



UNIVERSITY
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University of Glasgow
Department of Computing Science
CS1P Case Study Report



**transforming
assessment**

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Overview

The level 1 Computing Science course consists of two lectures per week, one two hour labs and a one hour tutorial every fortnight (one in each week). Labs and tutorials are divided into groups of around 10-15.

Drivers for Change

Learning to program involves taking many steps up a ladder. Missing any one of these steps often precludes further progress up the ladder, and can lead to lowered motivation at best, total withdrawal at worst. Programming cannot be learned by reading or hearing about it. It must be experienced through the practical activities of (a) problem solving, (b) coding, and (c) debugging. It is hard to define exactly what the click-into-place factor is but like many skills/understandings, the components of programming tend to click into place. Before this, they are a total mystery, afterwards it is hard to understand where the problem was. It takes different students different amounts of time to reach the click point on any particular topic. In past years, lecturers have often delivered significant amounts of material before the students have worked with any of it. Because of the stepwise *and* experiential nature of programming learning, students are unlikely to be able to engage with or understand new material when they haven't had a chance to practically work with, and embed understanding of, the material of the last lecture.

Aims of intervention

The click-into-place factor means that learners can be completely halted in the learning process quite easily, with no clear vision of how they could help themselves to overcome the hurdle. Frequent opportunities, probably more often than weekly, to get formative feedback are required to ensure forward progress. Making progress in programming is usually very rewarding, because programs work on the screen, whereas being stuck with no available strategies for forward progress is conversely very demoralising. *Who* should provide the formative feedback is an interesting question. It may well not be best for the original deliverer of the material to try again, since they were unsuccessful the first time. Thus undergraduates who have recently taken the course may be closest in experience to the learners, and hence best able to offer insight into their problems. The current intervention was designed to increase student engagement and in turn enhance performance and progression rates.

Method

The traditional bi-weekly lectures and rotating fortnightly tutorials and labs were replaced with one weekly lecture and one large group tutorial (LGT) with a two hr lab in between, every week. Feedback from tutors was used to shape the LGT session. A tick system was introduced for completion of weekly exercises amounting to a total of three ticks per week. These could be completed/awarded at any time during semester in which they're given but two-thirds was required to be completed in each semester. A free programming project (FPP) was introduced for each semester in order to give the students additional ownership. Students were actively encouraged to help each other more after the mid semester 1 test to enhance exposure to assessment format.

Summative assessment

Consisted of two programming exams and three written exams



- Class Test 1 in Wk 6 Semester 1 (5%) introduced students to the style of written exam to make students aware early that ability to program at a machine is only a necessary condition of doing well at this course, not a sufficient one.
- Lab Exam 1 at the end of semester 1 (10%) was a seen programming problem. Students could prepare a solution in advance, in their own time, but could not bring any record of it with them into the exam hall or lab. They had to then reproduce their solution and get it working on a machine. This tested coding and debugging skills, not problem solving skills (which are tested in the written exams).
- Class Test 2 in the semester 1 exam period in January (15%) provided further practice with written exam style
- Lab Exam 2 at the end of semester 2 was the same style as the first lab exam.
- Degree/terminal exam (60%) had a similar structure to the two class tests.

Evaluation Methodology

Qualitative data was gained from 42 students in a staff/student review session at the end of the first term conducted by course leader Quintin Cutts and from 5 students at a consultation pyramid discussion session conducted by Christine Sinclair, Centre for Academic Practice and Learning Enhancement, University of Strathclyde. Quantitative data was collated from the REAP Assessment Feedback Experience Questionnaire (AFEQ) and a small questionnaire, which was distributed to students at the end of semester 1.

Course redesign in relation to David Nicol's 7 Principles of good feedback practice & Gibbs & Simpson's first 4 conditions of good assessment practice

Principle 1: Helps clarify what good performance is (goals, criteria, expected standards)

In terms of linking proximal and distal goals, although there had been no direct provision of this in the current redesign, the course leader did express an interest in incorporating this into future iterations of the course. Regarding criteria provided in lectures, the changes had resulted in some compromise to the provision of exemplars. Quintin explained,

I think for me there is a really delicate balance between showing the students things and that being one way of learning, so watching me solve a problem being a demonstration and using the contact time for discussion to get them to do things and talk about feedback. I don't know where the balance lies but I find that two hours a week just isn't enough.

It was difficult to provide students with a clear idea of standards in relation to their regular exercises, as Quintin explained,

I think one of the weakest parts of the design was the fact that we had this set of exercises that the students would do each week and there were three ticks associated with each part, so they got a tick for getting each part of the work completed. The intention was, with the recognition that students worked at different rates that the students could complete these at any time and in any order so if they missed a bit they can go back to it later. That was really founded on the firm judgement that programming is based on step-wise learning and it's fatal if you miss a step so if you do miss a step, you've got to go back and get it. You can't carry on without going back. However the difficulty with that

was that we couldn't really put model solutions up at any point, which is one way of them seeing what they are heading for, because obviously they could hand them in right up to the end of the semester. The tutors didn't like that either because they had to start off each tutorial lab with a different section, saying 'well I can see you are having trouble with this' without telling them how to do it. So I think there needs to be a redesign around that aspect.

However students were provided with at least a couple of clear opportunities to become familiar with the expected standard for subsequent assessments. The early semester 1 class test aimed to introduce the principal style of assessment to the students and to reinforce the information that students had been given about expected standards in the assessments. Quintin elaborated,

We tried to give them some idea of what to expect in the final assessment because we had a class test at week 6 and at week 13, so that was to try to give them a heads up on how they were going to be assessed.

Student perspective

On the whole, students appeared to be fairly happy with the provisions of criteria. Results from the Student Assessment and Feedback Experience Questionnaire (AFEQ) revealed that the large majority of respondents (81%) felt that it had been clear to them what the tasks required (*Figure 1A*) and 63% agreed that the criteria used in marking had been clear in advance compared to just 16% who disagreed (*Figure 1B*). 83% of the respondents felt that their understanding of how to do the tasks came from the teaching staff although a slightly higher 89% indicated that their understanding came from working it out themselves (*Figure 1C*).

Figure 1A: Student AFEQ responses to clarity of tasks

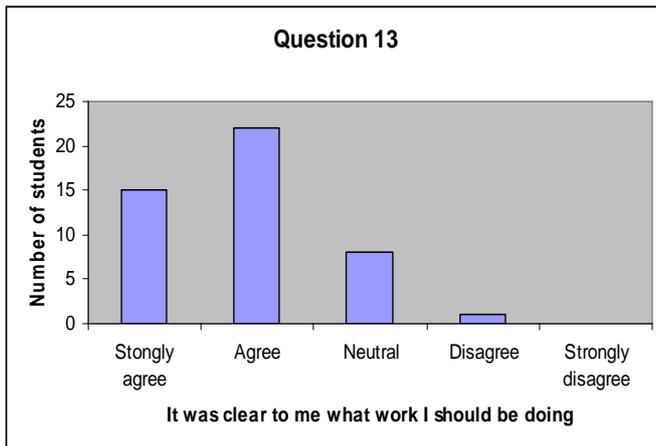


Figure 1B: Student AFEQ responses to clarity of marking criteria in advance

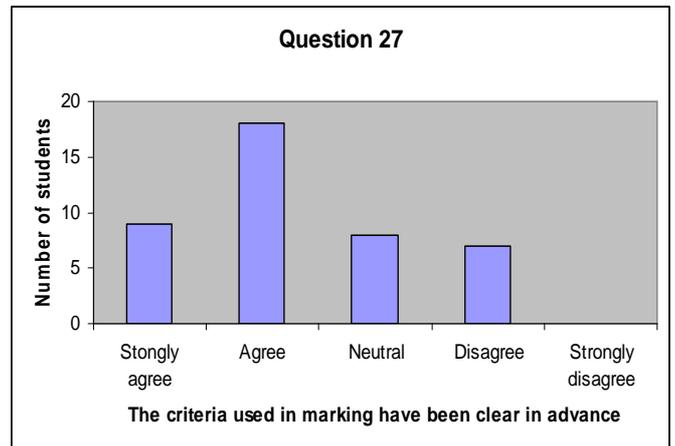
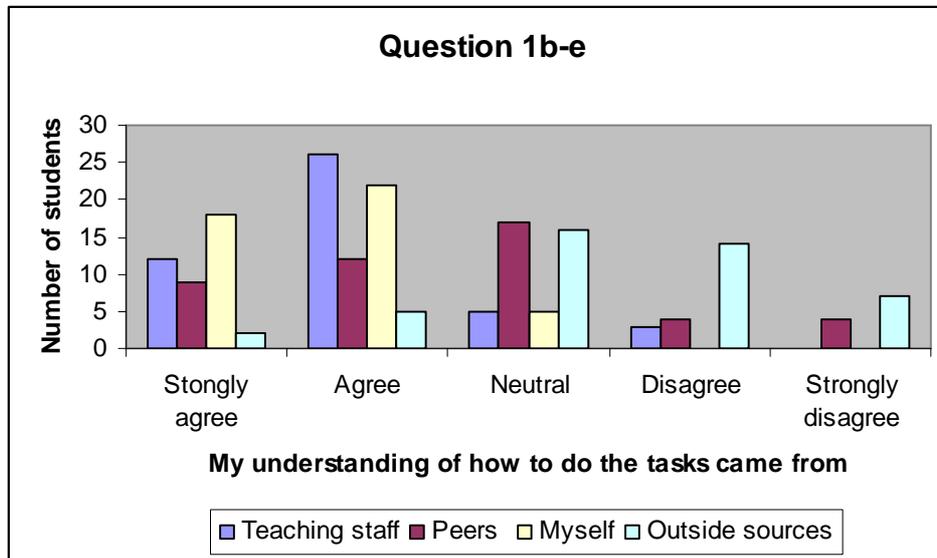


