

Beyond Content: Engaging Students in Tertiary Foundation Courses in Information Technology

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Abstract

Introductory IT courses are traditionally seen as difficult courses to deliver: they must be broad ranging both in content and target audience yet need to effectively deliver technical content. We use an action research approach to explore the development of an interactive foundation course that encourages student participation in tutorials, covers an appropriate practical component, and meets the demands of the tertiary sector for more exciting and innovative course delivery. The course has been delivered over the academic year 2008 and feedback from students and staff collected. We examine the effect of the different delivery methods on attendance and assignment quality. We further discuss the adjustments we have made for internal and extramural delivery modes. A reflective approach to course design and delivery has enabled us to continue developing the course to engage students and to provide the foundation for second and third year IT courses.

Introduction

Computer Science (CS) and Information Technology (IT) educational development has traditionally been a complex area. The desire to respond to rapid developments in technology may override the need to achieve understanding of fundamental concepts while a tendency to focus on programming and computation may affect the acquisition of broader skills that are required in industry (Gupta, 1998). Gupta (1998) argues that new developments directed at maintaining currency and relevance do not address the key challenges of falling student numbers, high failure rates and designing appropriate introductory courses. Such introductory courses for CS/IT present many challenges in that they must be broad ranging both in content and target audience yet need to effectively deliver technical content.

A major restructuring of ICT degrees at Massey University required the Information Technology Discipline Group to develop a first year foundation course for a newly formed IT major. The course is required to meet the needs of first year Information Science students (both CS and IT) and effectively contribute to their readiness for second year study. It is also required to address the needs of a broader cohort of students who "go into a world where the implementation of ICT..... touches virtually every corporate activity" (Stoettinger & Schlegelmilch, 2002, p. 63). Course development was therefore initially undertaken with this broad audience in view and also against a background of a student cohort increasingly wired into social networking, virtual environments and mobile multimedia.

This paper, which is an expansion of a paper presented at the NACCQ conference (Stockdale, Le Heron & Parsons, 2008), describes the path we have followed in the developing and presenting of a new foundation

course through the first year of delivery. Using an action research approach we reflect on student and staff experiences to inform further development of the course. Our experiences in foundation IT course development may be of relevance to other tertiary institutions faced with similar challenges

Issues and Challenges

Anecdotally, IT is seen as a 'geeky' occupation that is male-dominated with little identifiable career structure, involving long hours and little contact with people. The school curriculum does little to change these perceptions and recruitment into the IT industry continues to be problematic (Stockdale & Stoney, 2007). It is not then surprising that tertiary IT foundation courses are traditionally seen as challenging by lecturers. These courses are time consuming to design and run, students have a vast variety of skill levels, the content matter is necessarily broad and the language used full of acronyms, abbreviations and jargon. In view of these preconceptions, our first challenge in planning was identified as designing a course with appropriate content that would engage the students.

In deciding on the content we were influenced by the need to address the role of technology as "a core element of university-level education" and the view that IT courses need to address both the foundational elements of the subject matter and the applications of the technology (Shackelford & LeBlanc, 1998, p.128). This approach was emphasised by Turner (1998) who argues that students must have experiences beyond the technical and that the inclusion of social, ethical and professional topics reflects both industry's demands and the maturing of the informatics discipline. This was borne out in our discussions with industry where many employers have stated that they want their graduates to have a good grounding of technological knowledge together with a high level of soft skills. To achieve the balance required we have taken the approach described by Randolph (2007) in that we based course development around a core textbook. We then extended the topics from the book to incorporate a range of other material to cover additional content that we felt to be necessary to meet the requirements of the IT Major.

