The Determinants of Student Failure and Attrition in First Year Computing Science

Matt Roddan

TABLE OF CONTENTS

PAGE

Abstract..... 3

Introduction..... 4

Method..... 13

Results..... 16

Discussion..... 25

Conclusion..... 32

References..... 34

Appendix 1: Departmental Data..... 36

Appendix 2a: Background Questionnaire..... 38

Appendix 2b: Background Questionnaire Variables..... 42

Appendix 3: Activity Log..... 43

Appendix 4a: Post-Exam Questionnaire..... 44

Appendix 4b: Post-Exam Questionnaire Variables..... 45

Appendix 5: Interview Codings..... 46

Appendix 6: Departmental Data Statistics..... 47

Appendix 7: Background Questionnaire Correlations..... 49

Appendix 8: Interview Code Correlations..... 51

Appendix 9: Interview Transcripts..... 52

Abstract

This paper presents explanatory and predictive models of student failure and subsequent attrition within a first year university Computing Science course, based on data collated from a number of sources. Previous research from the field of student attrition and failure is reviewed. Such research highlights the need for data analysis at the departmental level, where the university experience for a student is primarily shaped. Data was gathered through the use of an online questionnaire, weekly interviews and a post-exam paper questionnaire. Additional data from the Department of Computing Science regarding student attendance, assessment and entry scores is also analysed. A large number of variables were gained, most of which were not significantly related to performance in exams sat mid-way through the academic year. Notably, attendance and amount of revision did not elicit high correlations with exam score, and it is suggested that understanding of the course material is a key factor. It is concluded that the factors examined within this study are not sufficient to predict student performance, although several areas are recommended for future research, including student self-assessment of understanding and commitment, previous computing experience and temporal patterns in student behaviour.

Introduction

This paper examines student failure and attrition in the first year of a large (415 students), undergraduate Computing Science course at Glasgow University, in the academic year 2001-2. The aim of the investigation was to understand why so many fail this course (last year 42.2% failed the further programming module), and do not pass on to the second year.

The high percentage of students who dropout of courses is presently a significant concern. Recent figures published by the House of Commons (1997) suggest that 17% of students who enter higher education in the UK dropout without gaining a qualification. Student attrition is certainly a 'hot topic' at the moment, and indeed, many universities and other educational institutions worldwide are conducting research with the hope of discovering the reasons for such high rates. Such a high percentage affects not only the individual, but also the institution, the education system, business and industry, and society as a whole. It is therefore important to examine attrition and investigate what can be done to improve the situation.

Recent research by the Student Retention Committee (Patrick, 2001) reported a rate lower than the national average at Glasgow University (overall <12%, males 13.5%, females 10.8%). This rate typically varies between courses, and unfortunately, the Department of Computing Science did not fare so well, with a dropout rate of approximately 40% in the academic year 2000-2001. Needless to say, the department is concerned, and is keen to conduct an investigation into first year attrition and retention.

The transition from school to university can often be difficult, especially in Scotland, where entrants are typically 17 years old. Along with the extra freedom comes a significant amount of responsibility a student must take in managing their own time. In order to progress satisfactorily, each student must adapt their study patterns and come to recognise that learning is not a passive activity. This may be tough with such a large increase in class sizes (even after dividing the year group, lecture classes may have as many as 300 students) and decrease in staff-to-student contact. Doing insufficient work, or failing to understand the course material early on can have a big impact upon academic progress, and

by the time exams come round, it is often too late for such students to catch up. It is inherently difficult with such a large year group for departmental staff to identify struggling students at risk of failure, and so this project aims to give some insight into student behaviour, helping early detection and subsequent intervention by the computing department. Intervention will, of course, be most effective in reducing overall rates of attrition within the course if it accurately targets those most at risk of dropping out.

Background Theory

Much of the research in this area focuses and builds upon Tinto's work (Tinto 1975, 1987, 1988), and despite recent criticisms (Brunsden & Davies 2000), his model continues to dominate.

Tinto suggests a longitudinal model of attrition (Figure 1), at the centre of which are the key concepts of academic and social integration. These ideas repeatedly arise in attrition research, and it is generally held that a student who interacts more within both the academic and social spheres of their university is less likely to dropout than one who does not. Persistence may be seen as a primary result of such interactions.

What is meant by academic integration is to become involved in the course, and essentially 'doing the course'. This may involve being active in group work, organising yourself well, seeking help when it is required etc., and is measured primarily, according to Tinto, by academic performance and intellectual development. Social integration on the other hand may be having an active social life with friends on the course, participating in University societies or activities, or simply knowing and speaking to peers. However, successful integration involves more than simply 'having' these interactions. It requires students to see themselves as a "competent member of an academic or social community within the university" (Beder, 1997). It is intuitive that having these friends and feeling confident in being part of the university culture provides a good support network when problems arise, and so persistence is more likely. Conversely, students who do not become suitably integrated have feel alienated and may not deal with difficulties so well, making dropout more likely.

The literature points to a number of factors which are important in determining whether an individual will become integrated. Each student has a set or pre-existing attributes which should be examined.

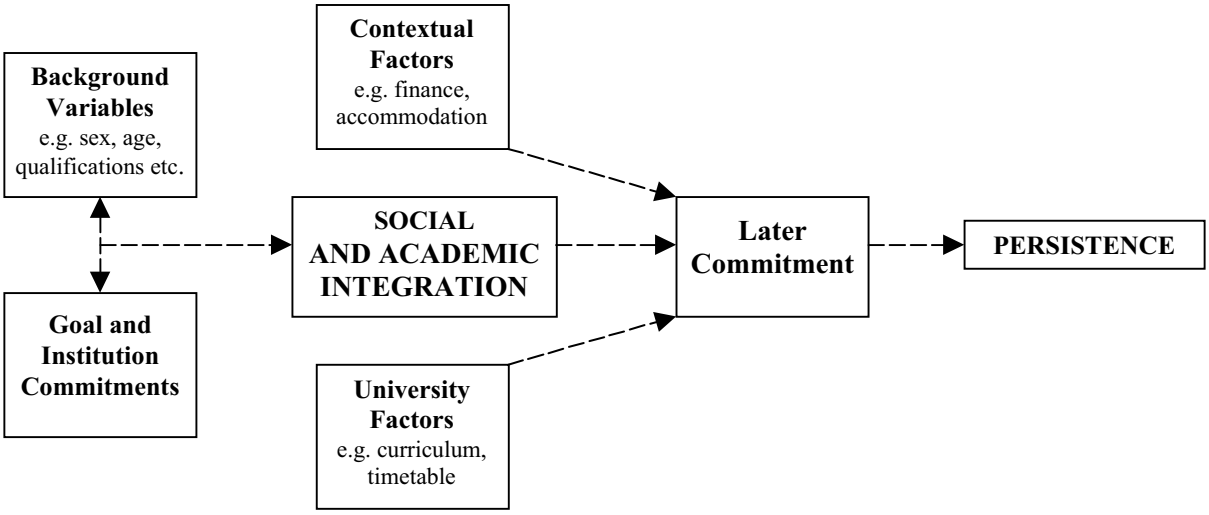


Figure 1: A conceptual schema for university persistence (redrawn from Tinto, 1975)

These include previous qualifications, sex, race, age, social status etc. These characteristics interact with the student's goals (e.g. to complete and successfully pass a course/degree) and commitments (to the course and to the institution) to influence integration. This in turn, combined with the influence of any contextual factors (e.g. accommodation, employment and family commitments, finances), and factors particular to the university (e.g. timetable, teaching environment, curriculum) impacts the subsequent re-evaluation of goals and commitment, which is the primary determinant of persistence.

When looking at the background characteristics of students, the research is not in agreement, and as yet, no one core set of significant variables has been identified that predicts attrition. Which variables are important, and how they are significant is widely debated.

One variable that is reliably identified in the research as a significant predictor is entry point score (derived from a student's previous qualifications). Students with high grades on their A-Levels (or national equivalent) are much less likely to drop out than those with low entry scores (HEFCE, 2001; Arulampalam et al, 2001; Montmarquette et al, 2001). The research also tends to agree that part time students are more likely to dropout than full time students (Windham, 1994; Moore, 1995; Montmarquette et al, 2001), and being female increases your chances of persisting (Montmarquette et al, 2001; Arulampalam et al, 2001).

The importance of social class as a predictor is debatable. Arulampalam et al (2001) report that class is largely insignificant. Research published by the House of Commons states that higher attrition rates are found in the lower social classes (classes IV and V), but when looking at those students with good A-Level results separately, these class differences disappear, suggesting non-completion is primarily related to academic-related causes.

One area of conflict is age as a defining characteristic. Typically, older students are cited to have higher attrition rates (Montmarquette, 2001; HEFCE, 2001), yet some research has found dropout probability to fall with age (Arulampalam, 2001).

For the purposes of this study, it may be most appropriate to examine the significant background attributes identified by research at Glasgow University (Patrick, 2001). Recall that in this study, the overall attrition rate after the first year at Glasgow University was just under 12%. It presented that higher rates were found amongst older students (19.5%), students in social classes IV and V (17.2%, 26.4% respectively), and students with lower entry scores (approx. 20%). In addition, students who scored poorly on questions testing commitment had a rate of 15.6%. These results are in accordance with Tinto's longitudinal model.

The general theme throughout most of the background research is that attrition is seen as undesirable, and every effort should be made to prevent it. It should be noted that not all researchers are in agreement with this view (Manski, 1989; Hartog, 1989). At the Workshop on Graduate Student Attrition in 1998, it was proposed that an overall attrition rate of 20-45% should not be viewed as a problem. Some even suggested that a rate of 50% is not as bad as it sounds.

We should perhaps see the decision to enrol as a decision to initiate an experiment, a possible outcome of which is dropout. Under this standpoint, the university should support this 'student experimentation,' and expect a high level of non-completion, allowing students to look around for a course that best suits them.

However, that view may not be so applicable for this study. At Glasgow University, students must pass the courses they take in order to gain their 'credits,' which permit them to pass onto the second year. So there is little opportunity for experimentation. In addition, the culture is somewhat different at British universities, where students take a three or four year course and then move on into the world of work. Compare this to other countries, especially on the continent, where students may take as long as they like or need to complete their degree, and an extra year is not a problem. When considering that the majority of English and Welsh students now pay fees to attend university in this country, it is not as easy as just deciding to take another year. Even Scottish students, who don't pay fees, often face financial hardship and emerge with large student debts. The decision to enrol on a university course therefore is often one that is thought about carefully before it is acted upon.

Furthermore, many researchers disagree with the notion of an acceptable level of attrition, and argue that institutions should do a better job of reaching out to students and helping them. Tinto believes it is fundamental that students at risk of failure be given any assistance they need, and that simply viewing some student fallout as expected and desirable is irresponsible.

There is substantial evidence to show that extra support provided by universities does have a significant effect on student performance and retention. Sharon Beder (1997) proposes three options available to universities. The first of these is *Orientation Courses*, often used in the US, which are designed to better prepare students for their university experience, "instilling a sense of membership in the academic community." Some institutions offer voluntary or compulsory *Introductory Courses*, which take place throughout the year. These aim to improve social and academic integration, educate students about the support available to them, and teach them organisation and study skills. Thirdly, *Mentoring and Peer-Tutoring programs* are used to offer support and guidance on a one-to-one basis. A further possibility suggested in the research (Arendale, 1995) is providing additional teaching (or Supplemental Instruction, SI) for those who want or need it.

Research has shown that these programs do work. They significantly improve pass rates, exam grades and levels of retention (Glass & Garrett, 1995; Nelson, 1993). Blanc et al (1983) found that students identified as 'high-risk' for non-completion attained better grades and were more likely to return the

following year if they took an SI course. Even at Glasgow University, students who take an Access Course show a lower attrition rate of 9.1%, compared to the overall average of 12% (Patrick, 2001).

So, this evidence highlights the fact that targeting students for intervention is beneficial, and hence, that this research is worthwhile.

Further support for attrition research at this level is provided by the Workshop on Graduate Student Attrition (1998). Many universities (including Glasgow) have conducted completion and retention studies at the university level, but data is somewhat lacking at the departmental level. This is quite an important point, because as much as the university level data is important and interesting, it doesn't explain why there are such big differences in attrition levels between departments and courses. The university experience for a student is primarily shaped at the course level, and so it is important to conduct research at this level. It should be noted here that the Department of Computing Science is currently conducting research in this area, the goal of which is to build predictive models of the behaviour of students at risk of failing Computing Science, and to develop software to support the application of these predictive models. This psychology project can be seen as a contribution to the research, coming under the first part of this aim. The main objective here is to identify important factors in failure and to build a predictive model. I am also carrying out a 4th year Computing Science project alongside this one, which will build a piece of software to apply the predictive model gained. So, these two projects have a valid application within the current body of research, and as such, the results gained may hope to be of use to a number of people.

Within the Computing Science research, data from three software systems is being collated and analysed. It would be beneficial if students at risk could be easily identified from data that is generated automatically with little human effort. Information about attendance, engagement in lectures, completion of exercises and practise of using the departmental computers will be gathered by the Laboratory Support System (Draper, 2001), the User Action Recorder (Evans, 2001) and the Personal Response System (Draper et al., 2001). Additionally, interviews, questionnaires, focus groups and observational studies will be employed to gather human data. Data Mining techniques will then be used to analyse the data.

Level 1 Computing Science

It is appropriate at this point to give a short overview of the first year course at Glasgow University, to better understand this paper.

The course takes on between 400 and 450 students a year and is broken up into two modules, each worth 20 credits (students must attain 120 credits in their first year by taking three subjects in total). CS1P teaches the principles of programming, and students learn to program in Ada95. CS1Q covers a wide range of computing topics, including databases, Human Computer Interaction (HCI), computer hardware and architecture. Each module has two lectures per week, as well as a tutorial and lab every fortnight. For the purposes of this study, data will be collected about the CS1P module, as students tend to have the most difficulty with this section of the course.

A study pack is distributed amongst the students every fortnight. These contain a number of programming exercises for the students to complete in their own time, in order to practise the skills they are learning in lectures. In addition, a number of the questions must be submitted for assessment in the lab every other week. Students achieve a pass mark if they make a serious attempt at the questions, and they must pass six out of the ten study packs to pass the year. Assessment is in the form of two class tests and lab exams, sat in January and June. The class test is a written examination, and assesses student's understanding of programming. For the lab exam, students are given a program to write a few weeks beforehand, which they must reproduce under exam conditions on a computer. The class test is generally seen as a better test of progress and understanding, and has a stronger correlation with final year results. Students must attain a G grade overall to complete the module and gain their credits, and a C to progress onto Level 2 Computing.

Unfortunately, the scope of this project did not allow for collection of the end of year exam results to determine which students have failed, or for collecting data on which students drop out. Therefore it concentrates on the results from the exams sat in January 2002. The Computing Department state that these results are a very good indicator of what the final end-of-year results will be. This is supported by the literature, which identifies academic performance after the first semester/term as the most

important, and almost the sole determinant of university persistence (Montmarquette, 2001; Tinto, 1988).

Why do students fail Level 1 Computing Science?

Through reviewing the background research, and by talking to lecturers and staff working on the departmental research, a number of areas of interest were identified for investigation by this project. It was not clear which of these factors, if any, were likely to be good predictors of failure, and so a large number of variables were identified for analysis in the hope of gaining a clear picture about performance in first year Computing Science. Appropriate psychological collection tools were chosen to gather this data (interviews and questionnaires).

Firstly, some of the automatically generated data for all students was analysed. This includes attendance at the laboratories and tutorials, assignment performance and entry point scores. This data is automatically collected by the department (or is easy to collect), and so it would be useful if good predictors were found in this data.

To gather data about students' background, studying and socialising habits, opinions etc., a questionnaire was employed. It was decided that this should be administered via the web to make it easily available to all students, and to facilitate the data collection and subsequent analysis (as all information is automatically stored in an electronic, spreadsheet format).

It is of interest to gather data about students' behaviour over time (study, socialising, working habits each week, for example). However, this is difficult to collect from a large sample of students regularly throughout the term, and so an 'Activity Log' was developed which allowed them to record their behaviour as they went along. Students were then able to quickly input their weekly totals (e.g. hours of study, hours socialising etc.) into a webpage. The aim here was to identify patterns of behaviour, and how they change over the course of the year, and which of these patterns relate to failure.

Interviews with a small sample of student were conducted regularly (approximately once a week). This produced qualitative data which can be used to gain greater insight into first year student behaviour, and to explain the results gained from the other data sources.

Finally, another round of questionnaires was distributed immediately after the exams in January to obtain information on revision habits and students' self-assessments.

In this paper, the determinants of failure at Level 1 Computing Science at Glasgow University, and subsequent attrition were studied by obtaining data from the students on this course in the academic year 2001-2. Information gathered was measured against the results of the exams the students sit in January 2002. The aim of the project is to identify the variables that are instrumental within student failure, and to build a predictive model of failure.

Method

The target population for this study was the Level 1 Computing Science class at Glasgow University in the academic year 2001-2. Permission was obtained from the Department of Computing Science to recruit subjects from the class, and so the students were briefed about the study during a lecture in the middle of the first term. They were advised of the basic aims of the experiment, that all information they submit would be treated in the strictest confidence, and in no way would it be used against them as part of their academic assessment. Students were then asked if they would volunteer to take part in the data collection. There were five main sources of data in this investigation. Each will now be examined in turn.

Departmental Data

The Department of Computing Science records information about every Level 1 student (n=417), which was made available for the purpose of this investigation. The information included within these records includes;

- Entry Point Score
- Tutorial and Laboratory Attendance
- Assignment Performance

Detailed explanations of this data, and the variables obtained can be found in Appendix 1.