Figure 1C : Student AFEQ responses regarding the most valuable sources of understanding**Principle 2: Facilitates the development of self-assessment (reflection in learning)**

Because of the nature of the discipline, if a programme is working for a computing science student, self-assessment is a natural consequence of the process thus providing the students with more opportunities to work at the programming while receiving immediate feedback facilitates a rich opportunity for enhanced self-assessment. Furthermore as Quintin outlined,

They definitely have more time to reflect at the large group tutorial as they are hopefully talking to each other about the questions and reflecting on them then so that's certainly going to be a reflection point. I think in general people have found them useful.

Student/Tutor Perspective on Self-assessment in the group task process

AFEQ responses suggested that 85% of the students understood how to improve their work after finishing a task (Figure 2A). As expected, knowledge of how students could improve their work in the future primarily came from working it out themselves (80%) compared to 69% from teaching staff and 46% from peers (Figure 2B). 59% of the students expressed confidence in being able to predict their own performance in tasks with 30% feeling unsure and 11% indicating that they were not confident in doing this (Figure 2C). A comparatively high 61% considered their performance on tasks to have been to a high standard with 22% opting for the neutral option and 17% who felt that their work had not been of a high quality (Figure 2D). However it is worth noting that since only approximately a third of the class responded to the questionnaire, which was distributed at the final lecture, it may be that only the more motivated student's opinions have really been captured here.



Figure 2A: Student AFEQ responses regarding their understanding of improvement techniques

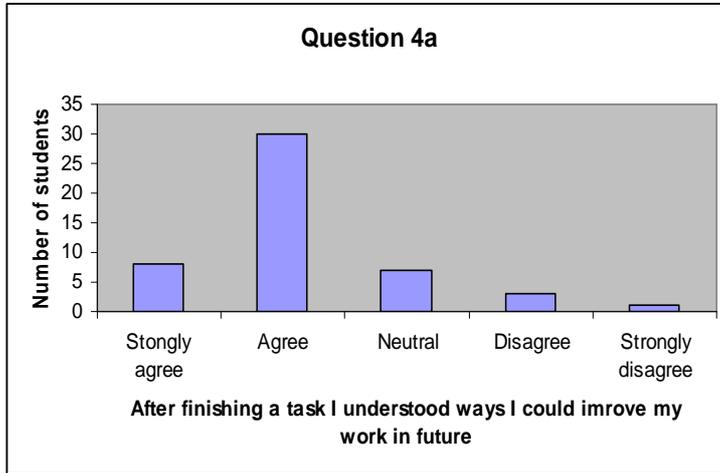


Figure 2B: Student AFEQ responses regarding where their understanding came from

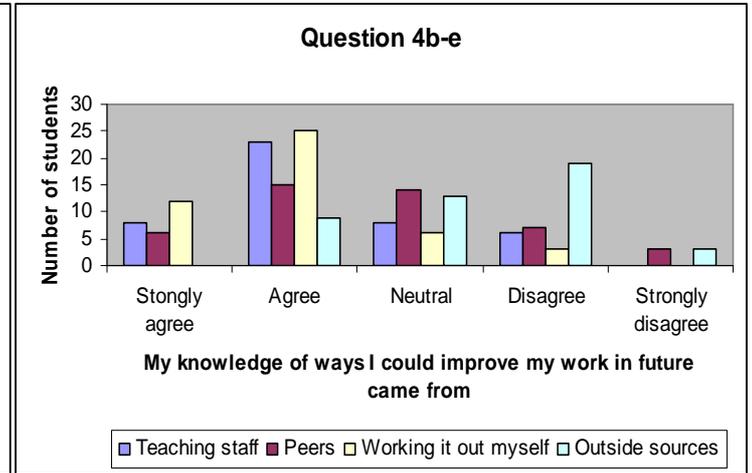


Figure 2C: Student AFEQ responses to their ability to self-assess their performance on tasks

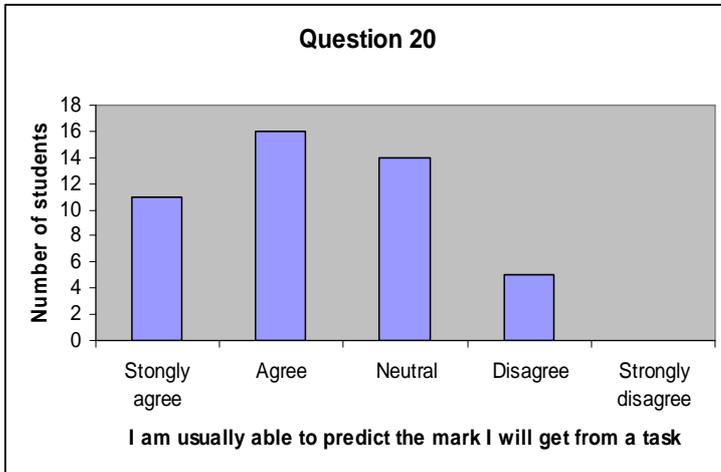
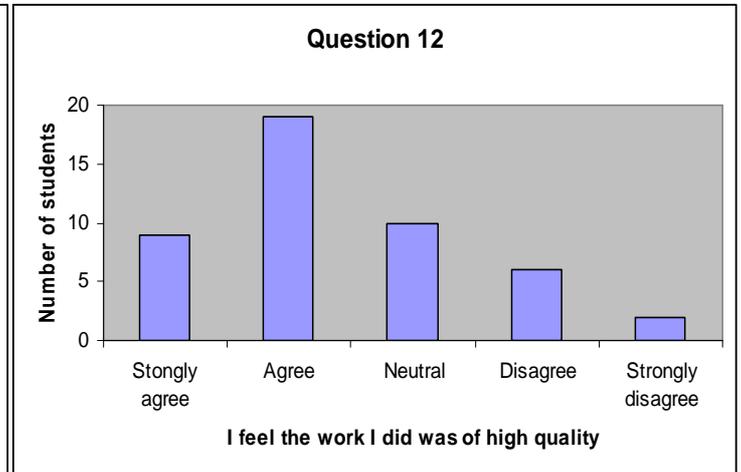


Figure 2D: Student AFEQ responses to their self-assessment of the quality of their work



Principle 3: Delivers high quality information to students about their learning

Early feedback was available from handset questions in both the lecture and the LGT. Students were encouraged to make the link between incorrect answers to handset questions in the lecture, and remedial avenues. For the lecture, this was really extra insistence that they should do the practice work for that cycle before the LGT. If they were experiencing difficulties after the LGT, then they were encouraged to talk to their tutor about it at the next lab session. The tutors would



talk to the students in the lab about their completed exercises, providing a source of feedback. In addition, the tutors used written feedback and a “common errors” tick sheet to provide feedback to the students on their submissions. However this process was not without problems, as Quintin pointed out,

I didn't get the impression that the students objected to the tick exercises but I get the feeling that the tutors are not as happy because they are not getting something in every two weeks and then handing it back. You know there is something really concrete about that as a tutor, you know you have poured over their programme, you have made comments on it, a few or many and handed it back.

Quintin further pointed out that the idea was that the tutors would have more face-to-face time with students and less marking time this year but that it could be difficult to give a student good feedback while they are actually working on a machine. Although one would expect students to be able to best engage with immediate feedback, unless they record it in writing, it may well be lost. It is also difficult for tutors to identify problems on-screen at the time of providing the feedback. However the students did have substantial opportunity for individual verbal feedback. Quintin elaborated,

They are getting feedback once they have done the tick but of course in the whole 2 hour lab at any time they can put their hand up so there will be feedback all the time if they get stuck. They get feedback on the class test and the lab exam.

Some generic feedback was provided after the first class test with regard to student's comparative performance in relation to the class average.

