage of students using a computer for more than 10 hours/week

However, it is interesting to see the responses to a question concerning the number of hours that they use computers each week. As can be seen from figure 2.21, that has been increasing over the years of the study. Although the original study requested detailed information about the number of hours, Figure 2.21 shows those who use the computer for more than 10 hours a week, a median point derived from the original survey.

A related survey, discussed in Chapter 4, showed that most of the time spent on the computer was used for game playing, surfing the web and chat rooms. Educationally related usage was a distant 4th in the list.

The responses to the questions relating to computer usage and the students' feelings were aggregated into a single response. This is shown in Figure 2.22. 100% would be a rough measure of someone feeling happy, competent and at ease when using a computer. The percentage is the class average of this very rough and ready measure. It can be seen that the feelings towards using computers have been fairly constant over the period of the survey.

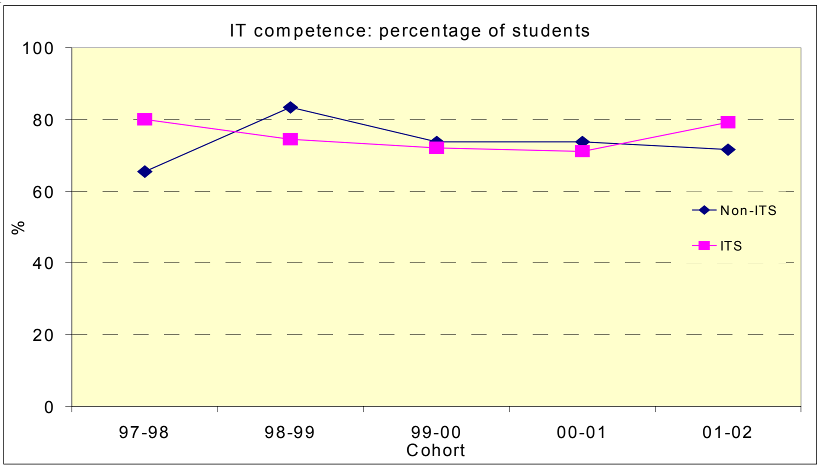

Figure 2.22 Feelings towards using computers. 100% would indicate a feeling of competence and comfort. Class average

The next three questions were related to the ownership of computers and the technical details. Figure 2.23 shows the percentage of students owing a computer, Figure 2.24 the percentage of these having a CDROM capability, and Figure 2.25 the percentage having a modem. These questions were considered important as much of the course material was placed on the web over the period of the survey and it was possible to access the university network from home via the web. At the same time, some of the coursework was also made available in CDROM format.

As was to be expected the responses followed very closely the development of technological progress. It can now be safely assumed that only a small minority of students do not own a computer, and this is probably because of financial problems. During the past two years the university has allowed students to borrow laptop computers which have wireless LAN capability for use on campus, and circumstantial evidence shows that those not owning a computer themselves now have access to one for most of their study time.