Background Questionnaire

A questionnaire (Appendix 2a) was developed to examine the factors which may distinguish between passing and failing students. The 26 items on this questionnaire looked at parents' educational and occupational background, students' courses, studying and socialising habits etc. For easy distribution amongst the students, it was implemented with HTML and ColdFusion programming languages and placed on a University website on the world-wide web. The webpage was connected to a database, meaning that all information submitted was easily and automatically stored in a digital format.

The website was accessible throughout the year, and students volunteered to fill in the questionnaire in their own time. A sample of 87 students was obtained. 26 Independent Variables were obtained from this questionnaire, which can be found in Appendix 2b.

Activity Logs

In order to gain information about how student behaviour changed over the course of the year, an activity log was drawn up (Appendix 3). This enabled students to quickly fill in the details of their activity over a single week. Eight different types of behaviour could be recorded;

- Contact Hours* (Computing)
- Contact Hours (Other Courses)
- Self-Study (Computing)
- Self-Studying (Other Courses)
- Travel
- Socialising
- Exercise
- Outside Employment

(* Contact Hours = hours spent in lectures, labs and tutorials)

Two activity logs were included in each Study Pack, which was handed out every other week. Students were asked to fill these in and then to total the hours spent on each activity. These totals could then be entered into another webpage each week, and stored in a database for later analysis. Unfortunately, this data collection had to be abandoned after a few weeks. Although several attempts were made to motivate students to complete the logs and submit their weekly totals, a very poor return rate was observed. Despite these logs being presented as a method of 'self-reflection' which would benefit their study, some reported that they did not find them particularly useful and as they were not compulsory to complete, could not be bothered to do so. In order to obtain a better return rate on data collection of this design, it is advised to provide more incentive to fill in the logs (possibly financial). Additional support from the course department would also be beneficial; either by making the activity logs a compulsory part of the course, or by promoting them more in lectures.

Post-Exam Questionnaire

A further questionnaire (Appendix 4a) was distributed amongst the students after their January exams. This examined the amount of revision done by students for the exams and their self-perceptions of how well they are progressing with the course. A sample of 37 students was obtained by distributing the questionnaires in four tutorial groups selected at random. 8 Independent Variables were obtained, which are presented in Appendix 4b.

Interviews

A series of weekly interviews were conducted with a small sample of students (n=9), with the intention of gaining some qualitative data. An insight into the course from the students themselves would be helpful to explain the quantitative data gained from the other information sources.

Thirty subjects were picked at random from the population of Computing Science students and were briefed about the interview process. Each student was then asked to give their consent to take part. Nine students agreed, and were subsequently interviewed every week. Subjects were interviewed on five occasions (on average), although some were harder to contact on such a regular basis, and so there is less data available for these students.

The interviews were conducted on quite an informal basis, adapting the questions to each student accordingly, but with a core set of questions to cover each week. Items covered included the student's progress through the course, previous qualifications, study habits at school and university, and the student's own opinions of what constitutes a good or poor student. Notes were taken during each interview, and a transcript was written up immediately afterwards. Every interview was written up anonymously, and these transcripts can be found in Appendix 9.

A set of quantitative data was also obtained from these interviews. Two coders rated each interviewee independently on a set of 13 scales;

- Good Previous Qualifications
- Motivated
- Organised
- Prepared for Exams
- Adapted to University Life
- Integrated in the Course
- Committed to the Course
- Enjoying the Course
- Enjoying the University
- Keeping up with the Course
- Having Difficulties with the Course
- Has Effective Study Techniques
- Has Previous Computing Experience

The coders were given a written description of each code, so they knew what to look for in the interview scripts. The full set of codes and their definitions can be found in Appendix 5. An inter-rater correlation of 0.731 ($p<0.0005$) was obtained.

Results

In view of the large set of data obtained from this study, only the significant and most pertinent results will be reported here so as not to unnecessarily clutter with all the results. The full set of statistical results can be found in the appendix.

1. Departmental Data

Table 1
"Departmental Data Descriptive Statistics"

	N	N_0*	Mean	Median	StDev**	Minimum	Maximum
Class Test	391	24	48.6	50	20.43	2	98
Lab Exam	381	33	13.73	16	5.579	0	20

* Number of students with no exam data ** Standard Deviation

Table 1 presents the population statistics for the entire first year Computing Science class. It can be seen that the means for the class test and lab exam are approximately 49% and 14/20 respectively, so the average student gets just under half-marks for one, but almost three-quarters on the other. This supports the general view held by lecturers that the class test is a more reliable test of understanding, as it is easier for poorer students to get a reasonably high mark in the lab exam.

The full set of correlations from the departmental data is presented in Appendix 6. As many variables are being tested, a strict p-value of 0.01 was chosen. The first interesting result to report is that a correlation of 0.592 ($p<0.0005$) was found between class test and lab exam scores, so the performance in these two exams is highly related. Many relationships were found to be significant at the 0.01 level, although the coefficients were low (e.g. Attendance at Week 6 – Class Test correlation = 0.168, $p<0.0005$). This suggests that although there are significant correlations between the variables and exam performance, the predictive relationships are weak.

The low correlations of weekly attendance ('Week 2' … 'Week 12') are not unsurprising, as it should be expected that a single measure of attendance at one tutorial or lab will be weakly linked to end performance. The overall attendance measure ('Attendance %') has a slightly higher correlation with class test score (0.293), but this cannot be said to be a strong predictor. The same is true of the maximum consecutive absences (Class Test correlation = -0.243, $p<0.0005$; Lab Exam correlation = -0.271, $p<0005$).

It has been suggested that some failing students may elicit a particular pattern of attendance behaviour, namely having a high attendance rate early on, which subsequently drops around week 5 or 6 in the first term. To gain a measure of this behaviour patter, two percentages were calculated for each student; percentage of labs/tutorials attended in weeks 2-6, and percentage attended in weeks 7-12. The latter percentage was then divided by the former to give a ratio of later attendance compared to earlier attendance. A score of 1 would indicate that the student attends the same proportion of labs/tutorials after week 6 as they do before. A score greater than 1 signifies a higher proportion attended after week 6, and less than 1 shows a lower proportion attended. This variable did not correlate highly with class test (0.103, p=0.042) or lab exam (0.138, p=0.007). However, when coding the variable into lower attendance (ratio < 1) vs. same or higher attendance (ratio >= 1), significant differences were found in mean exam score between these groups when performing an ANOVA (Class Test p=0.003, Lab Exam p<0.0005). These results suggest that students whose attendance drops off after 6 weeks score significantly lower in January exams than those whose attendance levels stay constant or improve. Furthermore, the later weeks (Wks. 7-12) had a higher correlation with class test (0.298) than the earlier ones (Wks 6-12 = 0.138), indicating that it is more important to attend in the second half of the term. These are interesting results, warranting further analysis by future studies.

The StudyPack – Exam Score correlations generally increase with each subsequent Study Pack, as the difficulty also increases. This implies that the students who achieve low marks on the later packs are the students who are having more difficulty with the course, as illustrated by their lower marks on the exams (e.g. the StudyPack5 – Class Test correlation is 0.319, p<0.0005). However, the overall Study Pack percentage has the highest correlation (Class Test = 0.370, p<0.0005, Lab Exam = 0.341, p<0.0005). These relationships are illustrated in Figs. 1 & 2.

Figure 1: Mark Percentage vs. Class Test

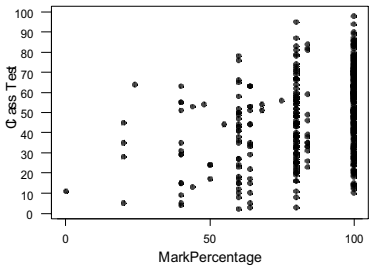
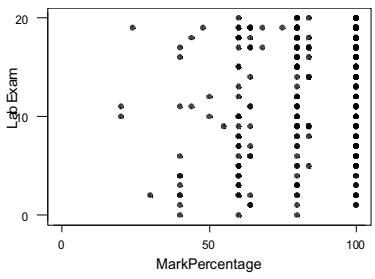


Figure 2: Mark Percentage vs. Lab Exam



As expected, students with higher entry point scores significantly achieve higher marks in the January exams. This result supports the previous research. However, some caution should be taken here, as the relationships are only moderately strong (Class Test = 0.385, Lab Exam = 0.206).

A stepwise regression performed on the data with class test as the response variable entered three variables, giving the following equation.

Mean Class Test Score = -6.43 + (1.25 * EntryPoints) + (0.317 * StudyPack%) + (0.0437 * Attendance%)

When taken together, these variables explain 25% of the variance in the Class Test score, which is quite low. So, this regression model would not produce very accurate predictions.

2. Background Questionnaire

Table 2
"Background Questionnaire Descriptive Statistics"

	N	N_0	Mean	Median	StDev	Min	Max
Class Test	78	0	50.01	50	21.19	2	95
Lab Exam	74	4	14.027	16	5.25	0	20

Table 2 presents the descriptive statistics for the sample of students who answered the background questionnaire. The mean and standard deviation values are very similar to the population statistics (obtained from the departmental data), so there is high confidence that the sample is representative of the population, and the results are likely to reflect the true results, had the entire class been sampled.

The full set of correlations can be found in Appendix 7. Only one variable met the significance level of $p<0.01$, but by changing this to a less-strict level of $p<0.05$, four variables are identified as having a significant correlation with exam results, which are shown in Table 3.

Table 3
"Background Questionnaire Correlations"

	CLASS TEST		LAB EXAM	
VARIABLE *	**Correlation**	**P**	**Correlation**	**p**
FLTIME	-0.319	0.005	-0.243	0.038
MTECH	-0.268	0.029	-0.246	0.053
IDEALHRS	-0.242	0.033	-0.278	0.017
GOODGRADE	-0.228	0.045	-0.285	0.014

* Definitions of these variables are found in Appendix 2b

These results would suggest that part-time students (FLTIME Gp 0) do better in exams than the full-time students (FLTIME Gp1), and students who have a mother with a technical occupation (MTECH Gp 1) do worse than those who do not (MTECH Gp 0). These results are very much unexpected, and

totally go against the background research. Looking at the data for these two variables closely (Figs. 3-6) there are few students in these categories ($N_{\text{Part Time}} = 4$, $N_{\text{MotherTech}} = 3$), and their results are likely to have caused a significant correlation by accident. Therefore these results should be ignored as an anomaly. Remember that at the 0.05 level, we expect 1 in 20 significant results by chance (Type I error).

Figure 3: FullPartCode vs. Class Test

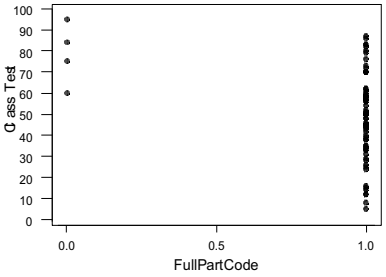


Figure 4: FullPartCode vs. Lab Exam

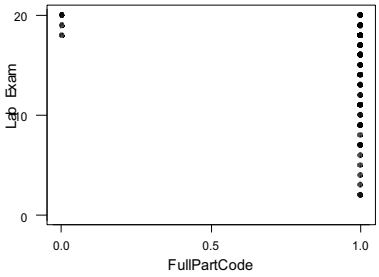


Figure 5: Mother Tech vs. Class Test

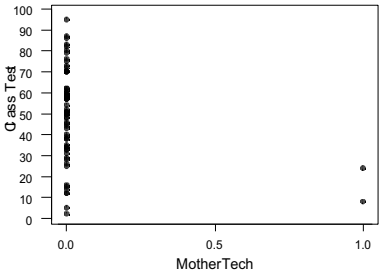
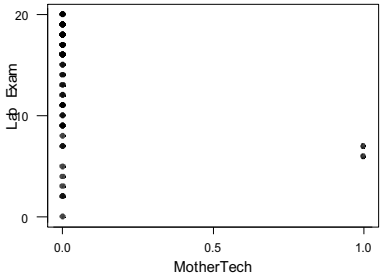


Figure 6: Mother Tech vs. Lab Exam



The 'IDEALHRS' variable is the response to the question, "Relative to your own view of how much a student should be studying, how many hours of self-study per week should a student do on Level 1 Computing Science?" The negative correlation between this variable and exam result reveals that students who estimate that they should be doing a lot of hours get lower results. This might be indicative of students who are struggling and having difficulties, and hence believe that they should do a lot more to succeed in the course. Students who are progressing well, on the other hand, may estimate that they need not spend a lot of hours on study. It should be noted that this variable is not a measure of how many hours students did study in a week at any point during the course, and so does not show either way whether amount of time spent on revision is linked to exam performance. Also, the correlation here is low (Class Test = -0.242, Lab Exam = -0.278), and these results again could be due to chance, so this is not a strong result.

The answer to the opinion statement, "Getting a good grade in Level 1 Computing is very important to me (1= strongly agree, 5= strongly disagree)" is demonstrated by the 'GOODGRADE' variable, which also has a low correlation with exam performance. This negative correlation suggests students who disagree with this statement (and hence, it is not so important for them to get a good grade), get lower results. However, examining the data closely once again, it was observed that the majority of students answer 1 or 2, with very few answering 3, 4 or 5, and so it is possible that this significant result is also an accident.

Age was not found to have a significant correlation with exam scores, although differences were found between age categories in terms of the variance. The data was divided into "traditional" (Group 0: 16-19yrs) vs. "non-traditional" (Group 1: 20+ yrs) students.

Table 4
"Traditional vs. Non-Traditional Students Descriptive Statistics"

	N	Mean	Median	StDev	Min	Max
CLASS TEST						
Traditional	66	49.3	50	20.45	2	95
Non-Traditional	12	53.6	57	25.57	12	87
LAB EXAM						
Traditional	62	14.11	16	4.98	0	20
Non-Traditional	12	13.58	17	6.71	2	20

It can be seen from the descriptive statistics (Table 4) that the non-traditional students on average do slightly better on the class test, and very slightly worse on the lab exam, although these differences were not found to be significant upon performing an ANOVA to test the mean differences (Class Test ANOVA p=0.520, Lab Exam ANOVA p = 0.752). It should be noted however, that there is much variability in the older students' data, as the standard deviation is higher for these students in both exam categories. This variability is further illustrated in the boxplots (Figs. 7 & 8) of exam score by Age Code. Therefore, it can be said that it is more difficult to predict results for mature students, as there is so much variation in their exam scores. For this reason, non-traditional students were removed from the data.

When examining the correlations for the traditional
'Il).18) lending further support to the suggestion that
relations t

Figure 7: Boxplot Class Test by Age Code

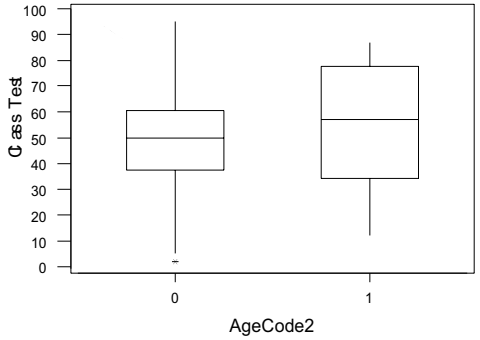


Figure 8: Boxplot Lab Exam by Age Code

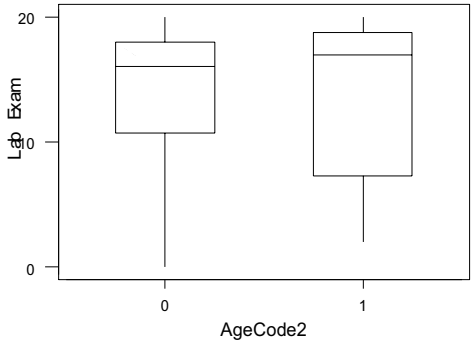


Table 5
"Traditional Students 'GOODGRADE' Correlation"

	Correlation	p
LAB EXAM	-0.395	0.002
CLASS TEST	-0.300	0.014

This result could still be an accident, as there are still few students answering 3 or 4 on this agreement statement, but this does merit further investigation, as this question may be a good measure of commitment to the course. The data for 'GOODGRADE' was subsequently divided into two groups. Recall that students were required to answer on a scale of 1-5 (strongly agree – strongly disagree). Group 0 was coded as the response 1 or 2, and Group 1 was coded as the response 3, 4 or 5. This therefore attempted to distinguish between students who were committed to the course (and therefore attaining a good grade was important to them), and those who were not so committed. Analysis by means of an ANOVA identified that there were significant differences in both mean lab exam score and class test score between these groups (Table 6).

Table 6
"Class Test & Lab Exam ANOVA: 'GOODGRADE' Group 0 vs. Group 1"

	N	Mean	Variance	F	p
CLASS TEST					
Group 0	73	51.5	422.64	7.17	0.001
Group 1	6	28.3	309.46		
LAB EXAM					
Group 0	69	14.6	23.24	16.53	<0.0005
Group 1	6	6.3	17.87		

This shows that the students who tend to disagree that getting a good grade in computing is important (which suggests they are less committed), achieve lower scores in the January exams. Some caution should be taken however, as the variances between the groups are somewhat different.

Stepwise regression analysis was performed on the data (traditional students only) with class test as the response variable, to obtain a predictive model for the class test score. Three variables were entered into the equation by the analysis; ('MTECH' = mother has a technical occupation, 'FLTIME' = Full-time/Part-time admission status and 'GOODGRADE' = "Getting a good grade in Level 1 Computing is very important to me.")