Student Perspective on Tutor Feedback

The majority of students in the staff/ student feedback session found the class test to be very useful. Most students found the instant feedback to be advantageous to extremely valuable, with only around two percent finding discussion of answers no better than marks returned individually on paper. Most of the students considered the comments to be better than in previously written feedback, with many students indicating that it was much better. The class majority (just over half) expressed that they considered it to be very useful to be able to see the class average and most of the remaining students thought that it was quite good. Some students suggested that there could be more elaboration on discussion of the concepts or more problem solving incorporated into the test, but the most significant factors highlighted for improving the tests was an increased awareness of the time factor and a need for more regular practice and feedback on these types of exercises. Some attention was drawn to handset problems such as uncertainty about having voted for the answer of their choice. The main advantages pinpointed by students were the promotion of informal peer support and discussion, gauging one's performance relative to peers and having the opportunity to receive instant feedback. The main disadvantages or challenges were expressed as being time management and uncertainty or unease about correct usage of handsets or in voting accuracy. Open ended responses from the review session after the class tests included the comment,

Initial worries about whether answers would register or not, however it was easy to use and the immediate feedback was very useful.

Good getting immediate feedback on how you did, rather than waiting a week etc.

A lot better than I thought it was going to be (This idea of changing previous answers by having to delete subsequent ones sounded like a nightmare). Instant feedback also good. Saves marking time too.

It was good to see how the class did as a whole.

I think that it is very useful. Instant feedback is always nice and it allows for more interaction regarding answers on the test

Results from the class questionnaire revealed that 33% of respondents felt that receiving and discussing generic feedback on the class test using EVS was more advantageous than having answers marked and returned individually, while 28.6% felt that it was significantly better and 21.4% felt that this kind of feedback was extremely valuable. 14.3% felt that it was slightly useful while only 2.4% did not find it any more beneficial (Figure 3A). 42.9% of the respondents considered the explanations and comments to be more useful and 31% felt them to be much more useful than individual written feedback while 23.8% regarded them as being just the same. Only 2.4% considered them to be a bit less useful (Figure 3B). 52.4% of the respondents felt that it was important to see the class averages, although only 7.1% indicated that it was extremely important. 33.3% felt that it was quite good while 4.8% felt that it was only slightly important and 2.4% indicated that it had not been important at all (Figure 3C).

Question 2:

How does this method of having the whole classes' answers discussed as a group and face to face compare to having your answers marked and returned on paper individually:-

Figure 3A: Is it quicker? Does it matter to you?

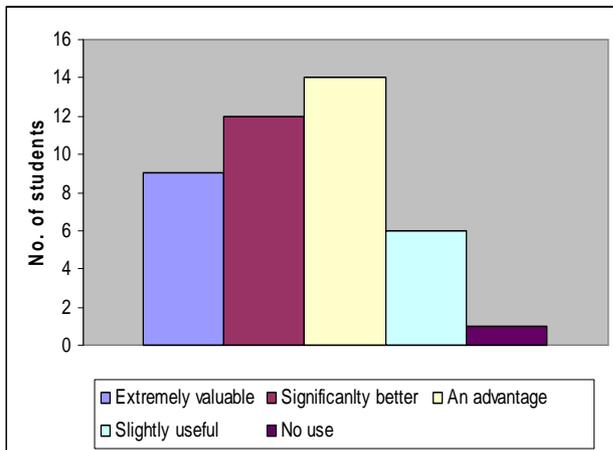


Figure 3B: Are the explanations and comments more useful?

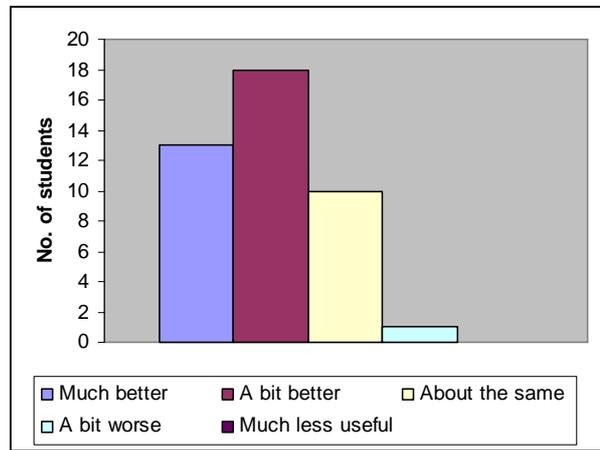
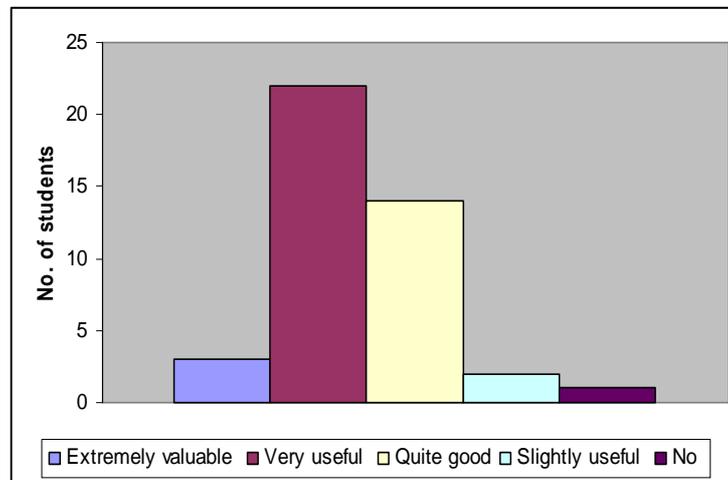


Figure 3C: Is seeing how the class did on average for each question important?



AFEQ responses indicated that 63% of respondents found that the teaching staff had given them helpful feedback on their progress compared to 11% who disagreed (*Figure 3D*); similarly 63% felt that they had a clear performance of how they had performed on the task (*Figure 3E*); 84% agreed that the feedback had been prompt (*Figure 3F*) but only 37% felt that it had been detailed (*Figure 3G*). However 67% felt that the feedback that they had been given had helped them to clarify things that they did not understand (*Figure 3H*). Despite this, while 80% considered their understanding of their performance on tasks to have come from the teaching staff, a slightly higher 85% felt that it had come from their own knowledge (*Figure 3i*). Students tended to seek help equally from teaching staff and peers with 49% of the responses for each (*Figure 3J*). Finally students indicated that when they got information on the course, it primarily told them, how much effort they needed to put into the course (83%); their performance relative to other students (62%); their strong and weak points (62%); whether they were suited to studying that subject (61%) and information about the correct or expected answer (58%) but interestingly, less (40%) about where to get information about the correct or expected answer. This is somewhat surprising in light of the availability of the tutors during the lab time and may indicate more about the student's lack of endeavour to approach staff for help rather than a lack of availability of help. This is reinforced by the results that suggest that students rely on their own reflections of problems and on help from peers as much if not more in some cases than on expert help.