Turner (1998) addressed our second issue of effective course delivery that enhances learning and advocated the four approaches of discovery, active, collaborative and peer learning as more appropriate than traditional paradigms. These approaches were addressed in our course design together with the results of our discussions regarding the use of technology to deliver the content. Students have very different opinions on the usefulness and use of technology tools as teaching/learning mechanisms. Stoettinger and Schlegelmilch (2002) have found that both students and tertiary institutions are not embracing

the use of technology within the classroom. Students, on the whole, like the use of IT-based tools to deliver content but are influenced by their skill levels, which are determined by the level of their previous exposure to ICT. We therefore needed to plan for the use of technology as a delivery mechanism in a way that was compatible across different levels of IT skills.

Another challenge was the need to effectively present the first year course as a showcase for further IT learning and a pathway to subsequent study. There is a rapidly declining number of students studying CS/IT at a time when the need for IT professionals is becoming acute. We were very conscious that we needed to overcome the preconceptions of potential students that include lack of interest, poor transition from high school to tertiary curricula, gender bias and poor fit with industry. The course therefore needs to address the issues of attracting students, capturing their interest and encouraging them on to further technology studies.

Reflecting on the Method

Action research is a research method that enables a qualitative investigation of change. Its purpose is to 'institute a process of change and then to draw conclusions from this process' (Hunter, 2004. p.295). The method also involves an iterative process that allows for re-examination of the application of devised solutions to a problem to determine whether actions have been appropriate. It also supports investigation of the impact of the change on the organisation or group (Olesen & Myers, 1999).

We used an action research approach to gather data from both staff and students to inform the development, delivery and evaluation of the new course. It should be emphasised that the data gathering has not been regarded as a research project and the primary purpose remains the development of the first year foundation course. However, in support of the need to reflect on the design, development and delivery of the course we have used the principles of action research (Susman & Evered, 1978, cited in Hunter, 2004). This enables and informs a cyclical process of assessment of our progress as follows:

- Diagnosing: We have diagnosed the issues and challenges affecting development of a new course
- Action Planning: We have planned the actions to be undertaken to address the diagnosis
- Action Taking: We have conducted and monitored the planned actions
- Evaluation: We have evaluated the ongoing effects of the actions
- Specifying Learning: We have documented the knowledge obtained from the process.

Data collection and analysis has involved collaboration amongst the

discipline group staff drawing on several years of collective experience. Reference to a variety of curricula relating to delivery of IT courses and an extensive review of textbooks was made. Discussions with CS staff who constitute a complementary but separate group within the Institute have been ongoing to enable 'cross pollination' of ideas and this has proved to be an invaluable two way exchange. Once course delivery was underway, we informally and formally surveyed students on their experiences. We also continued to conduct informal discussions among the staff and reflect on the participants' reception of the different elements of the course.

Planning and Designing the Course

The first stages of the action research are diagnosing the challenges and planning the actions to address that diagnosis. We began the diagnosis and planning process with discussions on the issues affecting foundation course delivery and what we considered to be important in terms of content and format. We found professional bodies such as the ACM and AIS to be helpful in providing background material for foundation courses. Initial content development for the course was guided by the ACM/IEEE IT curriculum (ACM, 2008) which highlights the need to balance the technology content with social and related IT issues.

We were conscious of the requirement to prepare Information Sciences (IT) students for further study while at the same time staying broad enough to attract students wishing to take the course as an elective (see Table 1). The title of the course was felt to be very important in attracting students. It is aimed at describing the content (hence 'Computer Applications') put into a relevant context ('and the Information Age'). This was felt to avoid connotations of a business orientation (Business Information Systems is taught in a separate faculty), while emphasising that the subject matter went beyond the technical.