"Background Questionnaire Stepwise Regression (Traditional Students)"

Response is Class Test on 21 predictors

Step	**1**	**2**	**3**
Constant	53.21	70.17	95.34
MTECH	-37	-43	-41

T-Value	-2.68	-3.29	-3.28
GOODGRADE		-11.6	-10.3
T-Value		-3.03	-2.80
FLTIME			-28
T-Value			-2.26
S	19.3	17.8	17.0
R-Sq	13.21	27.62	35.00

Even if the correlations between these three variables and class test score were not found by accident, it can be seen here that only 35% of the variance is explained by these variables, and so the predictive models obtained would not be very reliable.

3. Post-Exam Questionnaire

The descriptive statistics for the post-exam questionnaire can be seen in Table 7. Again, the means and standard deviations are similar to those of the population, so there is high confidence that the sample is representative of that population.

Table 7
"Post-Exam Questionnaire Descriptive Statistics"

	N	N_0	Mean	Median	StDev	Min	Max
Class Test	33	3	52.55	52	20.36	14	87
Lab Exam	34	2	14.029	16.5	5.697	2	20

Table 8
"Post-Exam Questionnaire Correlations"

	CLASS TEST			LAB EXAM		
VARIABLE	**Correlation**	**P**		**Correlation**	**p**	
Lab Revision 24	-0.384	0.027	*	-0.099	0.576	
Lab Revision Week	-0.318	0.071		0.109	0.540	
Class Revision 24	-0.155	0.389		0.180	0.309	
Class Revision Week	-0.096	0.593		0.229	0.193	
Understand Now	0.703	<0.0005	*	0.170	0.336	
Understand Before	0.388	0.026	*	-0.004	0.982	
Study Pack	0.283	0.110		0.136	0.445	
Other Respects	0.393	0.023	*	0.438	0.010	*

* Significant at the $p<0.05$ level

Table 8 displays the set of correlations for the post-exam questionnaire. No significant correlation was found between amount of revision for an exam, and performance in that exam. However, there is a reasonable negative correlation (-0.384, p=0.027) between 'Lab Revision 24', and performance in the class test. This result shows that students who put in more hours during the day before the *lab exam* fare worse off in the *class test.* It would seem that doing more revision for the lab exam is indicative of

the poorer students, who cannot catch up despite large amounts of revision. The lab exam is sat in one week, and the class test is at the end of the following week. Therefore, revision for the lab exam should not interfere with revision for the class test, and so this result cannot be explained in terms of students focusing their time on revising for one exam to the detriment of the other, so how should it be explained?

Amount of revision for the lab exam does not coincide with lab exam score. However, those students who cram for the lab exam, and put in a lot of hours in the day beforehand may well be the ones who have a poorer understanding of the course, and are worried about the exam. It has been suggested that the poorer students memorise the lab exam 'parrot fashion', which would require more time. Better students understand the program they are required to reproduce, and so spend fewer hours on revision. They understand the semantics of programming, and know the syntax, and so just learn the basic program structure. For the poorer students, the lab exam may be more of a test of memory, whereas the class test really is a test of understanding, as it consists of unseen written questions, and so they obtain lower scores.

The students' self-assessment of how well they understand the course ('Understand Now') has the highest correlation with class test result (0.703, $p<0.0005$), and there is also a reasonable correlation with how well they understood the course before revising (0.388, $p=0.026$). This gives further support to the finding that understanding is the key aspect in exam performance, and not the amount of revision done. It also shows that students demonstrate a good estimate of their own understanding.

How well students judge they kept up with the Study Packs throughout the term did not correlate with exam scores, although a general assessment of how they were keeping up ('Other Respects') did have a positive link. The correlation of 0.393 is a moderately sized relationship. So again, students show some self-awareness in terms of their own progress.

A stepwise regression was performed with class test as the response variable, and the three variables entered into the equation by this analysis ('Understand Now,' 'Lab Revision 24' and 'Understand Before') combine to explain 61% of the variance. This is quite a high value, and would provide a

reasonable predictive model for class test score. There are drawbacks to this model however, which are reviewed in the discussion section.

4. Interviews

Correlations between interview coding and exam results are presented in Appendix 8. Most were found to be statistically insignificant, although some demonstrated strong, significant relationships.

Class test score was positively correlated with both students' motivation score (0.757, $p=0.03$) and preparedness score (0.789, $p=0.02$). However, these variables were also very highly correlated with each other (0.968, $p<0.0005$), suggesting that the same underlying factor was being measured by these two codings.

A further interesting result was the strong relationship between class test score and students' previous computing experience score (0.922, $p=0.042$). This result is further examined in the next section.

Great caution should be taken here when interpreting these results, as the sample is very small (N=9, with 8 interviewees sitting the exams). The primary value of the interviews is to provide qualitative data over quantitative. Overall, a considerable amount of time and effort was spent preparing and conducting the interviews, which is not reflected in this write-up. The interviews were designed to give confidence that the results from the other data sources were not totally misunderstood and that no major factors have been overlooked in this investigation, as well as to draw attention to areas of interest, potentially for further study. The decision was therefore made to focus on the more pertinent and valuable results obtained from the questionnaires and departmental data.

Discussion

As much as the significant results found by this study are of great interest, and hopefully useful in future predictions of student grades, it is also important to examine the variables that were not found to be significant predictors of exam performance. Within the background questionnaire, such variables include gender, social class, intended degree, home computer access and travel time.

It is inherently difficult to ascertain the real reasons behind failure. In addition, it is generally held that within this subject area, it is typical to find that so many variables turn out to be non-significant when using such psychological methods of gathering data. Many academics have strong personal opinions on why students fail a certain course, and the background questionnaire set out to test the factors viewed as important by a variety of people. The issue here is; did the questionnaire actually test these factors accurately? (i.e. is it valid?). On face value, the questions do seem to address the underlying factors appropriately. Furthermore, the questionnaire was administered, and the data was collected as accurately as possible. There is the inevitable question of "have the respondents lied?" Although this seems unlikely, it is impossible to accurately test such an assumption within this study.

As the questionnaire does seem to measure what it set out to, and the sample is representative of the population (and additionally supposing the responses are truthful), we should trust the results, and conclude that the majority of the variables measured are not significant. The benefit of such results is that these variables can be ruled out of having any strong link to exam performance within Level 1 Computing Science, and as such, need no further attention in future studies. The significant results will now be examined in further detail.

In regards to the departmental data, it is worth noting that the three variables entered into the predictive model (Entry Point Score, Overall Study Pack Percentage and Attendance Percentage) explain only a small amount of the variance in class test score (~25%). This demonstrated that the grade predictions from this model would not be very reliable. It presents that the departmental variables do not adequately explain student performance in Level 1 Computing Science. It is suggested that they merely illustrate previous student performance (Entry Point Score) and behaviour throughout the course ('Mark%' and 'Attendance%'), and do not address the real underlying factors which combine to affect success or failure.

Within the departmental data, entry point score has the highest correlation with class test score (0.385). This result coincides with those reported by previous studies (HEFCE, 2001; Arulampalam, 2001; Montmarquette, 2001). A recent study by Boyle et al (2002) also reported higher entry score indicates stronger performance in the first year of a university computing course, but that there is no such

indication of strong performance in the final year. It would be interesting to see whether this finding is true of Computing Science at Glasgow University. It is worthy to remember that a correlation of 0.385 only explains 14% of the variance, and so it is clear that there are other variables at work here. It is generally expected that the most successful at school continue to do well, but as students progress through their university career, previous grades become less important as other factors come into play. The key issue here is to identify what these fundamental factors actually are.

A second significant factor is the overall Study Pack mark. This result shows that the continual assessments throughout the year are only moderate indicators of how well students are progressing. By viewing the scatterplots of 'Mark%' vs. Exam Score (Figs. 1 & 2), it is evident that there are many students who do well on the Study Packs (scores of 100% are not uncommon), but perform poorly in the exams. Ordinarily, this might indicate that the Study Packs are not effectively testing students and preparing them for formal assessment. However, it is more likely that this result is explained by the way the Study Packs are marked. They are not assessed on a scale, but are given a pass or fail mark, which does not accurately reflect how much work a student has put in, or how well they have understood the assignment. To pass, students are required to make a 'serious attempt' at the Study Pack. It may therefore not be so surprising that performance on these continual assessments does not correlate more strongly with exam performance. It is suggested here that the Department of Computing Science should mark the Study Packs on a more formal sliding scale which better distinguishes between students' ability and understanding (a low pass grade could be implemented so that the actual scores received are not over-represented in the final grade). This would involve more work for departmental tutors, but by using this method, it is expected that the regression model would produce more reliable predictions of student performance.

The results from the attendance data are quite interesting. The low but significant correlation with overall attendance suggests that merely showing up at labs and tutorials is not the most important factor in getting a good grade. It was demonstrated that attendance in the later weeks (7-12) is more indicative of exam performance that attendance in the earlier weeks (2-6), but again this is not a strong link.

So, it is clear that there is something more going on than merely attending tutorials and laboratories. Having a good attendance record does not mean that students are paying attention or understanding the material. Furthermore, it was shown that the amount of revision had no clear effect on exam performance. Revising for many hours before an exam did not result in a better grade. This result is very interesting, and one that perhaps should be made evident to future students by the Department of Computing Science. It suggests that students who fall behind may not be able to catch up later on by simply putting in the hours. Statistical evidence from the post exam questionnaire demonstrated that students who state they have kept up with the course perform better in the exams, and these two findings combine to reinforce the view that students should make every effort to stay on top of the course and take care not to lag behind. This is a view shared by some of the students who were interviewed.

> **Student 5:** "It is also important to keep working on the study packs each week, and students who don't, and fall behind are likely to do badly."

Continuing on from the issue of revision, the significant negative correlation found between hours of revision done in the 24 hours before the lab exam and performance in the class test is one that certainly merits further examination. This result was explained by the poorer students spending more time memorising the program for the lab exam the day beforehand. It is proposed that these students do not have a good understanding of the course material, and that is why they obtain lower scores on the class test, which more reliably tests their comprehension. The Department of Computing Science assumed students would not be able to memorise a program of such length, but the view that they could, and indeed did is supported by subjective evidence from the interviews.

> **Student 5:** "For the lab exam, I did the program beforehand, and then learnt it. I knew most of it, so just quickly memorised any tricky loop structures."

Compare this to Student 6, who consistently had difficulty with the course;

> **Student 6:** "I did the program over the holidays, which took me ages, and then I learnt it parrot-fashion before the exam, which took about 5-6 hours. I just typed it out in the exam and was done in about half an hour. It was probably a carbon copy of the one I had written beforehand."

Further support came from the high correlation between students' own view of their understanding and class test score.

It may be quite disheartening for some students who just don't understand the course material, that the amount of hours they put in on study or revision may have little effect on their grades. One standpoint that regularly came up within the interviews was that although computing can be learnt, there does seem to be some involvement of natural aptitude, both in a general sense for academia, and also for computing.

> **Student 4:** "Programming can be learnt, but there is something else involved. Good programmers just have that knack."
>
> **Student 5:** "(Computing) can be learnt, but there are those people who just won't be able to do it. I think it just clicks for me."
>
> **Student 6:** "I've always had trouble with programming, even at school. It just doesn't click in my head. I just think that computing is not for me. I don't grasp it at all. I don't think any more study would have helped as I've put in a lot so far… I think you either understand it or you don't."

This 'natural aptitude' or 'knack for programming' is something that has not been measured in this study, but may be very important for future research. It has been shown that a previous qualifications score does not wholly measure this ability, so it would be worthwhile, perhaps in a follow-up study, to devise some tests which address various skills, for administering on future first year student at the start of the academic year.

Natural aptitude may be important for some, as it is likely that there will be students who, like Student 6, may have very good previous qualifications, and do well in other subjects, but just cannot do Computing Science. However, this is not true for all. There is not a clear-cut line for every student, and there will be many who fall into the 'grey area,' who are not unable, but still fail to succeed. For these students, their end result is more likely to be due to how well they have kept up and whether they have understood the material as they went along.

This idea of understanding relates strongly to the literature on deep vs. shallow learning. Based on the work of a number of researchers (Morton & Saljo, 1976; Svensson, 1977; Entwhistle, 1988), a 'Levels of Processing' approach to learning has been proposed. In this model, memory is a function of the 'depth' of processing upon the presentation of new information. Morton stated that this depth can be

determined on the basis of what students say about their learning. Shallow or 'atomistic' learning is focusing on the text sequence, and memorising the details. Deep or 'holistic' learning refers to relating the content to a bigger context (i.e. the authors intention), and thinking about how the new information relates to information already stored in memory. Deep processing is considered to be best to facilitate understanding, and some research has shown that it leads to better memory (e.g. Craik & Tulving, 1975). However, it has been demonstrated that deep learning on academic courses does not always lead to the best exam marks. Students have a choice of whether they want to learn material to broaden their understanding (deep), or whether they want to learn it solely for the purpose of passing an exam (shallow). A recent study examining learning techniques in a 4th year Psychology class at Glasgow University (Munro, 2002) inferred that students who chose to engage in shallow learning often perform as well as, or even better than those who chose to engage in deep learning. This does not appear to be the case for Level 1 Computing Science, however. It seems apparent that students really must have some understanding of what they are learning in lectures, and cannot simply learn by rote in order to pass the class test.

The high correlation between students' assessment of their understanding and exam result indicates that many show a reasonably accurate judgement of their progress. Consequently, it would be beneficial to identify *when* students can accurately judge their own understanding. It may well be the case that the students themselves have a good instinct that they are at risk of failing long before they can be identified by staff or tracked by their attendance and assessment records.

The correlation of 0.703 explains approximately 49% of the variance in class test scores, so there is still a large amount that goes unexplained. Hence, whereas some students are quite good at estimating their understanding, there are a significant number who are not. These students are a real target for intervention. It is worrying that there are some who misjudge their understanding, and think they are progressing well, but are subsequently surprised when they don't do as well as expected in the exams. In addition to the current aim of identifying the 'general' students at risk, some effort should perhaps be spent determining how such students with poor self-judgements can be identified.

It should be noted here that some care should be taken in interpreting this correlation. Some students would have known their exam results at the time they filled in the post-exam questionnaire. This could have biased the results somewhat, as some may have evaluated their understanding based on their exam scores, and so further study on student understanding would be advantageous to have confidence that the relationship is genuinely a significant one.

Another interesting area concerning students' self-judgement is their commitment to the course. Results identified that those students who are less concerned with achieving a good grade in computing do show poorer exam scores. This may not be an unexpected result, and may be difficult to address (i.e. how do you *make* a student become concerned about their work?), but it is a result that certainly merits additional investigation.

Thus, it is suggested that measures of student self-assessed understanding and commitment be developed, for use on multiple occasions throughout the academic year. This is something that relates to many variables measured within this study. The background questionnaire was administered once, mid-way through the first term, and it is likely that the replies to some of the questions will have changed over time. For instance, hours spent on weekly study, socialising habits, opinions about the course and university etc. It would be beneficial to examine these variables frequently, and it is unfortunate that the activity logs did not obtain a higher return rate. The data from these logs would hopefully have returned very useful information about the patterns of student behaviour over time. It was difficult to motivate students to fill in the logs regularly and enter their weekly totals into the webpage. The logs were presented as a method of 'self-reflection,' by which students could easily view and evaluate what they had been doing over the course of a week, identifying where changes should be made in their behaviour. Anecdotal evidence from the interviews indicated that the logs did work as intended.

> **Student 6:** "It wasn't until about week 7 or so, when I filled in one of those activity sheets, that I really noticed how little work I was doing. I think I did know that I probably should be doing more, but it didn't click with me until I actually saw it in front of me."

It is suggested for such data collections in future, that more time should be spent on preparation and on briefing the students. In this study, one lecture was employed to speak to the class about the entire

project (including the interviews, questionnaires and activity logs), which was evidently not sufficient. Regular and well-structured lectures on self-reflection and study techniques (which the students would benefit from in any case) are recommended, part of which should include filling out the activity logs. This would likely result in a higher return rate, making data analysis of the activity logs viable.

An area that is important to look at in future is previous computing experience. Information regarding each student's prior computing qualifications is on file within the department, but unfortunately was not available in time for analysis by this study. Whether this has any effect in exam performance is a controversial issue. Computing lecturers have stated that it can actually be a hindrance on first year computing at university. This view was also stated by some of the interviewees. For example;

> **Student 5:** "(My computing experience)… is not helping much with learning Ada95 in Level 1 Computing Science, and I think it would have been easier if I hadn't done any programming previously. I find myself getting confused with the syntax of Ada, often putting in lines of code from other languages."

This is a fair point, and it is likely to be true for a number of students. There is, however, evidence to the contrary. A recent study by Hagan & Markham (2000) found that students who have experience in at least one programming language before starting a university course perform significantly better in assessments. Furthermore, performance increases with the number of programming languages with which a student is familiar. There is subjective evidence from the interviews which echoes this finding.

> **Student 2:** "(previous computing experience)… is very important. I have no experience, whereas people who do find it very easy."

> **Student 8:** "Motivation and previous computing experience are the most important things to do well at computing science."

In addition, within the interview sample, a high correlation (0.922) was found between the previous computing experience coding and class test score. Although this correlation should not be trusted too strongly due to the small sample size, it does suggest that prior experience is a factor to examine in future research. Despite lecturers and students asserting that experience does not have any significant effect on exam performance, it may be that in practise, it actually does.

One of the main goals of this project was to build a predictive model of student exam performance. Though the study has not failed to do this, the models gained (via stepwise regression) do not explain a large proportion of the variance in exam scores, and so would not produce reliable predictions. This is primarily due to the high number of non-significant results observed. The model gained from the departmental data identified that the information currently being recorded and stored about students is not sufficient to infer whether they are progressing well within the course.