Figure 3D: Student AFEQ responses regarding accessibility to staff feedback

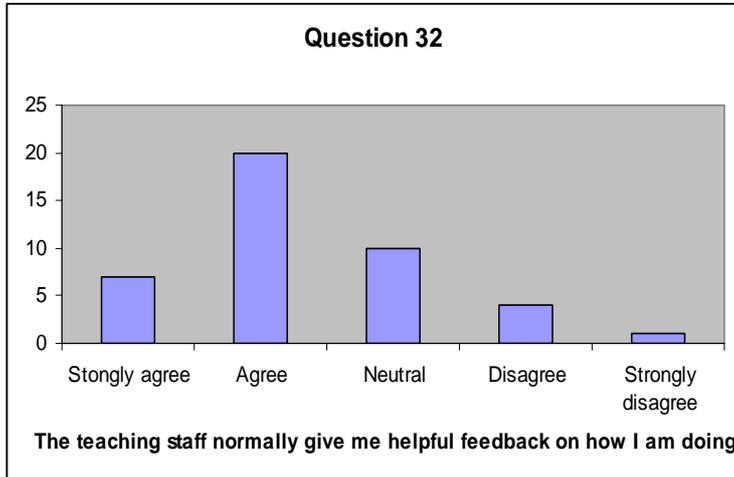


Figure 3E: Student AFEQ responses regarding clarity of feedback on tasks

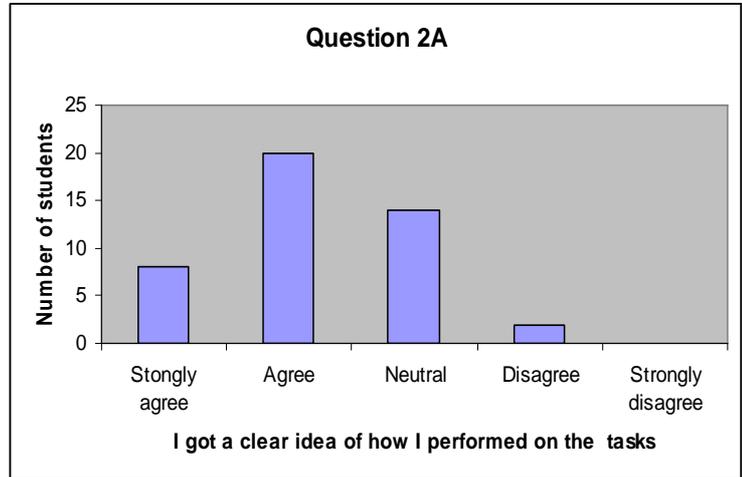


Figure 3F: Student AFEQ responses regarding timeliness of feedback

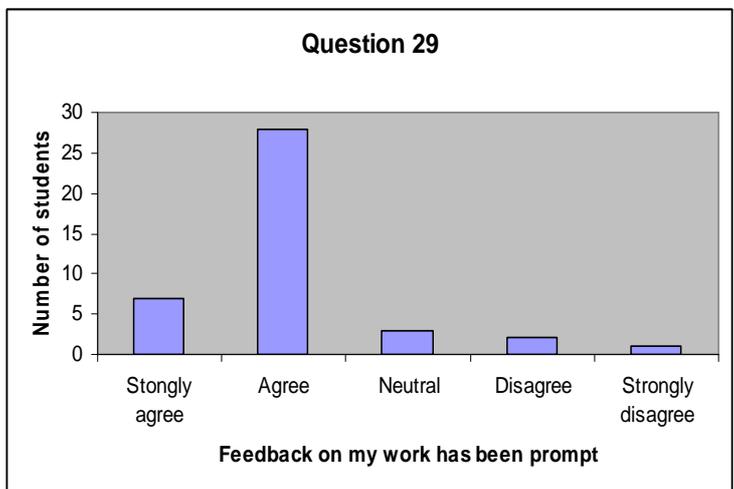


Figure 3G: Student AFEQ responses regarding degree of feedback

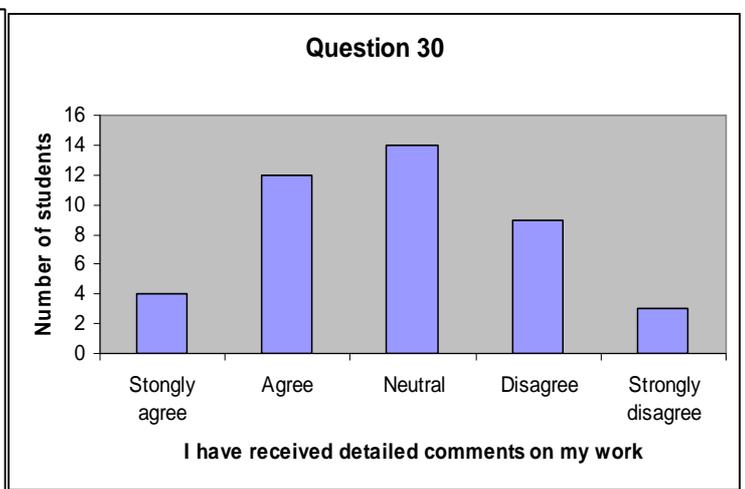


Figure 3H: Student AFEQ responses regarding the ability of feedback to clarify problems

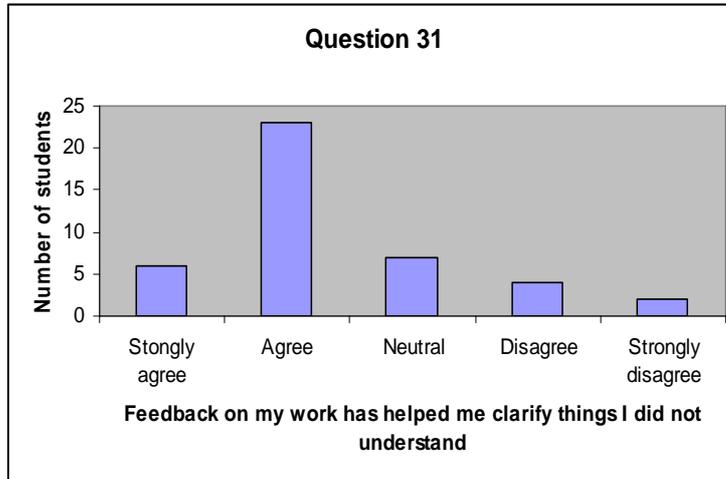


Figure 3i: Student AFEQ responses regarding where understanding of feedback on tasks came from

Figure 3J: Student AFEQ responses regarding where they seek feedback from

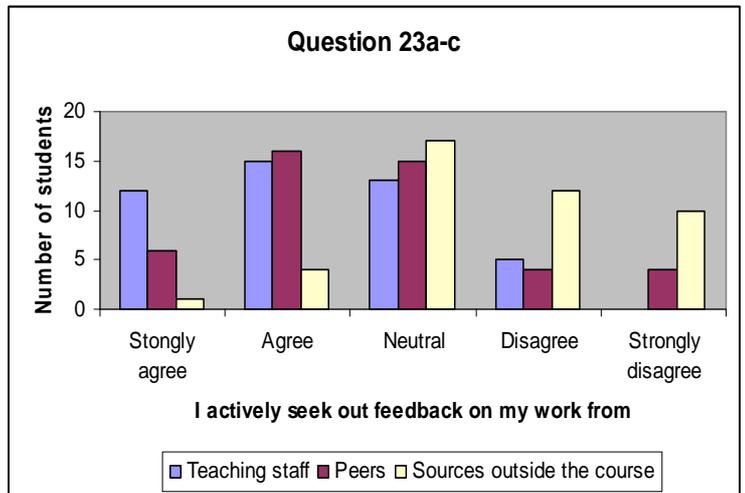
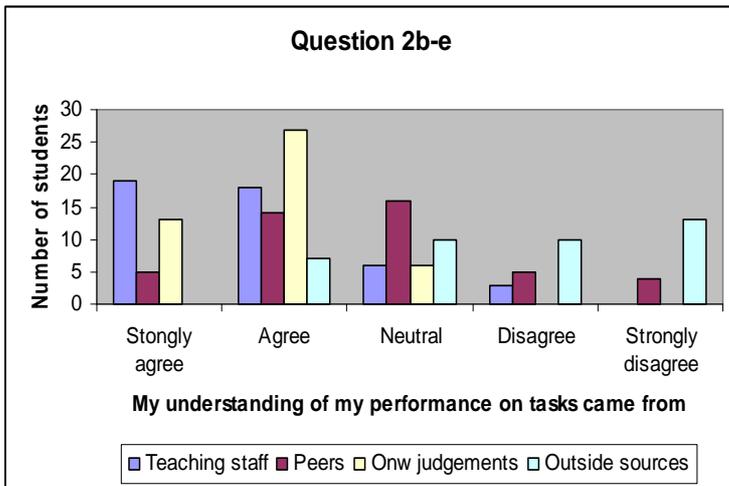
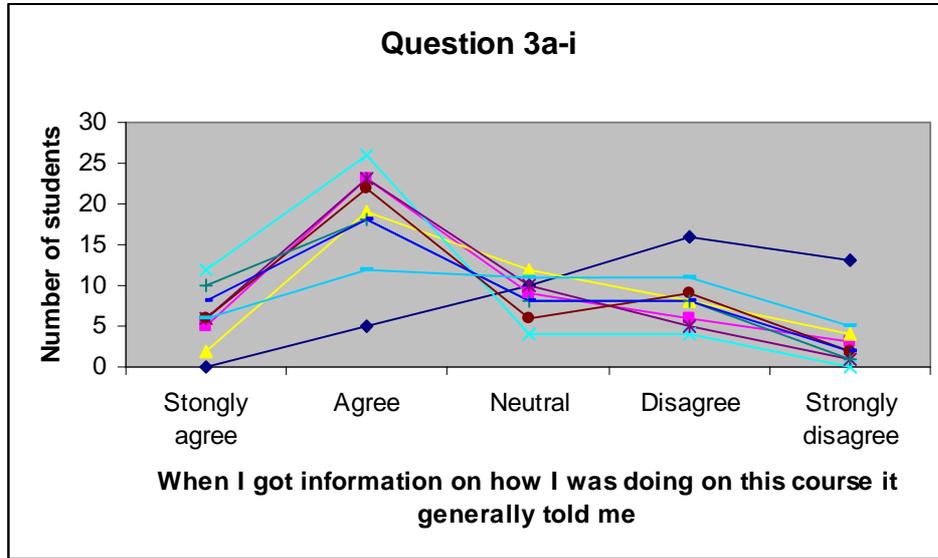


Figure 3H: Student AFEQ responses to what feedback generally told students about their learning



- Nothing useful
- Whether I was suited to studying this subject
- About my personal qualities
- How much effort I needed to put into this course
- What changes I had to make to my techniques for doing that particular task
- How well I had performed relative to other students
- What was strong and weak in the work that I produced
- Information about the correct or expected answer
- Where to go to find information about the correct or expected answer

Principle 4: Encourages teacher and peer dialogue around learning

Tutor/peer discussions

EVS voting handsets were used in lectures to increase engagement and promote discussion. Although initial plans to use confidence ratings were not in practice fully developed, the use of EVS was considered by the lecturer to be instrumental in enhancing the quality of active learning in class. As he put it,

I did suggest that the students used confidence ratings for EVS but I have not been effective at using them in front of the class. I tried to get them to discuss the last question again. We had some good discussions, there is no doubt that some of those questions generated good discussions.