First Year Course	Second Year Courses	Third Year Courses
Computer Applications and the Information Age	Systems Analysis and Design	Database Development
	Networks, Security and the Internet	Human Computer Interaction
	Systems Integration and Administration	Multimedia Development
	Application Software Development	Software Construction
	Web-Based and Mobile Systems	Emerging Issues in Information Technology
	<i>Non Information Science Students (to fulfil basic IT knowledge requirements for other courses of study)</i>	

Table 1. Framework of Courses Offered in the IT Major

It was determined that the course would comprise four components that would align with Turner's (1998) four approaches for effective course delivery that enhances learning:

- Quizzes. This component emphasises discovery learning by encouraging students to explore the set text, conduct Web searches and access other readings to answer the questions set on a weekly basis. The aim of this component is to introduce the students to facts, theory and concepts.
- Lectures. The purpose of this component is to explain and relate facts, theory and concepts that are absorbed through the quizzes. Despite the large class size, some element of interactivity is encouraged to promote peer learning.
- Tutorials. The seminar room based tutorials promote student discussion of issues relating to facts, theory, concepts and practice. The mixed style of interactive events are aimed at promoting collaborative and peer learning.
- Computer lab tasks. The practical component of the course promotes active learning as students follow task sheets that will enable them to build experience of the main types of software applications in current use.

Each component of the course is aimed at enhancing the approaches to student learning and complementing and informing the other components. The assessments were developed with a view to evaluating the overall learning achievements across the four delivery components. The course framework is shown in Figure 1.

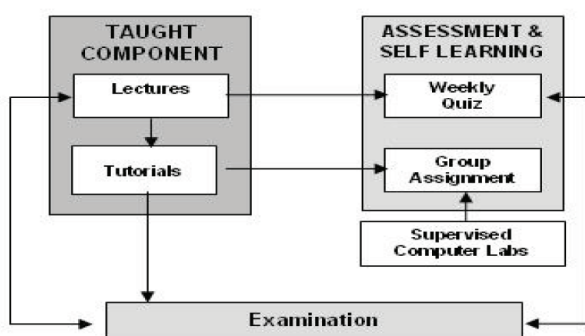


Figure 1. Course Framework

As a foundation technology course, it was felt to be appropriate to use the University's e-learning platform, WebCT, as a repository for all course materials (except the textbook). All administrative documents including course outline and semester schedule, the assignment sheets and lecture notes are located on the course Web pages. The opening page provides a bulletin board for course notices and reminders while all students are encouraged to post to the discussion board to promote peer learning. Additional tools such as animations and podcasts are

also posted under the appropriate content pages.

After considerable discussion it was decided to organise the course around a textbook (Randolph, 2007). A set text (Shelley, Cashman, & Vermaat, 2007) provides a framework for the course and forms the basis of a weekly quiz. Although it has been noted that students who are reasonably competent in IT tend not to use the textbook, those with less experience use it extensively and have found the book useful for ongoing reference.

Action Taking

This stage of the action research describes how we conducted and monitored the planned action. It addresses the four components of the course and the assessments in more detail as delivery evolved through the different modes of delivery.

Quizzes

The weekly online quizzes are designed to encourage students to read around topics before each lecture, and thereby aid formative learning throughout the semester. The quizzes support students in gaining a grasp of the concepts and theory for the relevant topic. Quiz questions are posted on WebCT for one week preceding the lecture and can be answered through accessing the nominated readings. Sufficient time is given to enable students to scan their sources as they work through the questions. An average of 75-85% of students completes the quizzes in different deliveries of the course.

Lectures

The lecture schedule follows the contents of the book although we supplement the material with expertise from members of staff. This is to ensure that all topics covered in subsequent years of the IT major are broadly addressed. The practice also adds a self study element (discovery learning) through the need for students to locate additional readings for the quizzes. An overview of the lecture themes is shown in Table 2.

Lecture Themes	Source
Usability and Web design Computer graphics Multimedia and online entertainment Human Computer Interaction Computer forensics History of computers	In-house expertise and additional material
How computers work Software applications What is programming? Databases, information handling & storage Security and privacy	Book chapters (summarised)

Table 2. Lecture Themes

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The lecture material is expanded with the use of case studies to give more currency to the topic areas. Quizzes are monitored to enable difficulties in specific areas to be identified and explained within the lecture. Interactivity within the lecture is encouraged through techniques such as impromptu voting on queries, asking for examples of technology use and other opinion seeking. Additional material in the form of podcasts, flash and other animation modules is loaded onto WebCT to enhance learning, particularly of the more technical elements of the content. Videos were made of all lectures in the initial delivery of the course for use as additional material on the Web. Students are able to access these tools as often as they wish and there are encouraging signs that they are proving beneficial and range of tools is gradually being extended.