The one model that would give reasonable approximations of class test scores, were it put into practise, is the model based on variables from the post-exam questionnaire, which explained 61% of the variance. Unfortunately though, this model does have a major drawback. The idea is to identify students at risk as early as possible, and here, the model relies on information about revision for the lab exam and student understanding, which was obtained late in the university year, after the January exams had been sat. The results from this questionnaire were useful however, in showing that a students' measure of their understanding may be a key variable, as previously discussed.

Conclusion

On the basis of the weak predictive models, it is concluded that though this study has highlighted some interesting results, and variables that may be somewhat important in predicting student exam performance and subsequent attrition, the crucial factors are yet to be identified.

One of the key values of this study has been to rule out a number of variables that are not important, and which therefore, need not be examined again. It is notable that attendance and time spent on revision, which would ordinarily be expected to correlate highly with exam performance, actually turned out not to be.

The data clearly supports the view that understanding the course material, rather than simply learning by rote, is one of the key concepts in success at Level 1 Computing Science. It is inferred that although natural aptitude for computing may be important for some students, for the majority, it is most important to keep up and to engage in 'deep' learning techniques.

A further important finding from this study is that students on the whole show good judgement of their own progress and understanding. It is therefore of interest to examine this in further detail. A few well-worded questions administered regularly throughout the academic year asking students to make self-judgments may be the best indicator found so far.

It is suggested that future research examine previous computing experience, self-judgements, temporal student behaviour (through the use of activity logs), and measures of natural aptitude for computing. It will be interesting to see what results emerge from the departmental research, and it may transpire that a combination of influential variables identified across a number of studies will result in the best predictive model.

References

Arulampalam, W., Naylor, R. & Smith, J. (2001) Factors Affecting the Probability of First-year Medical Student Dropout in the UK: a logistic analysis for the entry cohorts of 1980-1992. *Warwick Economic Research Papers* 618

Beder, S. (1997) Addressing the Issues of Social and Academic Integration for First Year Students. University of Wollongong, *http://www.utilbase.rmit.edu/Articles/dec97/beder1.htm*

Blanc, R.A., LeBuhr, L.E. & Martin, D.C. (1983) Breaking the Attrition Cycle: The Effects of Supplemental Instruction on Undergraduate Performance and Attrition. *Journal of Higher Education* 44, 1, 80-90

Boyle, R., Carter, J. & Clark, M. (2002) What Makes Them Succeed? Entry, progression and graduation in Computer Science. *Journal of Further and Higher Education* 26, 1

Brunsden, V. & Davies, M. (2000*)* Why do HE Students Drop Out? A test of Tinto's model. *Journal of Further and Higher Education*, 24, 3

Craik, F.I.M. & Tulving, E. (1975) Depth of Processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General,* 104(3) 268-294

Draper, S. (2001) Lab Support Software. Grumps Technical Report. *http://staff.psy.gla.ac.uk/~steve/grumps/lss.html*

Draper, S., Cargill, J. & Cutts, Q. (2001) Electronically Enhanced Classroom Interaction. *http://www.psy.gla.ac.uk/~steve/ilig/handsets.html*

Entwistle, N. (1988) *Styles of Learning and Teaching*, London, David Fulton.

Evans, H. (2001) Machine Instrumentation Tool Documentation. Grumps Technical Report. *http://www.grumps.dcs.gla.ac.uk/tools*

Glass, J.C. & Garrett, M.S. (1995) Student Participation in a College Orientation Course, retention and Grade Point Average. *Community College Journal of Research and Practice*, 1995, 19(2), 117-32

Hagan, D. & Markham, S. (2000) Does It Help to Have Some Programming Experience Before Beginning a Computing Degree Program? *SIGCSE Bulletin* 32, 3, 2000, 25-28

Hartog, J., Pfann, G. & Ridder, G. (1989) (Non-) Graduation and the learning function. An inquiry on self-selection. *European Economic Review*, 33, 1371-1395

HEFCE (1997) Undergraduate non-completion in higher education in England. Technical Report 97/29, HEFCE, 1997 at *http://www.niss.ac.uk/education/hefce/pub97/97_29.html*

Higher Education Funding Council for England (Jan 2001) Memorandum to the House of Commons Select Committee on Education and Employment, HC 124 ISBN 0 10 217801 1, *http:/www.parliament.the-stationery-office.co.uk/pa/cm200001/cmslect/cmeduemp/124/12402/htm*

Manski, C.F. (1989) Schooling as experimentation: a reappraisal of the post secondary dropout phenomenon. *Economics of Education Review*, 8, 305-12

Montmarquette, C., Mahseredjian, S. & Houle, R. (2001) The Determinants of University Dropouts: a Bivariate Probability Model with Sample Selection. *Economics of Education* 20, 474-484

Moore, N. (1995) Persistence and Attrition at San Juan College. Farmington, NM: *Office of* Institutional Research, Grant Development and Planning, San Juan College

Morton, F. & Saljo, R. (1976) Qualitative differences in learning: 1 – outcome and process, *British Journal of Educational Psychology*, 46, pp. 4-11.

Munro, C. (2002) Mind Mapping and Psychology Undergraduate Achievement. Unpublished Paper.

Nelson, R. (1993) The Effect of SLS 1122 and Faculty Mentors on Student Performance. Orlando, FL: *Valencia Community College*, 1993 (ED 371778)

Svensson, L. (1977) On qualitative differences in learning: III - study skill and learning. *British Journal of Educational Psychology*, 47 pp. 233-243.

Tinto, V. (1988) Stages of Student Departure: Reflection on the Longitudinal Character of Student Leaving. *Journal of Higher Education*, 59, 4, 438-5

Tinto, V. (1975) Dropout from Higher Education: A Theoretical Synthesis of Recent Research. *Review of Educational Research*, 45, 89-125

Tinto, V. (1987) *Leaving College*. Chicago, University of Chicago Press.

Patrick, B. (2001) Students Matter: Student Retention: who stays and who leaves. University of Glasgow Newsletter 227, April 2001 at *http://www.gla.ac.uk/newsletter/227/html/news15.html*

Windham, P. (1994) The Relative Importance of Selected Factors to Attrition at Public Community Colleges. *Paper presented at the 23rd Annual Conference of the Southeastern Association for Community Colleges*, August 1-3 1994, Savannah, Georgia

Appendix1

Departmental Data Descriptions

- **Previous Qualifications**

  Each student's entry point score is recorded on their acceptance to university. This is calculated from their Higher/A-Level results, and provides a good measure of previous exam performance.

- **Tutorial and Laboratory Attendance**

  Tutors take an attendance at the weekly tutorials and laboratories, which is kept on record. This data can be used to provide two Independent Variables. As well as looking at the total number of absences, it may also be of interest to examine the number of consecutive absences, which will indicate a prolonged period of absence, and attendance over certain periods.

- **Assignment Performance**

  Programming assignments are set periodically through the year. Although they are not graded, students are expected to make a serious attempt at each assignment, and are given a pass (a tick) or fail (a cross) mark. They must attain a tick for six out of the ten assignments in order to gain their 'class ticket' on the course. It will be of interest to look at how a students' assignment record relates to their exam performance, as well as each assignment individually. It may well be that failing to do the first or second assignment is a better predictor of failure/poor performance that missing one of the later assignments.

Appendix 1

Departmental Data Variables

VARIABLE	DEFINITION
Entry Points	Entry Point Score
Week 2	Attendance in Week 2 (lab or tutorial)
Week 3	Attendance in Week 3
Week 4	Attendance in Week 4
Week 5	Attendance in Week 5
Week 6	Attendance in Week 6
Week 7	Attendance in Week 7
Week 8	Attendance in Week 8
Week 9	Attendance in Week 9
Week 10	Attendance in Week 10
Week 11	Attendance in Week 11
Week 12	Attendance in Week 12
Week 2-4	Attendance percentage in weeks 2-4
Week 2-5	Attendance percentage in weeks 2-5
Week 2-6	Attendance percentage in weeks 2-6
Week 7-12	Attendance percentage in weeks 7-12
Ratio (7-12):(2-6)	Ratio of attendance in weeks 7-12 to attendance in weeks 2-6 (Week 7-12 / Week 2-6)
Study Pack 1	Assessment mark for Study Pack 1
Study Pack 2	Assessment mark for Study Pack 2
Study Pack 3	Assessment mark for Study Pack 3
Study Pack 4	Assessment mark for Study Pack 4
Study Pack 5	Assessment mark for Study Pack 5
Attendance %	Overall attendance in weeks 2-12
Consecutive Missed	Highest number of consecutive absences
Study Pack %	Overall mark for Study Packs 1-5

Appendix 2a

Level 1 Student Questionnaire

This questionnaire is designed to look at aspects of students studying Level 1 Computing Science at Glasgow University in 2001-2. Please answer all questions as accurately as you can. This should take you no longer than a few minutes. All information gathered will treated in the strictest confidence in accordance with the Data Protection Act.

Email ..... @dcs.gla.ac.uk (i.e. your Computing Science username)

Other Email ..... (Alternate contact address)

First Name .....

Last Name .....

Age .....

Gender .....

Mothers' Occupation:

- ☐ executive/managerial
- ☐ professional (medical/legal etc.)
- ☐ computer related
- ☐ academic/educator
- ☐ service/support
- ☐ engineering
- ☐ clerical/administrative
- ☐ sales/marketing
- ☐ tradesman/craftsman
- ☐ government/military
- ☐ student
- ☐ homemaker
- ☐ self-employed/own company
- ☐ manufacturing/production/operations
- ☐ retail
- ☐ unemployed/between jobs
- ☐ retired
- ☐ prefer not to answer

Mothers' Education Level:

- ☐ some school
- ☐ high school
- ☐ some university
- ☐ associates degree
- ☐ bachelors degree
- ☐ masters
- ☐ PhD
- ☐ prefer not to answer

Fathers' Occupation:

- ☐ executive/managerial
- ☐ professional (medical/legal etc.)
- ☐ computer related
- ☐ academic/educator
- ☐ service/support
- ☐ engineering
- ☐ clerical/administrative
- ☐ sales/marketing
- ☐ tradesman/craftsman
- ☐ government/military
- ☐ student
- ☐ homemaker
- ☐ self-employed/own company
- ☐ manufacturing/production/operations
- ☐ retail
- ☐ unemployed/between jobs
- ☐ retired
- ☐ prefer not to answer

Fathers' Education Level:

- ☐ some school
- ☐ high school
- ☐ some university
- ☐ associates degree
- ☐ bachelors degree
- ☐ masters
- ☐ PhD
- ☐ prefer not to answer

Where do you live during term time?

- ☐ Parents' home
- ☐ Student Halls
- ☐ Own Home
- ☐ Other

Where are you from?

- ☐ Glasgow
- ☐ Other Scotland
- ☐ Other UK
- ☐ International

Are you a

- ☐ Full time student?
- ☐ Part time student?

How do you travel to university?
(choose the option that best describes your journey)

- ☐ some school
- ☐ high school
- ☐ some university
- ☐ associates degree
- ☐ bachelors degree
- ☐ masters
- ☐ PhD
- ☐ prefer not to answer

How long does is take you to travel to university, door to door?

---------- **mins**

Appendix 2a

What subjects are you taking this year?
(enter as many subjects as you are taking and leave the rest blank)

1. Computing Science 1

2. _____

3. _____

4. _____

What is your intended degree?

- ☐ Single Honours Computing Science
- ☐ Single Honours Software Engineering
- ☐ Single Honours Electronics and Software Engineering
- ☐ Combined Honours Computing Science + another subject
- ☐ Other (not involving computing science)

How many hours per week (on average) do you spend on self-study for Level 1 Computing?

_____ **hrs**

Where do you have access to a computer?
(Tick all that apply)

- ☐ At Home
- ☐ At University
- ☐ At Work
- ☐ Other

Are you a member of any university clubs or societies?

- ☐ No
- ☐ Yes, one
- ☐ Yes, two or more

How many times per week (on average) do you go out with university friends?

- ☐ 0 times
- ☐ 1-2 times
- ☐ 3+ times

Relative to your own view of how much a student should be studying, how many hours of self-study per week should a student do on Level 1 Computing Science?

_____ **hrs**

Appendix 2a

Indicate how much you agree with the following statements

"It has been difficult to meet and make friends with other students on this course"

- ☐ 1 (Strongly Agree
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 (Strongly Disagree)

"Getting a good grade in Level 1 Computing is very important to me"

- ☐ 1 (Strongly Agree
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 (Strongly Disagree)

"I am happy I chose to attend Glasgow University"

- ☐ 1 (Strongly Agree
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 (Strongly Disagree)

"I am happy I chose to take Level 1 Computing Science"

- ☐ 1 (Strongly Agree
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 (Strongly Disagree)

Thank you for your time

Appendix 2b

Background Questionnaire Independent Variables

VARIABLE	DEFINITION
GENDER	Gender of student (1=Male)
AGE	Age of student
AGE CODE	Coded Age of Student (0 = 16-19yrs, 1 = 20+yrs)
MOCC	Mothers' occupation class (1-5)
MEDU	Mothers' education class (1-5)
MTECH	Mother has technical background (1=Yes)
FOCC	Fathers' occupation class (1-5)
FEDU	Fathers' education class (1-5)
FTECH	Father has technical background (1=Yes)
ORIGIN	Region of origin of student (1=Glasgow, 2=Scotland, 3=UK, 4=Europe, 5=International)
FLTIME	Admission status at university (1=fulltime)
TRTIME	Travel time, home to university
MATH	Student is taking a Math course (1=Yes)
SCIENCE	Student is taking a Science course (1=Yes)
DEGREE	Students intended degree (1=Honours Computing, 2=Combined Honours with Computing, 3=Other)
CSSTUDY	Hours spent weekly on Computing Science study
HMCOMP	Student has access to computer at home (1=Yes)
WKCOMP	Student has access to computer at work (1=Yes)
OCOMP	Student has access to computer elsewhere (1=Yes)
SOCIETIES	Number of university societies student has membership with
SOCIALISE	Number of times student socialises weekly with university friends
IDEALHRS	Students' opinion of how many hours they should spend weekly on Computing Science study
Agreement Statements (1=Strongly Agree, 5=Strongly Disagree)	
FRIENDS	"It has been difficult to meet and make friends with other students on this course."
GOODGRADE	"Getting a good grade in Level 1 Computing is very important to me."
UNIHAPPY	"I am happy I chose to attend Glasgow University."
CSHAPPY	"I am happy I chose to take Level 1 Computing Science."

Activity Log

WEEK 5 Mon 5/11-Sun 11/11

	MON	TUE	WED	THU	FRI	SAT	SUN	
0700								0700
0730								0730
0800								0800
0830								0830
0900								0900
0930								0930
1000								1000
1030								1030
1100								1100
1130								1130
1200								1200
1230								1230
1300								1300
1330								1330
1400								1400
1430								1430
1500								1500
1530								1530
1600								1600
1630								1630
1700								1700
1730								1730
1800								1800
1830								1830
1900								1900
1930								1930
2000								2000
2030								2030
2100								2100
2130								2130
2200								2200
2230								2230
2300								2300
2330								2330
0000								0000
0030								0030

KEY	TOTALS
CC – Computing Contact Hours Attended	……
OC – Other Contact Hours Attended	……
CS – Computing Self Study	……
OS – Other Self Study	……
EX – Exercise/Sport	……
SOC – Socialising	……
TRA – Travel to/from uni.	……
EMP – Paid Employment	…….

N.B. Contact hours are hours spent in lectures, tutorials or labs

Enter your totals into this weeks' activity log at
http://grumps-research.dcs.gla.ac.uk/matt

Data gathered will be used as part of a Level 4 project by Matt Roddan. All information will be treated with the strictest confidence in accordance with the Data Protection Act.

Appendix 3

Appendix 4a

Level 1 Computing Science

Post – Exam Questionnaire

The following questions are designed to examine your study habits and your experience of CS1-P so far. The Department of Computing Science is very interested in finding out what it can do to help more students to pass the course in future years. Please take a few moments to fill in this questionnaire; it should take you no longer than a few minutes. All information will be treated in the strictest confidence in accordance with the Data Protection Act.

Computing Science Username: _____

Approximately how many hours of revision did you do in the 24 hours before the CS1P lab exam?

_____

Approximately how many hours of revision did you do in the week leading up to the CS1P lab exam? (including the answer to the previous question)

_____

Approximately how many hours of revision did you do in the 24 hours before the CS1P written exam?

_____

Approximately how many hours of revision did you do in the week before the CS1P written exam? (including the answer to the previous question)

_____

How well do you feel that you understand the course material?
(circle your answer)

Not at all **Very Well**

1 2 3 4 5

Before revising for the exams, how well do you think you understood the course material?

Not at all **Very Well**

1 2 3 4 5

Throughout this course, how well did you keep up to date with the Study Packs?

Not at all **Very Well**

1 2 3 4 5

Throughout this course, how well did you keep on top of the course in all other respects?

Not at all **Very Well**

1 2 3 4 5

Thank you for your time.

Appendix 4b

Post-Exam Questionnaire Independent Variables

VARIABLE	DEFINITION
LAB24	Number of hours spent revising in the 24 hours before the lab exam
LABWEEK	Number of hours spent revising in the week before the lab exam
CLASS24	Number of hours spent revising in the 24 hours before the class test
CLASSWEEK	Number of hours spent revising in the week before the class test
Opinion Statements (1=Not at all, 5=Very Well)	
COURSENOW	"How well do you feel that you understand the course material?"
COURSEBEFORE	"Before revising for the exams, how well do you think that you understood the course material?"
STUDY	"Throughout this course, how well did you keep up to date with the Study Packs?"
OTHER	"Throughout this course, how well did you keep on top of the course in all other respects?"