Student Perspective

Results from the Pyramid discussion revealed that students found the labs and EVS to be particularly useful. Comments included,

PRS/handheld keeps you in lecture.



Exercises online are good if they are kept up to date.

However the discussions in the Wednesday lectures (LGTs) were considered by the students to be much more constructive in the first than in the second semester. Students expressed their desire for more feedback from the tutor to the lecturer about problems encountered in the labs as had been the case in the first semester. Student AFEQ responses revealed that 74% of respondents understood what doing a task well was on this course (Figure 4A) and again that the understanding came fairly equally from teaching staff (75%), peers (70%) and themselves (72%) (figure 4B). However 57% of the students expressed a desire for more discussion to accompany tutor feedback in particular (Figure 4C).

Figure 4A: Student AFEQ responses regarding student understanding of what doing a task well involved

Figure 4B: Student AFEQ responses regarding where their understanding came from

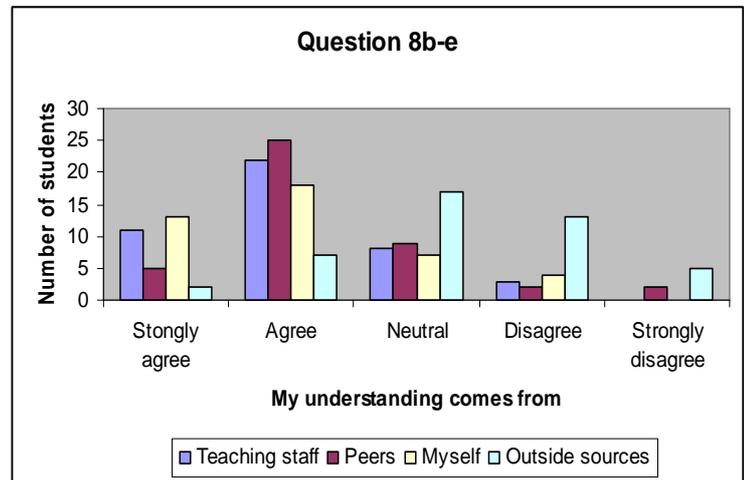
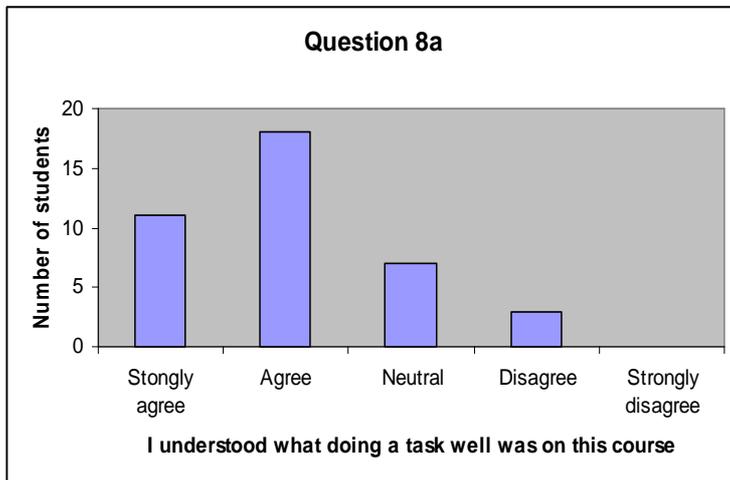
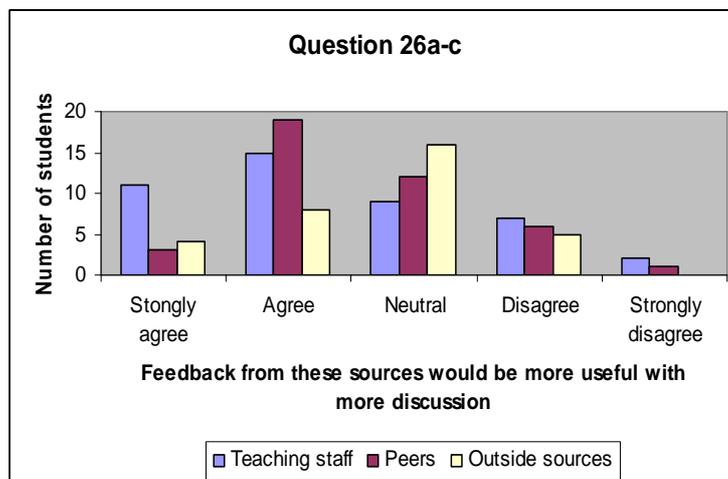


Figure 4C: Student AFEQ responses to whether feedback would be more useful with discussion





Principle 5: Encourages positive motivational beliefs and self esteem

Self-regulation

The students had more of an opportunity to be autonomous learners with staff assisting them than in previous formats where the lecture delivery was more transmissive. As Quintin elaborated,

They are getting more contact time one to one, probably less contact time as a group to one. If you have got a class with 15 students in it as some of our tutors have, that's 8 minutes per student. In a week it's not very much time and I always wanted to get little curtains that you could draw round the machines so that you could sequester them off but still address them as a group and that's not so easy to do when the whole lab is open. So in a sense they are getting less time with the lecturer as a leader doing things at the front showing them and they are getting less time with their tutor as a leader of the group at the front. I am more of a facilitator than I used to be a lecturer and the tutors tend to be facilitators as well. There's less of that focus of the tutor leading as the expert, although they are still walking round so there is still the expert there.

Course ownership

FPPs, which students have two opportunities to develop were designed to enhance ownership and engagement. Although the exercises associated with the Units would ideally be completed by the students in the week shown, students could complete them at any time up to the end of the semester to compensate for students moving at different rates and for illness etc. Specific time was built into the curriculum to allow for students to catch up if they fell behind, in an attempt to ensure that the ongoing lectures remained relevant to most students. At these times that the FPP could be worked on by students who were already up to speed. The FPP was formally introduced in week 7, after the students have sat their first class test. After six weeks of working on the projects at different rates, students can make the choice whether to catch up on earlier material or work on the project. Neither the exercises nor the FPP go towards the student's final mark, however they must complete two-thirds of these to gain any credit for the module. Students could complete the second FPP the following semester but completion was optional and depended on the motivation of each student.

Of 157 students, 97 submitted a specification document for FPP1. Randomly sampling 20 submissions shows that 13 of these had running programs, and so extrapolating to the whole class suggests that around 65, or 40%, of the cohort completed the exercise. Whilst not high, this is in line with an on-going observation that between 30-40% of students achieve highly in introductory programming, and hence it seems likely that the weaker students may have been concentrating on the earlier exercises, and that these 65 students were up-to-date with their exercises. The tasks are mostly games, e.g. Connect 4, blackjack, hangman, with a small number of alternatives such as an encryption/decryption program or a foreign language vocabulary learner. In FPP2, only 41 students submitted at least a specification, and again, around two-thirds of these had running programs, so only around 20% of the whole class. The tasks tended to be more ambitious and with full graphical interface. Examples are a gene sequencer, internet relay chat, maze game similar to Pacman, and an mp3 file organiser. These are products of the best programmers in the class.

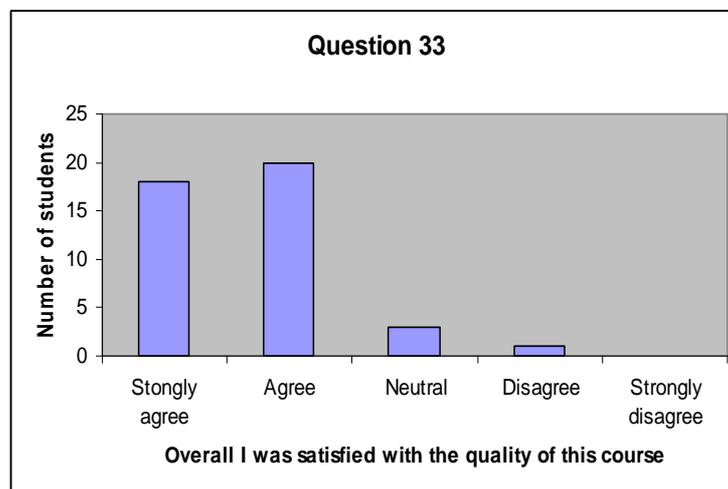
Student perspective

It is clear from the aforementioned results that students were being fairly autonomous in terms of relying on their own reflections to progress their work but how effective this was in questionable to some extent as the students did appear to have difficulty with becoming stuck and still felt unsure about how best to progress their knowledge in order to solve the problem in hand. This may have been a de-motivating factor for the students to some extent. There are no specific responses available regarding students' evaluations of the FFPs but it appears that students at least in semester 1 had a fairly positive reaction to the lecture style, as Quintin noted,

They seem quite engaged in the lectures. They seem to enjoy the large group sessions.