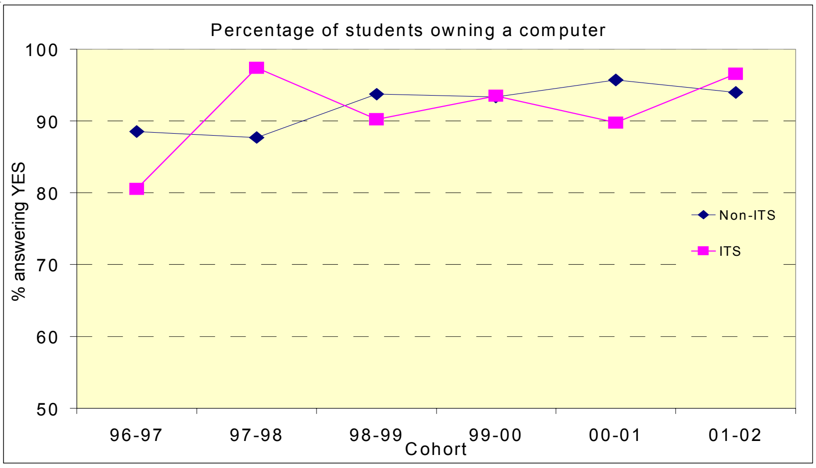

Figure 2.23 Percentage of students owning a computer

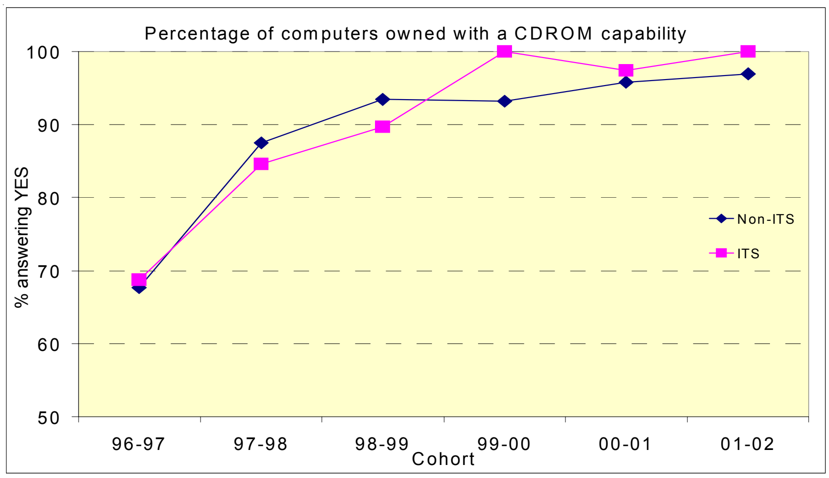

Figure 2.24 Percentage of computers owned with a CDROM capability

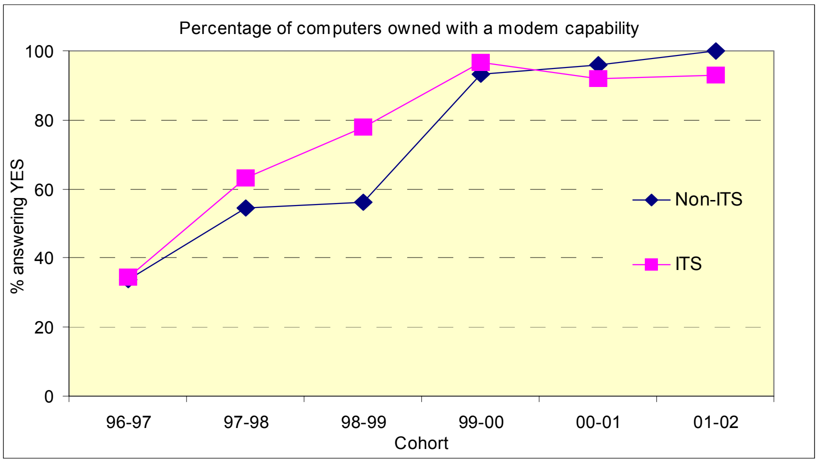

Figure 2.25 Percentage of computers owned with a modem capability

Two final questions related to the students' thoughts about how the courses should be presented. As the courses became more web based and interactive, it became possible to allow them to study in a self-learning mode, and not attend classes. In fact, the responses to a question asking if they would consider using this mode of learning, shown in Figure 2.26, indicate a trend away from doing so.

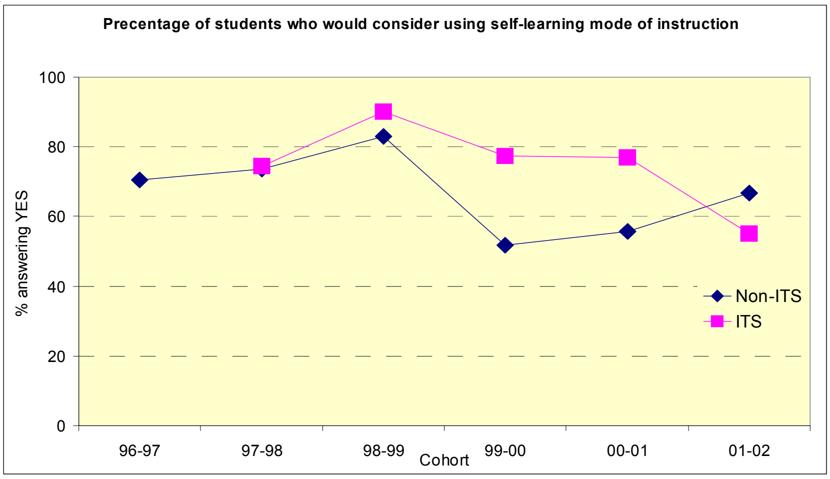

Figure 2.26 Percentage of students who would consider using self-learning mode of instruction

A related question asked if, owning a modem, they would consider doing some study work at home