Appendix 5

Interview Codings

(0 = Not At All, 6= Very Much So)

1. Good Previous Qualifications

Student has a good record of prior qualifications.

2. Motivated

Student is motivated to work and to pass the course.

3. Organised

Student plans well and ahead of time.

4. Prepared for Exams

Student has prepared sufficiently for exams, via reviewing lecture material and spending time on revision.

5. Adapted to University Life

Student has coped well with the transition from school to university and has settled in.

6. Integrated in the Course

Student has friends on the course and or socialises within the course. Student feels 'part' of the course vs. feeling left out or an 'outsider'.

7. Committed to the Course

Student is committed to passing the course with a good grade.

8. Enjoying the Course

Student is enjoying computing science.

9. Enjoying the University

Student is enjoying life at Glasgow University.

10. Keeping up with the Course

Student is not falling behind, is keeping up with the Study Packs, lectures and labs.

11. Having Difficulties with the Course

Student does not understand the course material, or is having difficulty applying the theory. Struggling with the course and finds the assignments difficult.

12. Has Effective Study Techniques

Student has a good, effective way of studying (which may be individual to the student). Knows what *they* need to do in order to pass/do well in the course.

13. Has Previous Computing Experience

1 – Has no prior experience of computing before this course (particularly programming experience). May have some very basic general knowledge of computers (word processing, internet etc.)

2/3 – Has a Standard Grade/GCSE (or equivalent) in computing

4/5 – Has a Higher/A-Level (or equivalent) in computing

6 – Good previous experience of computing and programming. May have studied multiple programming languages, and is already familiar with most of the lecture material.

Appendix 6

Departmental Data Correlations

	CLASS TEST			LAB EXAM		
VARIABLE	**Correlation**	**p**		**Correlation**	**p**	
Week 2	0.014	0.779		-0.026	0.622	
Week 3	0.178	0.001	*	0.121	0.023	
Week 4	0.026	0.610		0.081	0.115	
Week 5	0.099	0.051		0.065	0.208	
Week 6	0.168	0.001	*	0.116	0.024	
Week 7	0.202	<0.0005	*	0.164	0.001	*
Week 8	0.158	0.002	*	0.116	0.024	
Week 9	0.192	<0.0005	*	0.217	<0.0005	*
Week 10	0.206	<0.0005	*	0.246	<0.0005	*
Week 11	0.210	<0.0005	*	0.190	<0.0005	*
Week 12	0.115	0.024		-0.023	0.654	
Week 2-4	0.064	0.204		0.055	0.283	
Week 2-5	0.092	0.069		0.072	0.161	
Week 2-6	0.135	0.007	*	0.103	0.044	
Week 7-12	0.298	<0.0005	*	0.291	<0.0005	*
Ratio (7-12):(2-6)	0.103	0.042		0.138	0.007	*
Study Pack 1	0.099	0.053		0.017	0.736	
Study Pack 2	0.158	0.002	*	0.149	0.004	*
Study Pack 3	0.258	<0.0005	*	0.206	<0.0005	*
Study Pack 4	0.172	0.001	*	0.178	0.001	*
Study Pack 5	0.319	<0.0005	*	0.326	<0.0005	*
Attendance %	0.293	<0.0005	*	0.259	<0.0005	*
Consecutive Missed	-0.243	<0.0005	*	-0.271	<0.0005	*
Study Pack %	0.370	<0.0005	*	0.341	<0.0005	*

* Significant at the p<0.01 level

One-way ANOVA: Class Test versus Ratio Code

```
Analysis of Variance for Class Test
Source     DF        SS        MS        F        P
Ratio Co    1      3564      3564     8.70    0.003
Error     388    158998       410
Total     389    162562

                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level       N      Mean     StDev  ---------+---------+---------+-------
0         188     45.43     20.47  (--------*-------)
1         202     51.48     20.03                    (-------*-------)
                                  ---------+---------+---------+-------
Pooled StDev =    20.24                 45.5      49.0      52.5
```

Appendix 6

One-way ANOVA: Lab Exam versus Ratio Code

```
Analysis of Variance for Lab Exam
Source     DF        SS        MS        F        P
Ratio Co    1     529.2     529.2    17.75    0.000
Error     378   11270.1      29.8
Total     379   11799.3

                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level       N      Mean     StDev  ---+---------+---------+---------+---
0         177    12.452     6.020  (------*-----)
1         203    14.818     4.921                    (-----*------)
                                  ---+---------+---------+---------+---
Pooled StDev =    5.460            12.0      13.2      14.4      15.6
```

Regression Analysis: Class Test versus Entry Point, MarkPercentage, ...

```
The regression equation is
Class Test = - 6.43 + 1.25 Entry Point + 0.317 MarkPercentage
           + 0.0437 Attendance Percentage

327 cases used 88 cases contain missing values

Predictor        Coef     SE Coef          T        P
Constant       -6.427       5.516      -1.17    0.245
Entry Points   1.2458      0.1900       6.56    0.000
StudyPack%    0.31682     0.07056       4.49    0.000
Attendance%   0.04368     0.07483       0.58    0.560

S = 17.36       R-Sq = 25.9%     R-Sq(adj) = 25.2%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         3       34065       11355     37.70    0.000
Residual Error   323       97293         301
Total            326      131358

Source       DF      Seq SS
Entry Points  1       19468
Study Pack&   1       14494
Attendance%   1         103
```

Appendix 7

Background Questionnaire Correlations (full sample)

	CLASS TEST			LAB EXAM		
VARIABLE	**Correlation**	**p**		**Correlation**	**p**	
GENDER	0.020	0.859		0.089	0.448	
AGE	0.149	0.193		0.072	0.5242	
MOCC	-0.160	0.210		-0.136	0.304	
MEDU	0.155	0.193		0.189	0.292	
MTECH	-0.268	0.029	*	-0.246	0.053	*
FOCC	-0.036	0.773		-0.013	0.921	
FEDU	0.122	0.561		0.101	0.521	
FTECH	-0.045	0.712		-0.119	0.340	
ORIGIN	-0.038	0.738		-0.084	0.738	
FLTIME	-0.319	0.005	*	-0.243	0.038	
TRTIME	-0.083	0.471		0.012	0.919	
MATH	-0.072	0.530		-0.073	0.535	
SCIENCE	0.051	0.658		-0.028	0.813	
DEGREE	0.015	0.725		0.121	0.483	
CSSTUDY	-0.105	0.361		-0.195	0.096	
HMCOMP	0.135	0.238		0.090	0.448	
WKCOMP	0.130	0.258		0.148	0.209	
OCOMP	-0.120	0.293		-0.172	0.143	
SOCIETIES	0.052	0.352		0.081	0.468	
SOCIALISE	0.047	0.683		0.076	0.520	
IDEALHRS	-0.242	0.033	*	-0.278	0.017	*
FRIENDS	0.121	0.292		0.107	0.365	
GOODGRADE	-0.228	0.045	*	-0.285	0.014	*
UNIHAPPY	0.030	0.792		-0.041	0.732	
CSHAPPY	-0.080	0.484		-0.154	0.189	

* Significant at the $p<0.05$ level

Appendix 7

Background Questionnaire Correlations (traditional students only)

	CLASS TEST			LAB EXAM		
VARIABLE	**Correlation**	**p**		**Correlation**	**p**	
GENDER	-0.006	0.960		0.051	0.695	
AGE	0.178	0.152		0.093	0.473	
MOCC	-0.174	0.204		-0.125	0.384	
MEDU	0.125	0.562		0.241	0.597	
MTECH	-0.297	0.027	*	-0.293	0.037	*
FOCC	0.015	0.910		0.037	0.732	
FEDU	0.214	0.298		0.241	0.212	
FTECH	-0.002	0.987		-0.081	0.560	
ORIGIN	-0.118	0.345		-0.186	0.148	
FLTIME	-0.318	0.010	*	-0.205	0.114	
TRTIME	-0.52	0.679		0.067	0.603	
MATH	-0.136	0.276		-0.220	0.086	
SCIENCE	0.053	0.671		-0.098	0.448	
DEGREE	0.051	0.356		0.099	0.411	
CSSTUDY	-0.018	0.887		-0.084	0.514	
HMCOMP	0.088	0.480		0.111	0.389	
WKCOMP	0.155	0.213		0.167	0.195	
OCOMP	-0.003	0.981		-0.023	0.861	
SOCIETIES	0.072	0.331		0.101	0.561	
SOCIALISE	0.122	0.329		0.150	0.246	
IDEALHRS	-0.200	0.180		-0.259	0.052	
FRIENDS	0.183	0.141		0.157	0.223	
GOODGRADE	-0.300	0.014	*	-0.395	0.002	*
UNIHAPPY	-0.071	0.571		-0.118	0.362	
CSHAPPY	-0.072	0.566		-0.213	0.097	

* Significant at the $p<0.05$ level

Appendix 8

Interview Code Correlations

	CLASS TEST			LAB EXAM		
VARIABLE	**Correlation**	**p**		**Correlation**	**p**	
Good Previous Qualifications	0.492	0.400		-0.116	0.853	
Motivated	0.757	0.030	*	0.308	0.552	
Organised	0.620	0.189		0.415	0.413	
Prepared	0.789	0.020	*	0.458	0.361	
Adapted to University Life	0.763	0.077		0.760	0.080	
Integrated in the Course	-0.398	0.434		-0.786	0.051	
Committed	0.598	0.210		0.654	0.159	
Enjoying the Course	0.466	0.352		0.869	0.352	
Enjoying the University	0.125	0.841		0.674	0.212	
Keeping Up	0.686	0.132		0.651	0.162	
Having Difficulties	-0.690	0.130		-0.636	0.175	
Effective Study Techniques	0.479	0.336		0.342	0.507	
Previous Computing Experience	0.710	0.048		0.042	0.922	

* Significant at the $p<0.05$ level

Appendix 9: Interview Transcripts

STUDENT 1

(predicted B/C)
Interview 1
29/11/01

Student 1 is 18 and is studying Computing Science, Maths and Biology. He/she took a year out to go to dancing school before coming to university and now intends to take a degree in Computing Science. He/she is currently living in student halls.

What is your previous computing experience?
I took a Standard Grade in Computing, but that was a while ago, and don't feel it has particularly helped in my university computing course.

What do you find are the main differences between school and university?
At school you were made to practice the skills you were learning. Here, you are given the material to learn and it is up to you whether you practise or not. I don't mind this, as long as I am motivated.

Are you finding this to be a social course?
Yes, I do think that this is quite a chatty course in general though.

How much studying are you doing for computing, and how are you spending this?
I'm doing about 8 hours per week, which is about 5 on 1P (programming), and 3 on 1Q (HCI, databases etc.) I spend my study time for 1P in front of a lab computer practising my programming skills. I look at the basics of the programs before the labs, and then ask the tutors for help with anything I get stuck on in the timetabled lab.

What do you think makes a good student?
Someone who finds a balance between work and play. It is important to set blocks of time for both university work and for socialising. You should also make sure you attend the lectures.

STUDENT 1
Interview 2/3
6/12/01

What previous qualifications do you have?

Art	A
Maths	A
English	A
Physics	A

These subjects were pretty easy, and I just did a lot of study the day before each exam.
I also did;

Crash Biology	A
Crash Chemistry	A
Crash Maths	A
6th yr Biology	A

These were based on continual assessment.

How did you study for these subjects, and why do you think you did so well?
I think I did well in these because I tend to pick thing up quite easily.
At high school, you are given a lot of examples as you go along, and this helps to make sure you understand everything. I also found that I was able to cram a day or so before the exams, and still do well.

How are you planning to study for Level 1 Computing Science?
I think this will be quite different from school, and I won't be able to leave all my studying until the last minute. I find that at university, you are left to do much of the work yourself in your own time, and

so I'll have to find the motivation to make myself work. I think I'll start studying a few weeks before the exams. I'll probably read over my notes, do the examples and try some past papers. For programming, I think the most important thing is to get lots of practice in. I'm not really sure though how much study I'll need to do.

Have you picked up everything as you go so far at university?
I'm finding that most of the Maths and Biology work so far is repeated from 6th year, so I'm not having too much trouble. In computing however, it is all new, and I'm having to make sure I keep up, as new material builds upon everything you have learned so far.

How do you cope with exams? Do you get stressed?
I am quite worried about the exams this year. University is a lot more difficult than school, and I don't think I'll be able to breeze through the exams as easily as I did at school.

How motivated were you at school?
I was very motivated. I put a lot of pressure on myself. I did very well at Standard Grade, and so I was expected to repeat that at Higher. I wanted to do dentistry at university originally, and had to just get a B in Chemistry to get in, so that didn't put too much pressure on me. I was confident I would get that, and that I would generally do OK in my exams. There was no pressure from my parents.

Are you motivating yourself at university?
I'm not as motivated as I was at school. I took a year out last year to go to dance school. It was a good break from studying, and there was no academic work at all. I'm just now trying to get back into the habit of studying.

How do you think you will do in Computing?
I predict a B/C grade in level 1 computing. I should aim for an A really, as I think I am capable of it, if I worked enough.

How important is it for you to do well in Computing?
I'm not fussed really! I probably should be though. I'm intending to do a computing degree at the moment, but my heart is not set on it, and I may well change my mind.

Were you taught any study skills at school or university?
We weren't really given any at school. There's been a little bit at university. We have been taught how to use mind maps, but I'm not using them. I always re-order my notes within a day or so after the lecture, so that studying is a lot easier.

How have you got on with the assignments over the past week?
I've been doing the databases assignment. I'm finding the databases side of the course confusing in general. There are a lot of definitions and so on to remember, and so it's a lot more confusing than programming. It's a lot more theory than practical. I have managed to do the E.R. diagram, but I'm worried that it might be wrong. I should be OK converting the diagram into database tables once I've done the first one. I'll see how it goes, but I should be OK with it.

STUDENT 1
Interview 4
10/1/02

How have you been getting on with your assignments?
I haven't looked at the databases assignment in a while, but it seemed to be OK. As for the programming exercise at the end of last term (ISBN nos.), I grasped most of it, but I didn't understand how one function worked.

How are you preparations for the exam next week going?
I did a little bit over the holidays. The program for the exam seems OK, I'll just try it in the computer this week to make sure it works. I think I should do OK in the exam.

Do you get stressed by exams?
I do, about 5 minutes before they start. I got very stressed for my highers, but I got over it. I cope with nerves pretty well most of the time.

What are your thoughts on the HCI & databases exam?
I'm not terribly confident, but I think I'll be OK, as long as I get enough study in. It's a less practical course than the programming, and you're not forced to learn as you go along. In programming, you have to know everything you're taught as it's taught so you can do the assignments, but in these courses, you can get to the end of the lectures and know nothing.

From your perspective, now that you are halfway through the course, what do you think is important to be good at computing science?
I think it's most important to just go and practise. You've got to work it out for yourself, and as the lecturer says, you've got to be willing to fail in order to succeed. You should be quite a logical person, but it can be learnt. I'm a firm believer in you can do anything if you put the effort in.

How do you think you fit in against other students in the class?
I think I'm quite average. Some students have done a lot of computing before. They are used to the programming 'way of thinking.' I'm getting the hang of it now though.

What do you find the most difficult?
I think just grasping the main concepts to begin with.

STUDENT 1
Interview 5
16/1/02

How much preparation did you do for the practical exam?
It was mainly the stuff I did at home over the holidays. I did about an hour more on the code and then spent about one and a half hours memorising it.

How did the exam itself go?
Fine. It took me about 20-25 minutes to type it all in. I then spent the rest of the time using data to test the program. It was working fine most of the time, but there was just one set of data it wasn't quite right on. I'm not sure why it wasn't doing what it should have, but it was essentially working fine.

How is the preparation going for your other exams?
I have a Maths exam on Monday, the 1Q computing exam is on Thursday, and then I have another 1P and Biology on Friday. I haven't done anything yet. I'll get Maths out of the way and then spend two days on 1Q. The 1P written test should be fine. I am concerned about 1Q, but not worried. It's just because I haven't done anything for it yet. I just need to sit down and learn it.

What are your university plans after these exams are done?
I'll just carry on with the computing courses as usual. We have finals exams in May/June, but I should be OK with those.

STUDENT 1
Interview 6
11/2/02

Have you had any results for your exams yet?
Yes, I didn't do as well as I had hoped. I got 11/20 for the CS1P lab exam. It was stupid really. They took a lot of marks off for a silly mistake. Ah well, I still did well though. I got 70% though in the CS1P class test, which I'm happy with. I was quite prepared for that one as I did a couple of hours revision before the exam. I wasn't shocked where I lost marks and I know the areas where I am weak.

How did the CS1Q exams go?
I haven't had the class test marks back yet, though I think I've done alright. I did maybe 1.5 hours revision. I got full marks on the databases assignment (the CS1Q lab exam), so I'm really happy about that.

Why do you think you do well in exams?
To be honest, I just think I have a good exam technique. I know there are people who know more than me but they get similar marks to me. Some people get too stuck on one question and end up wasting time. I make sure though that I go through the exam over and over so that I'm confident. I have noticed at university that if I am having trouble learning something in the course, I will try to get it into my head, but if it's too tough and I'm spending too much time on it, I tend to forget about it and concentrate on my strengths. I think that way, I'll get more marks.

Are you still intending to carry on with computing?
Yes. I'll carry on next year, and I'm thinking of taking Management as well. I haven't decided on my degree yet, I'll just wait and see.