AFEQ results indicated that overall 89% of the students were satisfied with the quality of the course (Figure 5).

Figure 5: Student AFEQ responses indicating overall student satisfaction



Principle 6: Provides opportunities to close the gap between current and desired performance

Cycle of learning activities

The students had preparation work to do for the lab session, which could be done away from a machine, and was designed to take around an hour. The emphasis in this practice work was to encourage students to attempt to solve problems and write programs *away* from a machine. The lab session was a mix of a tutorial and laboratory session. The session started in a tutorial room, and the tutor may have gone over any aspect of the course, of work handed in, etc, that he/she felt would be of benefit to the whole group. Students then moved on to the laboratory, where they could continue working on the *practical exercise schedule* – and during this time, the tutor had an opportunity to speak to students one-to-one about their progress. There were three practical exercises/activities/tasks per week, clumped in fortnightly sections, with typically the first week's exercises being more preparatory/easy in nature, and the second week's exercises building towards a larger programming problem to be solved. Hence in total, the practical side of the course consisted of around 60-70 programming tasks. Each of the exercises had an away-from-



the-machine component and an at-the-machine component. The former formed the *prep for lab sessions* material. The sequence of activities described above formed one cycle, which was completed before the next content-introducing lecture, and so the lecturer could assume that all students should have had an opportunity to work with the concepts of the previous cycle before going on to the next cycle. It was hoped that this would shorten the length of the learning cycle. As Quintin outlined,

With all the questions that I ask with EVS, there should be a bank of questions they can move onto if they've failed that one and the exercises are graded in the sense that they are moving through the course material because it's step-wise, one leads to the next but everything moves forward towards the exam.

Student perspective

Students in the Pyramid discussion considered the labs to be a rich opportunity for practice between tasks. As one student commented,

The weekly lab problems are well designed, giving practices on specific areas to help learning.

However, while students appeared to enjoy the opportunity to have designated practice sessions as well as the typical cycle of learning activities and expressed a desire to have been offered more of these types of opportunities. Students in the staff/students feedback session indicated that they felt that they would benefit from the opportunity for more practice tests using EVS, with comments including.

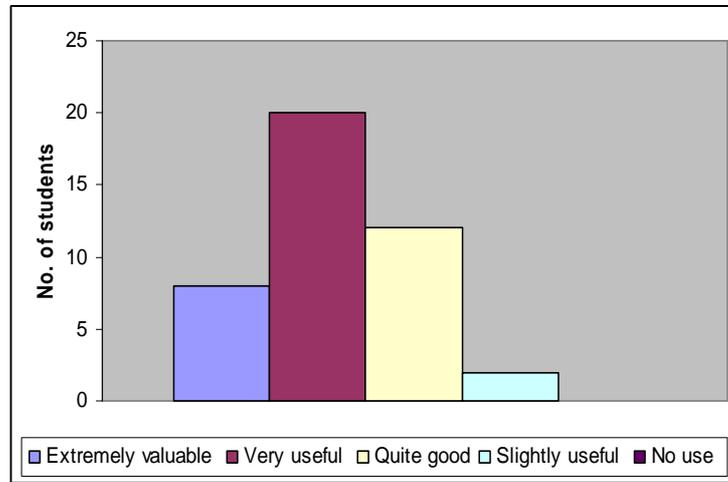
I feel that this is a very good way of doing a test. The ability to instantly get your mark and discuss it is extremely helpful. Good to see how everyone did, gives you a sense of how well you are coping compared to others.

We need to have it more often, this will develop a competitive environment among ourselves. Very important for future assignments.

Important having such tests more frequently for the review of the workload target throughout the semester

Feedback on the small questionnaire distributed to students at the end of semester 1 revealed that the majority of students found the test to be very beneficial for their learning. 47.6% of the students who were interviewed by staff indicated that the experience of doing the class test had been very useful for their learning while 19% felt that it had been extremely valuable. 28% felt that it had been quite good while only 4.8% considered that it had been only slightly useful. None of the students considered it to have been a waste of time (*Figure 6A*).

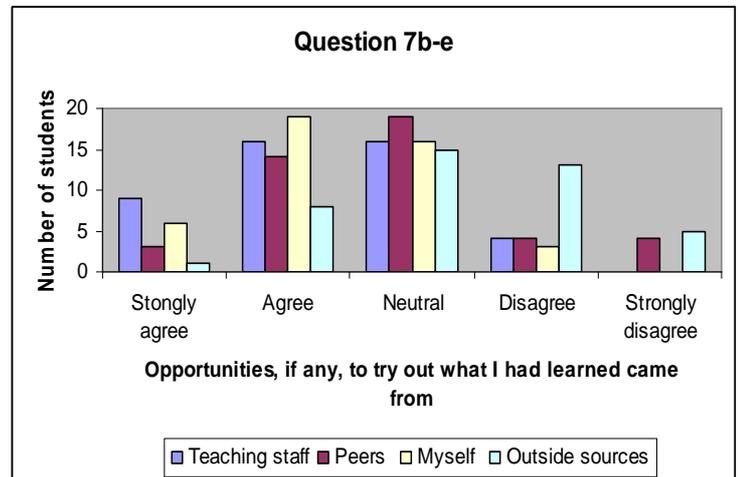
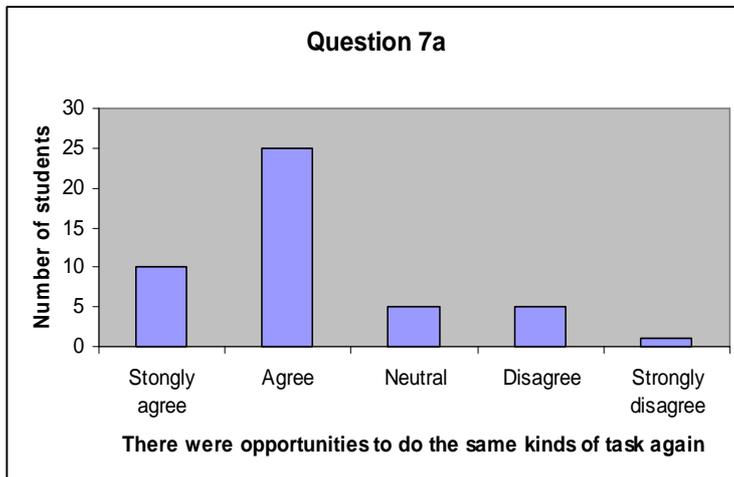
Figure 6A: (Question 2) How valuable for you was doing this class test?



AFEQ results revealed that 76% of the students felt that they had been given opportunities to do the same kind of tasks again and 55% considered the teaching staff to have provided them with the opportunity to try out what they had learned (Figure 6B), although an equal 55% also thought that these opportunities had been enabled by their own efforts (Figure 6C), which reinforces earlier findings regarding student autonomy.

Figure 6B: Student AFEQ responses regarding the opportunities available to build on skills

Figure 6C: Student AFEQ responses regarding where such opportunities came from





Principle 7: Provides information that can be used to help and shape the teaching

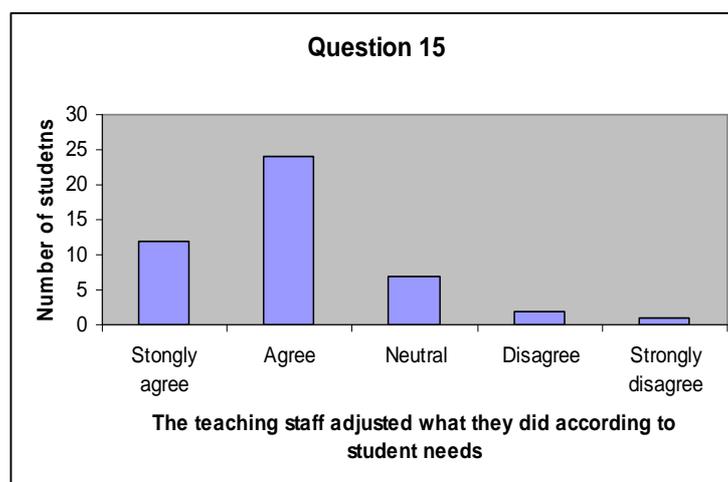
Use of handsets in lectures provided feedback directly to the lecturer. On the basis of questionnaire/focus group feedback from students, it seems that handset responses in the first lecture of the cycle need not be taken too seriously. However, the second lecture session, or large group tutorial, aims to check their understanding of concepts with which they have had more time to become acquainted. Both collated and individualised handset responses were passed on to tutors, to be used to direct their interactions with their tutorial/lab group. If a tutor's entire lab group got a question wrong, and the lecturer considered on reflection that it was a fair question, the tutor could choose to work with the whole group on that topic. Where individuals are getting particular questions wrong, the tutor could work with them individually during the lab session.