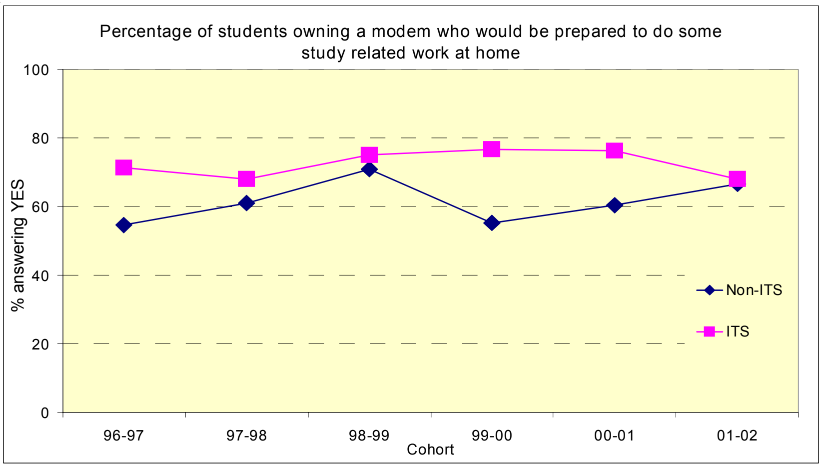

Figure 2.27 Percentage of students owning a modem prepared to do some online study related work at home

online. The responses are given in Figure 2.27. This percentage has remained remarkably steady over the period of the study even though modem ownership has increased from 25% to near 100% over that time.

2.8 Discussion of questionnaire answers

Many courses established over the past five years or so have made basic assumptions concerning the level of computer literacy of the students, and this is especially true of engineering courses. There has also been a very substantial move away from the more traditional pedagogies of engineering education to those which are more student-centred and interactive.

Admittedly, the two bachelor's degree programmes studied at City University of Hong Kong do not reflect the situation on a wider basis - they just reflect the unique conditions of the Hong Kong educational system that is currently in transition from a pedagogy formally based on rote learning to one more oriented towards more investigative pedagogies. The students studied in the survey reported here were products of a system in transition and their attitudes towards learning showed this, in their classroom behaviour as well as their general knowledge of the subjects they elected to study. The next chapter shows that the aptitudes of the students had dropped over the period of the study even though their entrance grades had improved. This dichotomy also seems to have been seen in the results of the study reported here.

For example, although their ownership, use of computers, and computer skills had risen steadily, their willingness to use computers as part of their course has decreased. However, the two courses studied were consistent in their responses which indicated that this feeling was prevalent independent of the programme.

One explanation could be that at the beginning of the survey period ownership of computers was low, although not significantly so, whereas web access, for example, has increased significantly. The decrease in willingness to use the computer/ web/internet for studying seems to have dropped by about the same amount as the increase in ownership, indicating that at the beginning of the survey those using computers were more willing to use them. As ownership has increased as well as access to the web, the change in use has also affected the students attitudes. It now seems that the computer has become more of a social tool than one for study. It is therefore not possible to correlate the increase in computer ownership with an increase in the desire to use computers for learning. This belief, which may be erroneous if the results from the survey reported here are corroborated, has been a foundation of the move towards more web based interactive learning pedagogies. Vast investments have been made in designing and evaluating these new pedagogies, many of which have not taken into account the changing nature of student attitudes towards computers.

From the survey reported here a number of clear trends can be discerned as far as Hong Kong is concerned. They may or may not have relevance to other countries. First, ownership of computers by first year engineering students is nearly 100%, and these computers are equipped with CDROM and modem capabilities. 100% of students are able to make use of computer applications, although these are heavily weighted towards web/ internet access and word processing but not spreadsheets and/or databases. There are a substantial minority - about 20% - of students who do not feel comfortable using computers, although over half those reporting used the computer for more than 10 hours a week.

Around 60% of students should be considered computer literate with respect to their knowledge of basic applications. The majority of students - around 80% - think that using computers helps them learn, but around 70% would be prepared to use computer-based self-learning pedagogies. In fact, the percentage of students that use a computer to do their (school) homework is only around 30% and dropping.

Clearly, these attitudes towards computer-based or computer assisted learning are of concern to those academics who are involved with developing such courses, and this surely has implications for such areas as distance learning which are becoming more and more dependent on internet-based-learning pedagogies.

Having established the academic equivalence of the two groups in this chapter, we will now consider, in the next chapter, how they performed in the assessments, and whether there was any significant difference in performance and learning.