Why do you think so many students fail this course?
I think they fall into two groups really. There are those who just don't understand the course, and then there are those who think they understand, and are over-confident. They end up not doing enough work and then don't get very good grades in the end.

STUDENT 2

(self-predicted B/C)
Interview 1
29/11/01

Student 2 is 19 and is studying Computing Science, Business Management and Maths. This student is not sure what degree he/she wants to take- it could or could not involve computing. He/she currently lives in halls. He/she has missed three weeks of university after breaking his/her shoulder.

What is your previous computing experience?
I have not done any programming previously, but I am familiar with word processing, internet etc. This does not help especially with my course.

What do you find are the major differences between school and university?
There is a much more relaxed attitude at university, and school was quite regimental in comparison. The work so far is not as difficult as it was for my A-levels (Maths, French and German), and it is not as constant. There is less contact with lecturers and tutors, and it is difficult to get hold of them outside timetabled hours, especially as they may be in different buildings. They do seem quite approachable though.

How much study are you doing for computing, and how are you spending this study?
Before I broke my shoulder, I was going to maybe 80% of the lectures, and I wasn't doing much study. I don't tend to do much work in front of the computers before my weekly lab. Since I came back, I have attended all my lectures and am starting to do more outside study. I think I have fallen behind quite a bit. I tend to spend my study time in the library, as it's close to home and it is quiet. I'm confident that I will catch up, and think I'll get a B/C grade in Computing.

How are you getting on with Study Pack 4 and the lottery program?
I'm finding it very difficult as I have missed so much work. It's hard to know where to start, and I guess I'll just have to go back and try to figure out what I've missed.

What do you think makes a good student?
Someone who is hard working and attends all their lectures, but also spends some of their time on social activities. As far as a good computing science student, I think they should have patience and also learn from their mistakes (especially in programming).

STUDENT 2
Interview 2 (via email)
28/02/01

How have you been getting on with CS1P? (Are you finding it easy/difficult? Is the workload too much/OK/too little?)
I am finding the course quite difficult at the minute, very difficult to catch up.

Have you managed to catch up after missing those three weeks when you broke your shoulder? Has it been easy/difficult to catch up?
Not fully as yet but I understand most of the implications a lot better.

How are the study packs going? Are the assignments going well?
Once again finding the program writing somewhat difficult.

How are you getting on with your other courses?
Other courses are fine, Maths is good and Business Management is boring but understandable.

How much preparation did you do for the CS1P exams? (lab exam & class test)
As much as I could with the amount of notes and experience that I had of the labs.

How did you study for these exams?
I went to the library most days but did a bit of a cramming session at the end.

How well do you feel that you understand the course material?
I understand it but just putting it to use is difficult.

Are you happy with your exam results?
Well I passed, but I'm not entirely happy. I know I could have done better.

Is there anything you think could have helped you to get higher grades in the CS1P exams? (e.g. more help from lecturers and tutors, more time studying, more practise programming etc)
Not really, just not breaking my shoulder!

Are you intending to carry on with computing next year?
Yes but I desperately need to put in some big-time work now.

How do you think you'll do in the degree exams in June?
Better than most will expect.

How important do you think it is to have previous computing experience to do well at 1st year computing?
Very important, I have no experience whereas people that do find it very easy.

STUDENT 3

Interview 1
23/11/01

Student 3 is 24 and is studying Computing Science, Maths and French. A mature student who has spent the last 3 years in Scotland. He/she has been a nurse for the past few years, but now wants to take up computing as a career, intending to take a degree in Software Engineering or Computing Science.

What is your previous computing experience?
In order to attain a place in university on a computing course, I have spent the last year studying for a HNC in computing and a higher in Maths. I also have a City and Guilds qualification in computing, and so far I've learnt to program in Cobol and Pascal.

How have you found the transition to university?
The workload is a lot greater than on my previous courses. The HNC was very basic, and I'm finding the work and hours of self-study needed are significantly larger at university. The mathematics course is particularly time consuming. However, as I'm returning to studying for a specific purpose, I am much more focused, and I tend to spend a lot of my time on university work.

What do you do in your spare time, and are you finding Computing Science to be a sociable course?
I used to spend a lot of time on various sports, particularly fencing and martial arts, but I don't really have the time to do it much anymore. I don't really socialise much with people on the course, but I tend to mix with the same group of people in lectures and tutorials.

How are you getting on with Level 1 Computing?
As a mature student, I'm finding very important to have done the work. I am very focused on my university career and am spending large amounts of time studying, in fact probably too much. This is mostly spent on Maths.
The pace of the programming lectures is very slow going and so far I've not learnt much new material. However, as the programming assignments are becoming more demanding, I am needing to spend more time on preparation. I'll probably end up spending about 6-7 hours per week on computing study.

STUDENT 3
Interview 2
30/11/01

What do you think makes a good student in general?
A good student looks at their work as they go along instead of waiting until the end of the year when you must revise for exams. It is important to get your head around the course as it is taught rather than months later. Students should also avoid doing excessive amounts of work as this does not necessarily mean you will pass the course.

What skills do you think are important to be good at computing?
It is important to have a logical mind and to pay attention to detail. You should be able to solve problems effectively, and should have a good understanding of maths for programming.

What do you think makes a bad student?
I think the people most likely to fail this course are young, 16 year old, recently left school males. Sorry if that sounds sexist! There are a lot of young students on this course, and I just think that girls are more sensible and mature at that age, and are likely to have a better attitude towards studying than the boys. I don't really think success at this subject is down to skill. It is a science, and so it can be learnt. It just depends on your attitude to work and whether you want to do it.

How many hours have you spent studying computing science in the last week, and how did you spend this study?
I spent about 8 hours on my HCI essay, which was probably too much, and maybe 3 on programming. For programming, I worked through Study Pack 4, preparing for my weekly lab. I am still finding the

programming quite easy. The lottery program was tricky in parts, but wasn't too difficult. My preparation for 1P is spent planning programs on paper, and trying some of them out on my computer at home.

How are you using the timetabled labs?
I am finishing them quite quickly, normally within the first hour. I ask the tutors for help, but mostly out of laziness. For example, if I've got a syntax error, I'll ask them to find it for me rather than spending time figuring it out myself.

STUDENT 3
Interview 3
7/12/01

What previous qualifications do you have?
I did a few courses last year so that I could get my place at university.

Higher Maths	A
HNC Computing	PASS

I also did a City & Guilds distance learning course in computing as I enjoyed the programming.

How did you study for these?
The Maths course ran a flexible drop-in class for 3 _ hours, twice a week. I studied in these each week, as it meant there was always a tutor about if I needed help. When it came to the exams, I knew the entire course. The HNC computing was a doddle, and a waste of time to be honest. They pretty much told you exactly what you needed to do in the exam to pass it.

You have qualifications in nursing, don't you? How did you study for those?
I did totally the opposite from last year! I did nothing throughout the year and just crammed for 2 weeks maximum before the exams. I am surprised I passed to be honest! I really shouldn't have with the amount of work I did.

Why did you decide to give up nursing and start a degree course in computing?
I just really wanted to give up nursing. I looked around at a few different courses, including medicine and law, but ended up deciding on computing. I knew nothing about it, but thought it would be a way to get a decent job for myself. I'm enjoying it, as computing is nowhere near as stressful as nursing was!

How motivated were you when you were studying last year?
I was really motivated, as I wanted to get onto the university course. I wouldn't have stuck with the HNC if I wasn't going to university because it was such a waste of time, but I figured I had started it so I might as well finish it. I have just carried that level of motivation on to university.
I am very motivated and determined to get a job at the end of this course, as I want a better standard of living for myself. I am very ambitious.

What are you intending to do when you finish your degree?
To be honest, I would like to carry on studying after this, as I enjoy learning now. I'd like to do a PhD or a Masters, but I want a job! I want a decent job, and I expect to do well. I'm not sure what opportunities are out there, so I'm not sure what I want to do at the moment, but I'm thinking perhaps software development. I also find the HCI quite interesting.

Have you been taught any study skills at university?
I have been to the Effective Learning Centre, where they teach you 'how to learn', the theory of learning and so on. I didn't stick at it as it was too time consuming, but it has been useful. I'm now more aware of the thought processes involved, and I've learnt to make my notes a lot more visual to help me learn.

How do you plan to study for your computing exams?
I'm hoping that there won't be too much cramming to do as the exams approach. I've worked constantly throughout the year so far, and I intend to carry on doing that. I'm not worried too much at all about the programming. I'll hopefully take another look at HCI over the Christmas break.

How have you gotten on with the assignments over the last two weeks?
I had no problems with the lottery program. The databases assignment however, is proving to be a bit of a nightmare! It's easy on paper, but the lectures are so dull. A lot of students are going to the lecture theatre to grab the notes and then are leaving before the lecture starts! I have done that a few times myself! I find the ER diagrams are fine, but I'm struggling with the practical aspect of linking the tables together in Access.

STUDENT 3
Interview 4
11/01/02

How did you get on with the last assignment (programming with ISBN nos.)?
I had no trouble with that one at all. It was fine.

How are you getting on with your preparations for this week's practical exam?
I'm actually having trouble with the program. It essentially works, but there's a bug in it somewhere. I just can't see where! I'm not worried about the exam though. I know I can recall the program in the lab, and I'm sure I'll pass.

Are you intending to memorise the program?
No. I basically understand the program, so I think I'll just memorise the structure and then try and write the rest as I go. The students who are having trouble have been trying to just memorise the whole thing though. I guess they don't understand how the loops and arrays and so on work, so they're trying to cram the specifics into their head without actually 'getting' them, if you see what I mean.

Do you tend to get stressed by exams?
Yes. I get very stressed! I'm normally OK if I know I've worked hard, but sometimes even then I get nervous. It normally happens in the exam, and even in class tests. My head tells me to calm down, but my hands shake. I think it may happen in my exams this year. I am a little worried about it as it really could mess up an exam for me.

Have you done much preparation for your HCI/databases exam in two weeks?
I haven't done any so far. I have an important Maths exam at the end of next week, so I'm concentrating on that. Then I'll start working for my HCI exam.

From your perspective, now that you are halfway through the course, what do you think is important to be good at computing science?
For programming, I think it's important to do the study packs. Programming is something that can be learned, but there is something else involved. Good programmers just have that knack. Being able to break down a problem is a skill that you should have also. Intelligence always helps of course! I think that is probably more important that having any previous computing experience. You can come into the course and succeed without having done any computing before, as the programming on this course is pitched at quite a low level, allowing those people to get on OK.

STUDENT 3
Interview 5
11/2/02

How did you get on with the CS1P lab exam?
I ended up making one stupid mistake! I put a 'less than' sign in where there should have been a 'less than or equals' and so the program didn't work as it was supposed to. They took 5 marks off for that, and the program is out of twenty. I'm annoyed at myself really, especially as I though that would have been my best exam mark

How about the CS1P class test?
I didn't do much preparation really. Maybe a few hours. I got 87% though, so I'm really pleased. I got really stressed because I thought the exam was longer than it actually was, and so I thought I had lost a lot of marks on the last question.

And the CS1Q exams?
I got 74% on the written test. I did a fair bit of work for that exam, but not excessively. I had a French exam that week, so most of my time was spent on that, but I did maybe 10 hours over the two days before the actual exam. I got most of the marks on the HCI section, which I was quite surprised by. I haven't had my results yet for the lab exam on databases, though I think I did OK.

Are you still intending to carry on with computing?
Yes, I'll carry on next year and probably am still heading for single honours computing.

STUDENT 4

(self-predicted A/B)
Interview 1
21/11/01

Student 4 is 18 and is studying Computing Science, Maths and Physics. He/she intends to take a degree in single honours Computing Science. He/she lives with his/her parents and travels in every day (approximately 1 hour travel).

What is your previous computing experience?
I studied some programming in 6th year at school (Hypertalk), but that hasn't really helped me in learning Ada 95 at university. It has helped me though in the planning of programs.

How are you finding the transition from school to university?
The pace is much quicker at university than at school, and the courses are more difficult. There is less contact with staff members, but I don't mind that. Having more responsibility is neither good or bad, I'm happy either way.

Are you finding computing to be a sociable course?
The lectures are not good for meeting other students in, and you tend to sit in the same small group each day. However, the labs and tutorials are friendlier, and I like the fact that group work lets you meet the people in your tutorial group.

How are you getting on with your courses?
My attendance has been good for all my subjects. I haven't missed any contact hours so far. The pace and difficulty are just right. I do about 3-4 hours study per week for computing, mostly just before the weekly lab, but I should probably be doing more. I have two jobs, working around 20hours per week, and that really interferes with my studying.

STUDENT 4
INTERVIEW 2
30/11/01

What do you think makes a good student in general?
A good student is someone who does all the work they need to, and keeps a balance between their academic work and their social life.

What skills are necessary to be good at computing science?
You must be able to work through problems on your own. Problem solving skills are very important. You must also be willing to work hard.

What makes a bad student?
A bad student leaves everything to the last minute. They miss a lot of the work as they go along, expecting that they can just cram for exams at the end of the year.

How much study have you done in the past week for computing, and how was this spent?
I spent about three hours in total, and this was mostly spent on programming. I try to plan the programs for assessed exercises in advance on the computer so that I am prepared when I go to my timetabled lab. I have also spent some time this week getting to grips with ER diagrams for my databases lectures. I am finding the programming is getting more difficult now, and we are being introduced to new concepts in databases, which isn't too bad so far.

How do you spend your time in the labs?
Firstly, I check my email, and then I spend my time moving between programming on AdaGide and the internet. If I am trying to concentrate on my work, I spend most of my time on AdaGide. The tutors haven't been much help so far. They tend to give a little bit of help then abandon you to do it all

yourself. If I get stuck, I try to figure it for myself, and then ask other students rather than tutors, as they don't want to give you the answer.

Are you spending much time looking over your lecture notes?
Yes, I find that I really need to look over my programming (1P) notes, as they are a good reference when it comes to writing programs for myself. I look at the 1Q notes to figure out what I may have missed in the lectures. The lectures are very boring, and I tend to zone out sometimes!

STUDENT 4
Interview 3
7/12/01

What are your previous qualifications?
I did my highers last year.

Maths	B
English	A
Physics	A
Computing	A
Biology	B

How did you study for these exams? Were you taught any study skills?
I didn't work too much really, as I worked throughout the year. I just crammed for a few days before the exams. We weren't taught any study skills at school.

How motivated were you at school?
I was quite motivated, as I wanted to get the grades to get my place at university. My parents didn't put any pressure on me, as they knew I would study on my own.

Are you still motivated at university?
Pretty much. I am working, but I don't have as much time to study as I'd like. I have two jobs, which impose a lot on my university work.

How do you intend to study for computing?
I'm intending to organise my notes over Christmas. I am worried about the exams, so hopefully I'll find the time to start studying for my exams over the holidays. I think I'll end up doing a lot of cramming though before the exams. I haven't been taught any study skills at university either, but I'm pretty good at learning anyway. I think there'll be a lot of bookwork initially for the exams, and I'll practise on paper and then on computer. I have got a computer at home with AdaGide. Programming is mostly practical, but you need to know the bookwork as well.

What are you hoping to do after university?
I am a very ambitious person, but I'm not sure what I want to do yet. If I do a degree in computing, I think I'll probably go straight into a job after uni.

How are you getting on with the assignments?
I didn't get all of the lottery program done, as I never did any in the lab. The databases program is OK, and I've managed to convert the E.R. diagram into tables so far. It has been quite easy initially, but I'm having problems with some of the relationships.

STUDENT 4
Interview 5
12/2/02

How are your assignments going?
Well, I've actually given up computing now. I wasn't really enjoying it, and it was taking up too much of my time, so I decided to take a course that I would like doing. I was intending to do an honours degree in computing, but it just wasn't what I expected it to be.

So, before you left the course, were you getting on OK?
Pretty much, yes. The programming assignments were OK, but they were getting harder. The CS1Q ones weren't too bad though. I was doing enough to pass them all.

How much preparation did you do for the programming exams?
Well, I studied throughout the week before, but that was for all my exams together. I did a reasonable amount for programming. The exam went OK. I got the program to work, and that was all that mattered. I did the program beforehand and just memorised it.

What about the class test?
That was mostly OK, apart from the last section. I got confused with the marking scheme, and I don't think I wrote enough for that section. It didn't go as well as planned, but I'm pretty sure I passed both the exams.

STUDENT 5

(self-predicted B grade)
Interview 1
28/11/01

Student 5 is 18 and is studying Computing, Maths, Statistics and Biology. He/she is repeating 1st year after missing much of last year through illness and dropping out. He/she intends to take a degree in Combined Honours Computing Science and Psychology. He/she is living in a student flat in Glasgow.

What is your previous computing experience?
I have taken Higher Computing (grade B) and SYS Computing (grade B) previously, and learnt BASIC, Intermoddeler and Prolog programming languages. This is not helping much with learning Ada 95, and think it would actually be easier if I hadn't done any programming previously. I find myself getting confused with the syntax of Ada, often putting in lines of codes from other lanuguages.

What are the main differences between school and university?
University is more self-orientated, and you are left to do things on your own more. It is more stressful, as there is more to worry about than just university, such as bills, work etc. I also think there is less contact with lecturers, and they are hard to contact as you have to find out about their office hours and then get in touch with them. Staff contact should be made more available.

How social are you in this course?
I went to freshers week last year, and tend to hang out with the friends I made last year. There are quite a few students repeating the computing course, and I speak to them rather than the new students this year.