Regular tutor meetings were held, which the entire course team were expected to attend. This session was part reflection, part forward-looking to the subsequent week's work. It gave the team members the opportunity to learn from one another's experiences, and to ensure that the tutors' actions are at least reasonably in line with the goals of the course leaders. However, over the duration of the course it became apparent just how important the feedback from the tutors was and it was noted that different lecturers gave different weighting to this process resulting in a somewhat mixed experience over semesters for the students. Quintin described how he would routinely send a mail round on a Tuesday afternoon after most of the labs had been completed inviting tutors to submit comments about what they found difficult in the lab sessions. He generally did receive a few responses but considered the possibility of sending a similar invitation to students in the future. He was also keen to introduce the implementation of an on-line forum to supplement the LGTs since the students had demonstrated a willingness to discuss problems with peers in the lab.

Student Perspective

Despite concerns over tutor variability across semesters, AFEQ responses suggested that in general 78% of the students thought that the teaching staff had used feedback from the students to adjust their teaching accordingly (*Figure 7*).

Student perspective on staff action on feedback



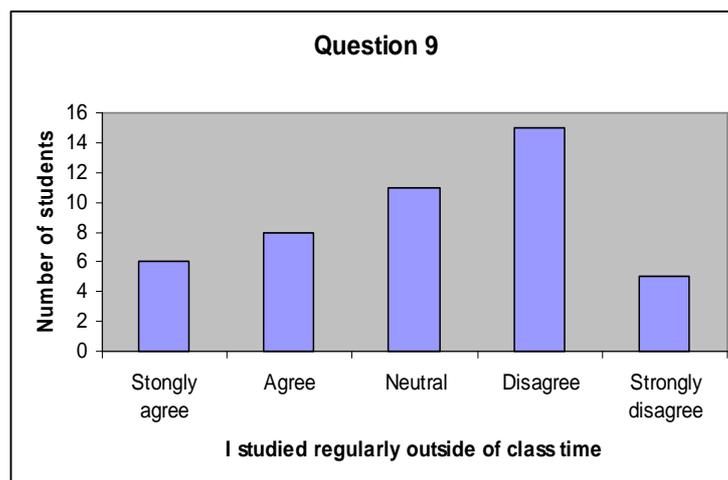
Condition 1: Sufficient assessed tasks are provided for students to capture sufficient study time

Paper and pencil exercises provided students with the opportunity work anywhere and in their own time, thereby offering them increased flexibility and helping them to distribute their study effort evenly across the duration of the course and engage with the concepts of the lecture. The exercises were designed to take no longer than 30-45 minutes, which is the typical time that may be available if a student has an hour break between lectures, or during a train journey into the university. If students wished to, they could try the material of the questions out at a machine, but this was not intended to be essential.

Student perspective

Notwithstanding the provision of the regular exercises, AFEQ responses suggested that only 30% of the students questioned had regularly studied outside of class time while 44% stated that they had not (Figure 8), although it was not clear that they were referring to doing the exercises or additional study.

Figure 8: Student AFEQ responses regarding student study time out of class



Condition 2: These tasks are engaged with by students orienting them to allocate appropriate amounts of time and effort to the most important aspects of the course

Although staff described some concerns over being unable to cover all of their prepared material in the lecture, there were more opportunities available to students to work regularly on problems and therefore to spread their efforts out more evenly across the year. As Quintin illustrated,

I feel I am able to cover less but then in a Wednesday large group tutorial, I was usually finishing it by saying go and read this in a book ready for the Friday lecture when I introduce the stuff... You don't learn programming by watching but having said that they are missing out on watching me solve problems and there were things that perhaps I might liked to have talked about that I didn't really have time to.

However on balance Quintin explained that really it was more important for the students to have time to work on the problems than hear about them even though it could be frustrating not to always have time to expand fully on the material.

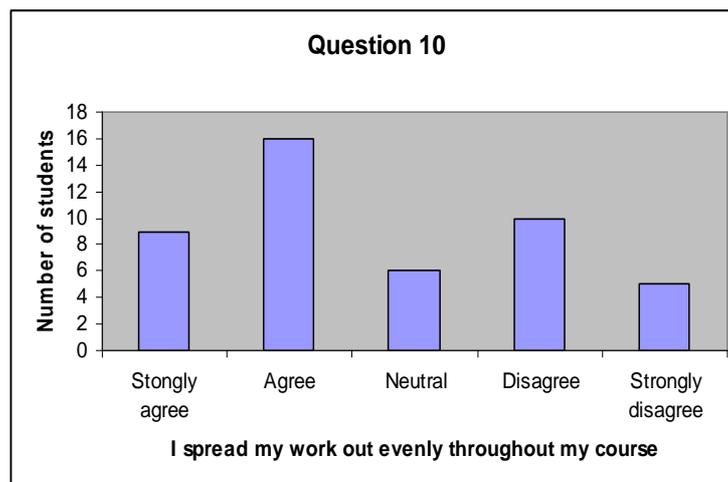
Well you see what's more important, that I cover all the material I want to by saying it? Or that they go away and try and try it out and do some work and the tutors tell me what they are having trouble with and I actually cover that in the large group tutorial? The second one seems more important in a way because it's such a practical subject.

Concerns were also raised regarding the structure of the paper and pencil exercises. One tutor noted that usually a student would complain that they spent all their time doing computing at the expense of other subjects because of the compulsory fortnightly hand-ins, which was required for their course completion, whereas after the changes to the course, the situation had reversed so that course work from other subjects was often given priority over the computing coursework.

Student/Tutor perspective on distribution of time on task

Despite tutor concerns, student AFEQ responses indicated that 55% of the students considered that they had spread their work evenly over the course (*Figure 9*). This reinforces Quintin's assertions that having more opportunities to do the practical work may have more benefits than simply covering more material as it helps students to regulate their learning. It also suggests that the low rate of agreement in figure 9 that the students did regularly study outside of class time is likely to have referred to additional studies over and above that of the structures exercises.

Figure 9: Student AFEQ responses regarding the spread of work throughout the year



Condition 3: Tackling the assessed task engages students in productive learning activity of an appropriate kind

The large group tutorials covered material from current and previous weeks, and was based on the Mazur model of peer instruction, with class-wide instruction/interaction also inevitably used. Handsets were used to record students' answers. The expectation was that the students would have engaged with the material covered, through the pencil and paper exercises and through previous weeks' lab exercises. The questions were therefore designed to work with the students' deeper understanding of the concepts.

Student Perspective on matching task to learning materials and appropriate study

Students in the Pyramid discussion indicated that they felt that they engaged in the appropriate tasks during the labs but that this was not as well integrated into the rest of the course as they would have liked. AFEQ responses revealed that 68% of the students also considered the assessments to measure the kind of learning that they should (*Figure 10A*). 63% of the respondents generally understood rather than memorised the material compared to 11% who disagreed (*Figure 10B*) although 60 % of the students indicated that their work had been held up a lot by not being able to understand something (*Figure 10C*). Thus it appears that while the cycle of learning activities and the assessments were constructive in facilitating a deeper understanding for students, again it seems that the main problem lies with what action students take when they do get stuck with a problem. This problem has been prevalent throughout the students' responses and was identified as a prime motivator for the initial redesign. Thus it appears that while the redesign has gone some way to aiding students to progress on the course, the bottleneck problem of understanding has not been effectively remedied at this stage.

Figure 10A: Student AFEQ responses regarding match between assessment and learning

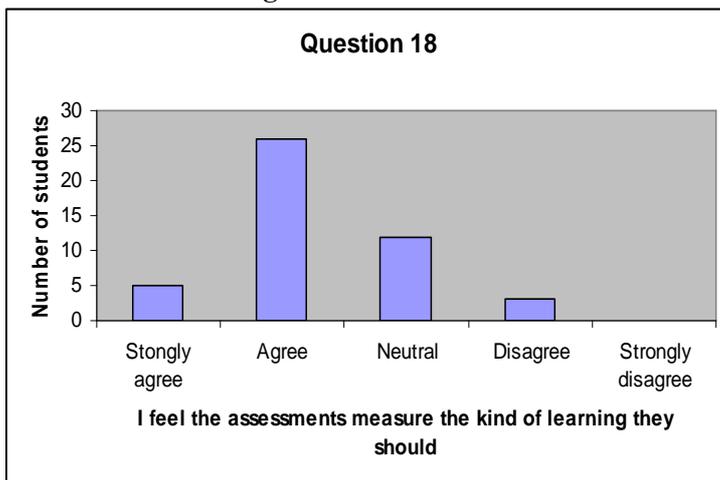


Figure 10B: Student AFEQ responses regarding level of learning

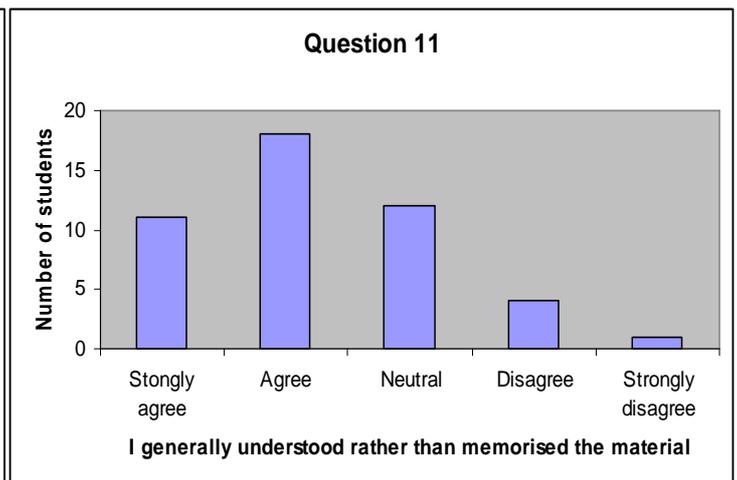
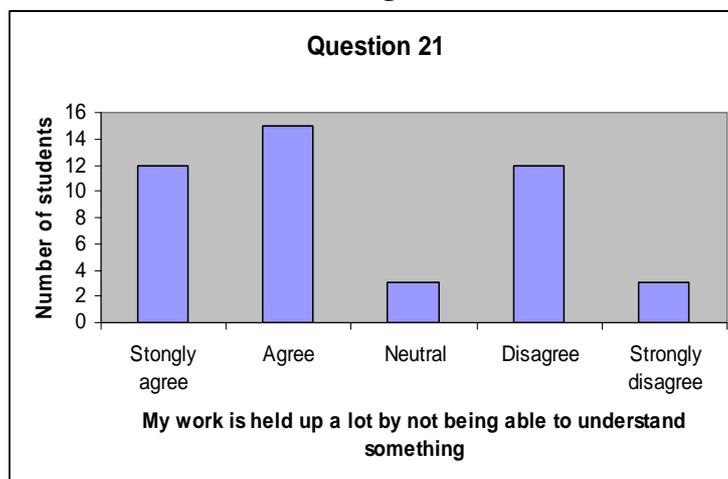


Figure 10C: Student AFEQ responses regarding disruption to learning by poor understanding of material



Condition 4: Assessment communicates clear and high expectations

The opportunities for practice assessments conveyed the appropriate standard of performance that would be required for the students and for the students who completed all of these, the system appeared to work well, as Quintin noted,

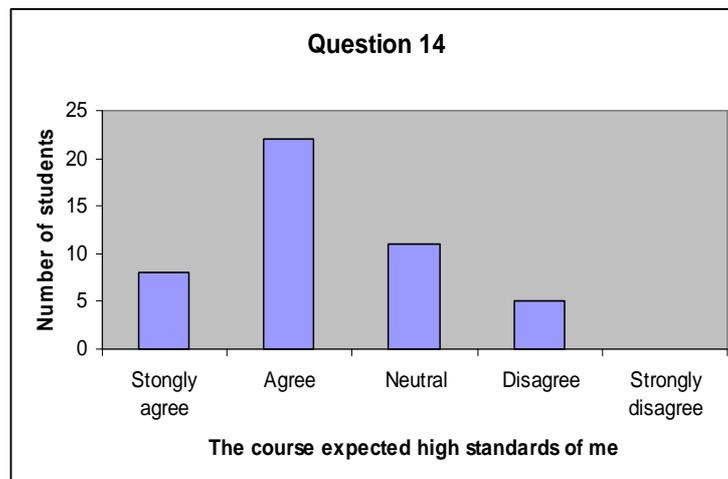
The students who stuck it out until the end of term, I thought did quite well in the lab exam.

However there was an issue regarding students who did not adhere to the course requirements in terms of time and effort and there was a feeling that these students were more difficult to track in terms of their perceived expectation and performance.

Student perspective of standards expected of them

AFEQ responses suggest that 65% of the students who responded considered the course to have expected high standards of them (*Figure 11*). However, student responses from the Pyramid discussion reflect the difficulties experienced by some of the students on the course. One commented that one difficulty had been that they had not been ‘warned about level expected’. It was suggested that staff should ‘warn people about different experience levels or restrict it to people with appropriate experience’.

Figure 11: Student AFEQ responses regarding the expectations of the course



Formal evaluation outcomes

Staff time on task

There has been a direct saving in staff marking time, as Quintin explained,

Tutors have 4 hours of contact time every week rather than 3 hours but in most cases they have less paper based marking, but where previously they would be guaranteed to have a hand-in every fortnight, now depending on how well their students are doing if they got their ticks then and there, there would be no paperwork to do at all.



Limitations

The current tick system was not working as effectively as hoped as by enabling students to have the liberty to submit the exercises at the end meant that they did not always distribute their efforts as evenly as if they were required to submit on a regular basis. They also suffered from a reduction in feedback in some cases as a result because of the difficulties of giving instant feedback for problems being worked on at the machines.

Sustainability

The tick system as it had been structured for the current term was not considered to be pedagogically sustainable in its present form. From the perspective of staff turnover, it was felt that although changes to the course structure were made fairly independently of the department, as long as Quintin could articulate the changes that he had made and their anticipated value, there was no reason why another lecturer could not offer students a similar experience. The changes were also thought to be reasonably sustainable in terms of technical support because although the support that was available for the initial period of the redesign was to be withdrawn, staff were competent enough to deal with any technical issues that may arise.

Institutional support

There was strong departmental support for the changes with support staff devising an on-line system on the departmental database for monitoring the tick format.

Future progress and strategic development

Future plans included a revision of the tick system in order to simplify the process. The importance of catching students very early in the process before they had a chance to fall behind too much was also noted and plans to discuss methods of encouraging early reflection were expected to take place before then next session. There was also some discussion about focussing more on active learning through concentrating more on the exercises than concepts since the exam is based on doing actual exercises rather than concepts and because by actively engaging more with exercises, students may ultimately gain a greater grasp of the concepts underlying them.

Dissemination

A paper on the Free Programming Project was written and presented at conference jointly with the University of Durham and staff attended learning and teaching conferences, which provides an opportunity for informal dissemination.

Conclusion

Results from the Student Assessment and Feedback Experience Questionnaire suggested that students were generally satisfied with the overall course. They felt that criteria for tasks had been clear and that their understanding came both from teaching staff and from their own reflection on the tasks. Most of the students felt that primarily through their own reflection on their work they had a good idea of how to improve their future performance and generally felt quite confident about this and about the quality of the work they produced. Impressions were that the teaching staff had provided them with helpful, prompt feedback and that they had been able to gain a clear



idea of their performance, although the feedback was not considered to be particularly detailed. However feedback generally helped them to clarify the learning material although their understanding of their performance came as much from their own reflection as from the staff feedback and many tended to seek feedback from peers as often as from staff. This pattern of learning through reflection fits well with Quintin's assertions about the most beneficial learning design for the students being one which offers them increased opportunities to actively practice the practical work rather than passively listen to the concepts. Information on the course generally alerted students to adjustments they needed to make in terms of effort in light of their performance relative to their peers, their strengths and weaknesses and information about the correct answers but not information about where to obtain information about where to get those answers. Students generally felt that they understood what doing a task well entailed and that this understanding came equally from staff, peers and themselves but they suggested that when provided with feedback, they would benefit from more discussion.

The class test in the first semester was considered by the students asked to be a very beneficial experience in terms of practice and they generally felt that they had been given opportunities to do the same kind of tasks again whether through structured opportunities or through their own efforts. The instant feedback on the test was highlighted during discussions as being extremely valuable and generally preferable to the traditional written feedback. Students particularly enjoyed the peer discussion afterwards and the opportunity to see the class averages. AFEQ respondents also expressed their belief that the teaching staff adjusted their delivery of material based upon the needs of the students, who felt that they had been able to spread their study efforts evenly throughout the year. Although the assessments were thought to be a fair measure of learning and many of the students suggested that they achieved a deeper rather than a more shallow understanding of the material. Many also felt that their progress had been hampered by being unable to understand the learning material at times, which coincides with their aforementioned concerns about not always being aware where to obtain information about the correct answers from and some concerns were raised about the ability of students to meet the expectations placed upon them.

These issues require some consideration during the planning stages of the next year's session. There has been some redistribution from staff marking time to increased contact time although the tick exercises also require some revision before the next session. The AFEQ results in this case study should be treated with some caution as views expressed in the pyramid discussion session suggest that there were substantial differences between student evaluations between semesters and it is difficult to gauge which time point students had in mind when responding to some of the items. The responses rate was also fairly low at around 50. however the general pattern suggests that the main problems appear to be the pervasive difficulty of helping students to overcome the isolated blockages in understanding that can hamper their progression to other parts of the course as well as in tracking these students and offering them remedial help once this pattern does start to emerge. However the students generally appeared to be responsive to the changes and with some revision, the redesign could yield promising outcomes in subsequent sessions if developed constructively in light of the lessons learned.