How much time are you spending studying for computing?
I am working a lot more this year than last, and am finding myself doing about 11 hours per week, including lectures. There is a group of us who study together in the labs on a Wednesday evening, and then we go out together afterwards. I spend my study time for computing in front of the lab computers trying out programs.

How much time are you spending on your other subjects?
I'm spending a lot of time on maths as there are always lots of questions to be getting on with. I'm finding that there is not much biology work to be getting on with outside of the contact hours. I'm not doing much for statistics, as I'm just taking this course to allow me to take psychology next year.

What do you think makes a good student in general?
Someone who can keep a balance between their social life and university. It is important to keep both in perspective. Also, a good student should attend most, if not all, of their lectures and tutorials.

What do you think makes a good computing science student?
They should be patient and determined, as it is very easy to give up when a program doesn't work at first.

What do you think makes a bad student?
Someone who is not willing to work at it, and gives up easily. It is also important to keep working on the study packs each week, and students who don't, and fall behind are likely to do badly.

STUDENT 5
Interview 3
14/1/02

What subjects did you study at Higher/A Level and what grades did you get?
I took six highers.

English	B
Maths	B
Human Biology	B

Chemistry	C
Computing	B
Business Management	B

How did you study for these exams?
We were taught some study skills, but I studied in my own way for exams. I pretty much abandoned the Chemistry. I hated it. I did a lot of past papers for Maths. The Computing Science just made sense. I didn't have to do much study for it as I understood it all as I went along.

How are you getting on with your university courses?
OK. I haven't really been going to the statistics lectures. I don't think they're much use really. Maths is pretty stressful. I find that most difficult. The Biology is OK, and I'm getting on with the assignments just fine. Computing is fine too. I go to all the lectures and pay attention in them. Computing generally just makes sense to me. The assignments have been OK too. I meet up with a group of friends once a week, and we work on the assignment for a couple of hours to get it out of the way.

How much study have you done for this week's practical exam?
I've done the program, and now I just need to memorise it. I'm not worried about the exam at all. Exams don't stress me. I've got exams for other subjects coming up that are much more important, so I'm concentrating on those.

And how about the HCI/databases exam? How are you planning to study for that?
I think I'll just use my notes from last year. I haven't been to all the lectures this year. I'll read over them, and if I don't understand them, I'll then look at the book. I don't think I'll have too much trouble.

From your perspective, now that you are halfway through the course, what do you think is important to be good at computing science?
I think you've got to be good at the practical side. The study packs have been really helpful, and I think that if you keep working at these each week, you should do alright. You learn the theory in lectures, and it is important to practise this theory on programs. People who neglect the practical side of programming are most likely to fail. I think you have to be determined and patient. It is easy to become annoyed and discouraged if your program doesn't work. You should also have good problem solving skills. Computing can be learnt, but there are those people who just won't be able to do it. I think it just clicks for me.

What grade do you predict for yourself in computing this year?
I'm hoping for a grade B.

STUDENT 5
Interview 4
14/02/02

How have you been getting on with the assignments?
Still no problems at all. I'm actually doing Study Pack 8 at the moment and it's going fine.

You did Computing last year but dropped out. Is the material you're learning now new to you, or do you remember it from last year?
I did the Further Programming course, but not the Introductory one, so it didn't really make sense to me. The stuff I'm learning now I've done before, but this time I understand it because I've also done the basics. I really don't find it too difficult at all.

How did the exams go?
They were fine. I got good marks for them both. For the lab exam, I did the program beforehand, and learnt it. I knew most of it, so I just quickly memorised any tricky loop structures. I did no preparation at all for the written exam. I think that because I did all the study packs as I went along, and I have done the past papers last year, I understand it and it doesn't cause me too many problems.

Are you still intending to take a degree in Computing and Psychology?
I'm not sure really. It'll definitely involve computing, but I'm not sure if it'll be a single honours, or a combined honours with maybe maths or psychology.

STUDENT 6

Interview 1
5/12/01

Student 6 is 18 and is studying Computing Science, Management and History. He/she is currently living in halls. He/she intends to pursue a degree in Combined Honours History and Management. He/she is currently having problems with the programming side of the computing course.

What is your previous computing experience?
I took Computing at Standard Grade (and achieved a grade 3), which involved programming in BASIC. This hasn't helped me at all in learning Ada95 this year. In fact, I struggled getting to grips with BASIC. I have also studied Higher and Advanced Higher Information Systems, and this primarily included databases, internet, hypermedia etc. This has really helped me when it comes to the 1Q section of the course, as I am already familiar with the majority of what I am now studying

What do you find are the major differences between school and university?
I am seeing really big differences and am having trouble with the transition. I don't like the teaching style at Glasgow University, and don't think there is any where near enough support available to students to help in this transition.

How are you finding the course so far and what grade do you predict for yourself?
I am having no problems with the 1Q module, and am hoping to get a grade B/C.
I am having real trouble however with the programming. On the whole, I understand the lectures, but I find it really difficult to apply that knowledge to programs I must write. I have found the assignments to be very tough. The understanding of the programming language just goes over my head. I am hoping just to get a passing grade in 1P, so a grade G or more will be fine. I need to pass the course, as I need the credits to go onto second year. I have no intention though to continue studying computing in second year.

Have you sought help from anyone?
I have bought the textbook and went to see my tutor, and they have been able to guide me a bit in the assignments. It does become clearer when things are explained, but I like to be told how to do something, rather than being left alone to learn it all on my own. I am having trouble adjusting to this new teaching style at university.

Have you missed many of the lectures and labs?
Admittedly, I missed a lot of lectures and so on in weeks 1-6, and not just in computing. I have been to most of the 1P lectures, as I know this is something I really struggle with. I have managed to get all of the notes from the lectures I missed. It wasn't until about week 7 or so, when I filled in one of those activity sheets, that I really noticed how little work I was doing. I think I did know that I probably should be doing more, but it didn't click with me until I actually saw it in front of me. So, I have been attending pretty much all the lectures, labs and tutorials over the past two weeks, and am trying to get back into it. I am now spending a lot of time on the study packs, but I am not getting much further.

Do you think computing science is a sociable course?
I know one or two people in my tutorials, but not many in the class as a whole. It is a really huge class. My other subjects seem to be quite similar. To be honest, I'm just having difficulty settling in to the ethic of the university, and I don't like that there is so little support available.

What previous qualifications do you have, and what grades did you achieve?
I have 6 Highers;

Information Systems	B
Administration	A
Business	A
English	B
History	B
Maths	C

I also have an Advanced Higher

Information Systems B
as well as a Scottish Group Award and an NVQ Level 2 in Enterprise Business.

Do your parents put pressure on you to study?
No, not at all. My mum has never put any pressure on me to study, at school or at university. In fact, she wanted me to take on less. At school, I took on a lot of extra-curricular activities, especially in Business areas.

What motivates you to work and achieve your grades?
I set goals for myself in school, and so I knew what I had to get and went all out to get it. I can be a very motivated person, but can get de-motivated quickly if I don't see results from the work I'm doing. Fortunately, I have seen results from my computing work, even when I've been having difficulties.

Do you consider yourself to be quite an ambitious person?
Yes, very. I have the next 5-6 years of my life planned out already. I want to spend four years getting my degree in History and Management, then a few more getting a PhD, and then I hope to teach high school. I have already been doing this for a while, as a classroom assistant.

What do you think makes a good student, in general?
In my case, I think I would be doing better now if I had been more isolated during the first half of this term, as I would have done a lot more study. However, that probably would have made me quite depressed. I am learning as I go along though. I am used to a set routine, and I work well under those conditions, and now that I have set a routine for myself, I am surprising myself with the amount of work I'm getting done. I think students need to be very self-motivated at university, especially with the lack of support available.

What skills do you think you need to be good at computing?
Honestly, I don't know. I think I should have chosen a different course.

Do you think you would have changed course if you had realised earlier in the term that you wouldn't do very well in it?
Probably not. I am a very persistent person. Sometimes out of wanting to succeed, but mostly just out of stubbornness. I would have stuck at it either way.

Do you have a paid job outside of university?
No, I never have. I have always had too much to do. It has always been more important to me to boost my CV and get good qualifications rather than paid employment.

STUDENT 6
Interview 2
11/1/01

How are you getting on with the course?
Well, I've actually decided to drop the course at the end of next week. I have spent a lot of time studying computing, and the amount of time I'm spending just doesn't justify what I'm getting out of it. I'm still not grasping the programs, and I wasn't intending to take computing to honours level anyway. Computing study was interfering with my study for other subjects. I'll have to take another subject, but hopefully that won't involve as much work.

How have you been getting on with the programming assignments?
The programs have just taken me ages to get into. I have finally got the hang of the program for the exam next week, and now I'll have to try and remember it. I'm not sure how successful I'll be in that. I have to do the programs the way I understand them, and often they end up being much longer than the model answers. I managed to get the ISBN program working, but my tutor said it was "very repetitive," whatever that means. It took me ages, probably 12-13 hours study just on that one assignment. When I get the model answers back, they just seem like Double Dutch to me. I really have no clue, and they don't look anything like the programs I write. I have to have them explained to me in order for me to understand them at all.

Have you done much preparation for the HCI & databases exam?
I haven't done any yet, but HCI seems OK. I've got a few important exams coming up, so I'll start studying for that exam after they're out of the way. I got really fazed when they started talking about discrete maths. I really don't like maths, and I didn't think there would be any in this side of the course. I have done databases before in school, but we did it in a totally different order, starting with normalisation. Here you don't do the normalisation until the end. That seems really weird to me, and I find it really difficult to change round my methods.
I should pass the exam if I study enough. I'm not sure how I'll do in the programming exam though.

Do you get stressed by exams?
Yes, they really stress me out. I will get worried as they get closer. I have a couple of really important exams coming up, and I keep thinking that I will be fine as long as I just get through these ones. I'm aiming for D's on the whole, with the aim of pulling up my grades next term. I need to get G's in my computing exams in order to get my credits to pass the year.

What grades do you hope to get eventually?
I'm hoping that I'll get A's and B's. I haven't really been to many of the lectures in the first term. When I arrived at university, I just went with the flow, along with others who didn't seem to be doing much work either. I can be easily swayed by other people. I socialised too much, and now I've realised that I need to do a lot more if I want to get by.

Why do you think you are struggling in computing?
It just doesn't logically make sense to me. I don't know why I thought it would, as I've always had trouble with programming, even at school. It doesn't click in my head. I just think computing is not for me. I don't grasp it at all. I don't think any more study would have helped as I've put in a lot so far. It may have helped me to be less stressed though if I had studied earlier.

From your perspective, now that you are halfway through the course, what do you think is important to be good at computing science?
I think you either understand it or you don't. I think most people who know they aren't suited for computing just don't go near it. I was optimistic I suppose that it would be pitched at a low level. I am getting it in the lectures, and I don't think it's pitched *too* high, but I just don't understand it. I understand the concepts, but I can't apply them to programs. I don't see things in the same way as a computer scientist.

STUDENT 6
Interview 3
5/2/02

How did you get on with the CS1P lab exam?
It wasn't too bad. I did the program over the holidays, which took me ages, and then I learnt it parrot-fashion before the exam, which took about 5-6 hours. I just typed it out in the exam and was done in half an hour. It was probably a carbon copy of the one I had written beforehand. I think it could have been more concise, but it did what it had to do, so I was happy.

How about the class test for CS1P?
I definitely got the 15% I needed, and I answered all but one of the questions. I maybe even got a pass in that one. I don't think I did too badly. Overall for CS1P, I think I'll get a D grade, maybe even a C.

How was the CS1Q exam?
I really overestimated how much I knew for that one, and I ended up going out the night before, so I did hardly any revision for that one. I probably got less than 50%, but enough for my credits. The practical went OK though. I got 14/18 for the first part, and I haven't heard the results for my report yet.

And your other exams?
I'm reasonably confident about Management. I think I'll get an A/B overall. I'm really crossing my fingers for a D in History. That one didn't go as well as I had hoped.

You've decided to leave the course haven't you? In your own words, why is that?
I never intended to take computing past first year, and so I was wasting too much time on a course that wasn't important to me. The time I was spending really was a detriment to my other subjects. If I had worked at it, and spent even more time, I think I could have come out with better grades, but it would have just taken too long. I'm now taking Humanities Computing. They've thrown me in the deep end with that one, and I'm doing something I've never done before, but it should be alright.

STUDENT 7

Interview 1
21/11/01

Student 6 is 17, from Glasgow and lives with his/her parents. He/she studies Computing Science, Maths and Social Policy and intends to take a degree in single honours in Computing Science.

What is your previous computing experience?
I have a higher in Computing, and I spent a year working for IBM (last year) before attending university. I am very familiar with BASIC, Perl and C programming languages.

How are you finding the transition from school to university?
At university, you are not forced into studying and you must take more of a grown-up approach to studying, which many immature students on the course do not. It's now your choice whether you do the work, and you must find your own motivation. I like having more independence, and I find that although there is less contact with staff, they are quite approachable.

Are you socialising much within the university?
I'm a member of the gym and the Glasgow University Union. Computing Science and Maths are not very sociable courses, and students tend to keep themselves to themselves. However, it is easier to meet people on the Social Policy course. I do find it pretty easy to get on with other people.

How are you getting on with Level 1 Computing Science?
My attendance so far has been good and I study approximately 4 hours per week. I'm finding the course pretty easy so far, probably mostly due to the fact that I've done a fair amount of computing before. However, the Maths is more difficult. The pace of the programming lectures has been fine so far.

STUDENT 7
Interview 2
29/11/01

What do you think makes a good student?
Good students go to the lectures regularly, read over their notes and have a genuine interest in what they are studying. Computing Science students should have good problem solving skills, and should be generally 'on-the-ball' when it comes to programming.

What do you think makes a bad student?
A student who is not prepared to learn things quite quickly. It is important in computing to quickly get to grips with the software and hardware they need to use. Also, someone who doesn't work on their own outside of contact hours is not likely to do well.

How much time have you spent studying in the past week and what are your study habits?
I have been ill at home, and so have missed quite a few days of university, and haven't spent a lot of time studying. I am currently catching up on my HCI essay, and then intend to have a look at this weeks program. I think I'll catch up quite easily, as I tend to get the programs done reasonably quickly. I am fed up with programming though, as I'm bored of writing code that has no point to it, and is of no use. I don't tend to spend much time in front of the computers before the lab, as there is always a lab group coming in to use your machine.

How are you using the tutorials and labs?
To be honest, I don't ask for help very much, as there is somewhat of a language barrier between the tutor and the students, and the demonstrator doesn't seem to be of much help.

STUDENT 7
Interview 3 (by email)

What previous qualifications do you have and what grades did you get?

English	A
Maths	B
Geography	B
Biology	A
Computing	B

How much study did you do for these, and how did you study for them?
Studied a lot consistently throughout year then did none for about 3 months before exam, then crammed like crazy the night before.

Did you find them easy/difficult?
Most weren't too difficult.

Were you taught any study skills at school?
Few

How motivated were you, and how did you find your motivation to study?
I wasn't too motivated towards end of year, but I found motivation in the desire to do well.

Do you think your exam results were due to you just being good at the subject, or because of the study you put into them?
A little bit of both, but probably more natural ability due to lack of studying!

How motivated are you at university?
Not very

How important is it to get good grades this year?
It's important to pass and I'd like good grades but not essential.

What are your ambitions with this degree? Do you consider yourself to be an ambitious person?
I want to get a good final degree, and I can be ambitious if I find something that interests me enough.

Have you been taught any study skills at university?
No

How do you plan to study for computing science this year?
Practise and more practise with programming, reading up on lecture notes and research on internet and books for the others. I'm also using the Ada book for more info and ideas on programming.

How did you get on with last weeks assignment (the database)?
Reasonably well, but a few points need clarification. It was new and interesting.

How are you getting on with this weeks study pack and assignment?
Er... I'll do it tomorrow.... ;o)

STUDENT 7
Interview 4
8/2/02

How is the course going in general?
I'm getting on OK. I'll be honest. I didn't go to any of the lectures last week. I was very lazy. But, I have been attending this week and I'm actually enjoying the lectures. In CS1Q, we're covering a lot of the stuff that I like, assembly languages and so on, so it's good. The study packs have been fine. I'm just doing the Study Pack 7 assignment, which is no problem.

How did the CS1P exams go for you?
The lab exam was fine; I got full marks, which I'm very happy with. I tend to have a bit of trouble getting the plan out when I'm designing my programs, but once I have it, I have no trouble with the coding. I didn't do much preparation for the lab exam. Maybe a few hours. I just memorized the basic structure of the program, and then worked around that. The class test was fine too. I was a bit worried about it as I wasn't sure what I should revise, but I actually found it really easy. Again, I did maybe a few hours of revision for that test.

How were the CS1Q exams?
I missed the lab exam. I revised loads for the written one. It was really difficult to prepare for though. The notes are very basic, and it's hard to know actually what to do. I did reasonably (41%), though I'm not too happy with that result.

What about your other exams?
They are OK. There are no exams for Social Policy, just essays. I am still not enjoying maths, and can't wait to give it up at the end of the year. I'm not too sure how I did in the Maths exam, though I don't think I did too great.

Are you still intending to carry on with Computing Science?
Yes. I'm hoping still to do a single honours degree in Computing.

With hindsight, what do you think is important to do well at this course?
I think it totally depends on the individual. It's easier if you've got a numbers-brain rather than a words-brain, if you see what I mean. You also have to be quite motivated. It is a subject that can be learnt, but it helps if you have a natural ability for maths and numbers.

STUDENT 8

(self-predicted A/B grade)
Interview 1
20/11/01

Student 8 is 18 and is studying Computing Science, Maths and Business Management. Originally from China, he/she studied Highers in Scotland for a year and then chose to study at Glasgow University. He/she based this choice on the fact that Glasgow has a very good Computing Science Department, and intends to pursue a degree in Computing, possibly combined with Business. Student 8 lives in student halls.

What is your previous computing experience?
I've never studied computing before, although I have general skills such as word processing, Internet use, repairing my computer and so on.

How are you finding the transition from school to university?
There are big differences between Scottish schools and university. There is a greater workload, and more pressure to work on your own. However, the difference is not as large between my Chinese secondary education and university, where the workload and pressure is greater. Lectures are very different from school lessons, as lecturers just tell you what you need to know, and there is more need for you to go away and study it in your own time. There is greater responsibility on you to coordinate your own study, which puts more pressure on students, and students must find their own motivation to work. This is probably a very good thing. I like that I can choose my honours after two years, as this gives me the opportunity to study a variety of subjects to see which I prefer.

Are you socialising much within the university?
I don't really like living in student halls, and would prefer to be in a private flat. They are too small and it is hard to get access to the Internet on my own computer there. Halls may be a good place to meet a number of people, but that doesn't necessarily mean you'll have much in common with them or become good friends. It is hard to meet and become friends with other students in Computing Science, especially within the 1P (programming) module. However, I think that there is a greater need for communication between students in the HCI module.

How are you getting on with Level 1 Computing?
I've attended all the lectures and labs of Computing Science, as well as my other subjects, mostly because I think I would fall behind quite quickly if I missed any. The workload is Computing is good, but I would like to know where to find more exercises to practice my programming skills. There is lots of reading to do in Business Management, although not much work per se, but the workload is great in Maths, more than Computing. I like the structure of the Computing course, having two modules. I prefer the 1P course, as it has more of a basis in Maths, which is my strongest subject, although I am not sure what the aim of this course is. I would like to know what the programming was building up towards, and what complexity of code I'll be expected to program at the end of the year. There is a lot of pressure from other students in 1P, as there are many who have previously studied programming. It is disturbing when these students are noisy in lectures, and it makes me worry when they have completed assignments way before me. This makes me unsure if I am progressing well in the course, and would like more feedback to show how I compare to the rest of the year.

I enjoy the 1Q module, and it is much like a social science course, although I often have to spend more time studying than other students, as English is not my first language, and sometimes I don't understand the entire lecture.

STUDENT 8
Interview 2
27/11/01

What makes a good student in general) ?
A good student is intelligent, and is someone who has chosen a subject suitable to them. You are likely to do well at a course if it is something that you have a particular strength in, and even intelligent people can do badly at a course if they have not chosen wisely.

What makes a good computing science student?
A good computing student should firstly have an interest in computing science. For 1P, students should spend time practising their programming skills. This practise is more important than actually attending lectures. You should also spend time reading textbooks to 'exercise your brain.' For 1Q, it is important to do a lot of reading, and to keep up to date with what is going on in the computing world.

What makes a bad student?
Lazy students are bad students. They may be intelligent, but missing lectures and tutorials, as well as failing to hand in assignments makes someone more likely to fail at this course. Computing is a sequential course, continually building upon skills you have learnt earlier in the course, and so if you fall behind, it is difficult to catch up. Students who socialise too much are at risk of failing. There are also those bad students who copy from other people, just getting the answer to an assignment, without studying themselves. They are more likely to fail as they haven't gained the understanding for themselves.

How many hours of CS study have you done in the past week, and how was this spent?
About 8-10 hours in the last week, mostly spent on reading up on HCI in order to write my essay that was due in. I spent maybe 2 hours in the lab actually programming, but will spend more this week as an assessed exercise is due. I also spend time looking over my lecture notes, as these are a helpful reference for my assignments.

How are you getting on with this weeks assignment? (Study Pack 4- lottery program)
The lottery program looks difficult, as it is difficult to see the steps that are needed to get it working. It is more confusing than previous programs, and they don't really help me to get this one up and running. However, I am confident that I will get it working and handed in on time.

What are your habits when using the lab computers?
I firstly check my email, and then spend my time on AdaGide, playing with the programs. Distractions don't tend to bother me as the course isn't too stressful so far, although it becomes more stressful as deadlines approach.

What are your habits in the timetabled labs and tutorials?
I don't ask the tutor for help very often. I get the impression he hasn't looked at the program before the lab, and isn't sure himself how it is supposed to work. When I have asked for help, he has been reluctant to give me any answers, saying I need to work it out for myself. So, I tend to just get on with it on my own. I haven't noticed that there is a demonstrator present in labs, but think they would be of more help as they are also students.

STUDENT 8
Interview 3
4/12/01

What subjects did you study at Higher/A Level and what grades did you get?
I studied 5 highers.

Maths	A
Physics	A
Biology	B
Chemistry	B
English	A

The English was at Intermediate 2 level. My English wasn't great when I first came to Scotland, so I took a lower level to improve my language skills.

How difficult did you find these exams?
I found most of them quite easy really. I hadn't done any exams in China previously (I left for Scotland before I was due to take them), but I didn't have much trouble. Biology was quite hard though. This was a new subject to me.

How did you study for these subjects at school?
We weren't taught any study skills as such. For Physics and Maths, I found that if I understood the work in class and I practised everyday what I was learning, and then I didn't have any problems when it came to exams. I could always get past papers from the teachers if I wanted more practise.
Biology and Chemistry were different. I found these subjects difficult, as there were many English words and descriptions that I didn't understand, like the names of the elements. For example, I had to read a lot of books, and used the Internet a lot in my study. My English improved quickly over the course of the year. I made sure I practised a lot, and read often.

Do you find this language barrier is a problem in Computing Science?
Sometimes I get stuck, but my English is a lot better now, so it doesn't cause me too many problems. I find often that where an English-speaker will take a few words to describe something, it may take me two or three sentences.

Have you been taught any study skills at university, and do you use them?
I have been to a drop-in study learning class a few times, which teaches you how to learn. I haven't found these very useful though, and I don't really have the time to go anymore anyway. I already know methods of how to study as my father taught me these a long time ago.

What was your motivation to study like at school?
I was very motivated at school. My intention was always to go to a British university and study computing, so I needed to work hard to get the grades. For example, Reading University required me to get 3 A's and 2 B's, which I did get in the end, but I wasn't sure I would. It just so happened I finally decided on Glasgow, which only required 4 B's.

Do you have this same motivation at university?
I'm still motivated, but not as much as at school, and not much at all for Business Management. I like Maths and Computing Science is my major, so I put pressure on myself to work for these subjects.

Do you have much pressure from your parents to work?
Not really. They know I put pressure on myself, and they know I'm motivated to work, so they leave me to it. It was their decision to move me to a British school though. I did have some say in it, and I am enjoying university over here, but I didn't really like coming to school on my own, especially as my English skills weren't great when I arrived. It has made me more independent and mature though, for example, I did all my University applications on my own, without help from anyone else, and I think this has been a great benefit to me.

What are your ambitions? What do you intend to do with your computing degree?
I wouldn't mind owning my own company. I guess that's why I'm studying business management.
I would also like to join a big international company, perhaps designing for Windows or Linux. I'm interested in international IT as well as the future of mobile phones. I wouldn't say I'm particularly a very ambitious person though.

How do you plan to study for your end of year computing science exams?
I'm not sure at the moment. I don't think they'll be too difficult, as long as I keep up as I go along.
I think 1Q will involve a lot of reading from textbooks, and I expect I'll use the Internet a lot too.
I think 1P (programming) is much more of a practical course though, and you just need practise rather than textbook study. I think that someone could do well in the exam by practise alone and no bookwork.

How did you get on with last weeks assignment? (the lottery program)
Not as well as I had hoped. I managed to get the program to draw the balls on the screen OK, but I had difficulty checking whether I had duplicate numbers. [*This was a common problem last week. It involved using arrays, the first complex data structure students had been introduced to, and a number of students found them difficult*].
I figured it out later though, after the lab, and it seems easy when you see the answers!

How are you getting on with this weeks' assignment? (1Q- databases)
We haven't had the work yet. I'm expecting we'll be using Microsoft Access. We've been making ER (Entity-Relationship) diagrams so far, and I think this week, we'll be making tables and relationships. I think it should be quite easy this week.

STUDENT 8
Interview 4
8/1/02

How have you been getting on with your assignments?
I'm finishing off my databases assignment today. They are going OK though.

Have you done much preparation for your practical exam next week?
I haven't done any yet. I've been spending a lot of time getting a report done for Business Management which is due today. I haven't had much chance to do much work over Christmas either. It shouldn't be too bad though. The program is given to you in advance, and it doesn't seem too difficult. I'll start it this week and make sure I have it memorised for the exam. I'm confident enough that I'll do well.

How about the HCI & databases exam?
I'm not so sure about that exam. They are written exams so I'll need to do more study for them. I've forgotten a lot of the HCI course, so I should start working soon. I think it may be quite difficult to do in an exam. Programming is the most difficult part of the course, but there is more to memorise in HCI. HCI is just common sense mostly.

Do you tend to get stressed about exams?
I have done a lot of exams and tests in China, so I'm pretty much used to it now. There were less exams and tests when I was studying at Aberdeen. I still get a little bit nervous, especially if I'm not very good at the subject. The Maths is OK. I'll just practise and I'll do fine. I have no idea how to study for Business Management. There is so much to know, so many chapters to memorise. In fact, there's too much. I guess I'll just systematically go through things.

From your perspective, now that you are halfway through the course, what do you think is important to be good at computing science?
I think that you've got to have an interest in programming to do well. Myself, I get excited when I get the answer right and my program works! The main thing is doing lots of practise. It is not difficult, but you do need to go to the lectures regularly. I think that I have talent when it comes to computing, but that isn't the most important thing involved. You really have to take an interest and do a lot of self-study. For HCI, you must follow the textbook. You really have to read something. In databases, you should read the notes and follow them step-by-step. You should practice and memorise.

How difficult do you think level 1 computing is?
It is average. It is difficult to get into it, but once you have the general concepts, such as loops, strings and arrays, it becomes a lot easier. Motivation and previous computing experience are the most important things to do well at computing.

STUDENT 8
Interview 5
8/2/02

How did you get on with the CS1P lab exam?
That went really well. I got full marks.

How did you prepare for the exam? Did you memorise the program?
I didn't do much preparation, maybe 5-6 hours. I understood it, so I did well. I didn't memorise it, I just knew how to do it in my head. The program I did in the exam was actually different from the original one I wrote beforehand.

How did the CS1P class test go?
That went well too. I got 66%. I didn't do much revision for that either. I did all the study packs as I went through the course, so I understood the course, and didn't need to revise much. I did do some preparation though.

And how about CS1Q?
The lab exam was fine (the databases stuff). I got full marks for that too. I did maybe 3-4 hours work. It was quite easy really.
I think I did badly in the CS1Q class test though. I haven't had my result but I think maybe I got 12 or 13%. I think I just revised the wrong stuff for that exam. There were a lot of chapters to cover.

What about your other subjects?
I haven't had the results back for those yet. I think they went OK, but I'm not sure about Business Management. I just hope I haven't failed that one.

So, are you intending to carry on with Computing Science?
Yes. I think I'll go on to second year, with the intention of doing a single honours in Computing Science.

How are you getting on with the current assignments?
OK. I only started Study Pack 7 in the lab this week though, so I didn't quite manage to get the second part of the assignment done. This term is definitely harder than the last, but I'm doing fine.

So, are you confident about the final exams coming up in June for Computing?
Yeah, they should be fine. CS1P will be alright, and so will the lab exam for CS1Q, although I'm not sure about the CS1Q written exam. I'll have to spend more time on that.

STUDENT 9

(self-predicted B/C grade)
Interview 1
20/11/01

Student 9 is aged 18, and is studying Computing Science, Maths and Exploring the Cosmos. His/her intended degree is a single honours BSc in Computing Science. He/she is from the outskirts of Glasgow and lives with his/her parents.

What is your previous computing experience?
I studied Advanced Higher Computing at school. There are big differences between this and first year Computing at Glasgow University. Although I have studied HCI, this is the first time I have been asked to apply HCI techniques in my work. I learnt BASIC-programming language at higher, and this is very different from Ada 95. Ada is more difficult, although I'm sure that I'll get better at is once I get my head around the basic concepts.

How are you finding the transition from school to university?
There are big differences between school and university. There is no teacher now telling you what to do, and I like having more responsibility for my studies. However, there is now much less contact with staff members, and I think that the course would be better if it was somewhere in between.

Are you socialising much within the university?
I attended freshers week, and joined one society, although I have never been to any of their meetings! It is very easy to meet people in Computing Science, and it's much more of a social course than my other Level 1 subjects. I regularly meet up with students on my course, as well as friends from school.

How are you getting on with Level 1 Computing?
I am very happy to be studying Computing Science at Glasgow University. I've encountered a few problems with the programming, but I am confident that I will be able to sort them out. I probably do about 5-6 hours of self-study each week on computing, and that will probably increase as the course progresses. Computing has already become the course that requires most of my time, and it as the foremost course of my subjects. The feedback on assignments is good, and helps me to see how I am progressing.

STUDENT 9

Interview 2
27/11/01

What makes a good student in general?
Someone who tries hard, can cope with the stress of the course and doesn't overload by working too much. It is important to study outside of contact hours, and this studying should be continual throughout the year rather than cramming for exams.

What makes a good computing science student?
Someone who spends a lot of time in the lab, and practises their programming skills regularly. It is important also to have a logical mind, so that you can identify the steps that are necessary to build a program.

What makes a bad student?
A bad student is someone who misses a lot of lectures and does not hand in assignments.

How many hours of CS study have you done in the past week, and how was this spent?
About 4 hours, spent looking back over lecture notes. This helps to get a better understanding of lecture material. I've also spent time at the lab computers programming.

How are you getting on with this weeks assignment? (Study Pack 4- lottery program)
This looks a lot more difficult than previous programming assignments, as you're not really told the steps involved to get your program working. It is quite overwhelming, and I have no idea how to get started on it. I will have to spend time in the lab looking at it before this week's timetabled laboratory.

What are your habits when using the lab computers?
I first check my email, and then start working my way through the study pack with AdaGide. I try to finish all the exercises in the study pack, even the ones that are not handed in. New emails coming in are likely to distract me from working, and I will stop working, read my mail and then go back to programming. I spend time looking at university websites, especially lecturers pages, to see if there is any additional information on the lectures.

What are your habits of using PRS in the lectures?
I don't find PRS very useful, and think the system is of greater benefit to lecturers than students. It sometimes gets in the way, and disturbs the lectures when you have to dig through your bag to find your handset mid-lecture. There are a few programming-based questions, which are helpful in testing your understanding of the lecture, and I think it would be more helpful to students if there were more of these questions.

STUDENT 9

Interview 3 (by email)
18/02/02

Student 9 decided to leave university in January 2002. The following interview was conducted by email.

Why was it you chose to leave university? Did it have anything to do with the computing course or any of your other courses?
I didn't feel completely comfortable in the course but thought that everyone felt that way and it would be a passing faze, but I realised that the only time I was happy was when I wasn't at uni or doing work for it. I didn't like it at all. I loved computing at school but the course work was nothing like my definition of computing at all and there was too much programming. I spoke to my advisor who told me that my two options were to stick with the course or leave, so I left.

Were there any other factors involved (financial, other commitments etc)?
Not really no. My mum said she was willing to support me through university.

How were you getting on academically with computing? (Were you finding it difficult/easy? Did you need to study a lot/not much? Were you understanding the course material?)
I could understand the course work fine as long as I could stay awake long enough it hear the lecturers. I didn't really have to study although I could have put more effort into the projects for the tutorials, but because of my lack of interest I didn't try as hard as I could have.

How were you getting on with your other courses?
They were fine. Maths, although being my most hated subject at school, was the one I was doing best in. I quite enjoyed it, put a lot of effort in to it, and did well. Exploring the Cosmos was very boring. Not the subject probably just the lecturers, but it made it very hard to listen especially when they gave you printed notes for the lectures anyway, making it harder to study and therefore I didn't really do too well in the tests. I passed them but not too well which is completely unlike me. I always tries my hardest in academic subjects.

Did you socialise much with university friends?
Yeah I made quite a few friends and also knew quite a lot from school, so I met up with people before lectures, arranged nights out and although I didn't have a lunch time as my lectures always ran later, I still managed to meet people for something to eat during any free time I had.

What have you chosen to do instead of university? (What are your plans for the next year or so, and do you intend to return to further education at all?)
I don't think I will return to further education because I can't find any other courses that interest me. Right now I have two part-time jobs and am looking for full time employment until I figure out what I want to do.

What would have made you stay on at uni, and is there anything the Computing Dept. could have done to help you stay? (e.g. more academic help)
I don't think so. Better course work and less programming would have been the only thing. If I had been offered more choices then maybe I would have stayed.

What were your study habits for computing science? (i.e. how often and how much study were you doing? Did you work at all with other students on the course?)
I didn't study with others and unfortunately I only studied when I needed to because of a test or there was course work to be handed in because of my lack of interest. The only subject I did more work for was maths because I wanted to please my tutor and I enjoyed it more.

How prepared did you feel for University life?
Completely! I was really looking forward to uni more than any of my friends which is why it was such a big shock for them when I left. I didn't feel old enough to go at the end of 5th year but about 6months later I couldn't wait to go.

Did you feel integrated within the university (socially and academically)?
Yes the uni make a lot of effort to get the students involved in as many clubs or union events as possible. Just joining your chosen union made you feel included.