Tutorials

The weekly tutorials are loosely related to the lecture topics, but are used to encourage students to think beyond the boundaries of technology and consider the wider implications of our networked world. They are aimed at enhancing collaborative and peer learning approaches and are designed to be very interactive. Topics for each week are presented as challenging questions while the format varies from open and group discussions to debating stances and team tasks. Exploration of ethical, environmental, security and privacy issues is included along with exercises that illustrate the principles of programming and elements of web design. Material is gathered from contemporary publications and real world case studies are used to illustrate different perceptions and viewpoints.

Computer Labs

The computer labs are the active learning element of the course. Six software applications are introduced to students in the lab sessions to give participants experience of a range of software and to build confidence in using a variety of tools. Tasks range from creating a blog and a webpage to document sharing, databases and simple programming tasks using Alice and Visual Basic. Task sheets associated with the six applications are posted to WebCT together with instructions for completion. The labs are run as drop-in sessions with no formal groupings and students are encouraged to work alone or with peers to complete the tasks, attending labs to gain help from the tutoring staff.

Formal Assessment

The four elements of the course described in Figure 1 are drawn into three internal assessment components, comprising 40% of the total mark and a final exam (60%). The quiz component assesses knowledge of facts, theory and concepts drawn from the themes of the subject area. The final exam is the major element of assessment and tests knowledge of facts, theory and concepts as well as an understanding of socio-technical issues using multiple choice and short answer

questions. The majority of the exam material is taken from lecture content although short answer questions also include discussion topics from the tutorials.

Learning from the tutorials is assessed in the internal mode by a group assignment that enables the students to display knowledge of socio-technical issues, web design and practical expertise. The assignment incorporates the web page creation component of the lab, the usability and design lecture and discussion content from the tutorial. While not assessed, the relevance of soft skills such as group collaboration and interpersonal communication are modelled in tutorial discussions and are required to successfully complete the group assignment. This follows the identification of the importance of group work in the ACM IT curriculum.

Finally, the computer lab component assesses basic expertise in six different types of applications. Students work at their own pace over a period of the weeks assigned to the tasks and are supported by tutors within the lab sessions. Once the tasks are completed they are demonstrated to a tutor to be signed off

Extramural Mode

Once course design was underway the requirement to deliver the course extramurally was identified. There were several challenges to converting this course for extramural delivery. The majority of the distance-learning cohort tend to be non-IT students, mostly of more mature age than internal students and often with limited computer skills. This last point adds difficulties to the lab applications and more practical elements of the course.

Figure 2 shows how the various components of the course were re-designed for extramural delivery. The quizzes were unaffected by the delivery mode, but the lectures were replaced with a series of online offerings to supplement and enhance learning from the book and other readings. A weekly newsletter gave an outline of the learning tasks for the week, highlighting the key issues from the reading and contributing website links from the Internet and from the publisher's student learning materials. Animations appropriate to the weekly topic were made available on WebCT together with videos of the previous semester's internal lectures. The tutorials took place on a course blog with a topic content sheet laying out discussion issues and indicated reading resources. The group assignment was incorporated into the blog to which the students were required to contribute. The website element of the internal assignment was incorporated into the relevant lab component where students were required to create and launch their own websites. All lab applications were changed to open source software to enable students to access them and instruction sheets were loaded to WebCT. A course email was created specifically for extramural students. This had a dual benefit of enabling all the staff involved in the course to access all the student queries and emails were easily identifiable from otherwise busy email boxes.

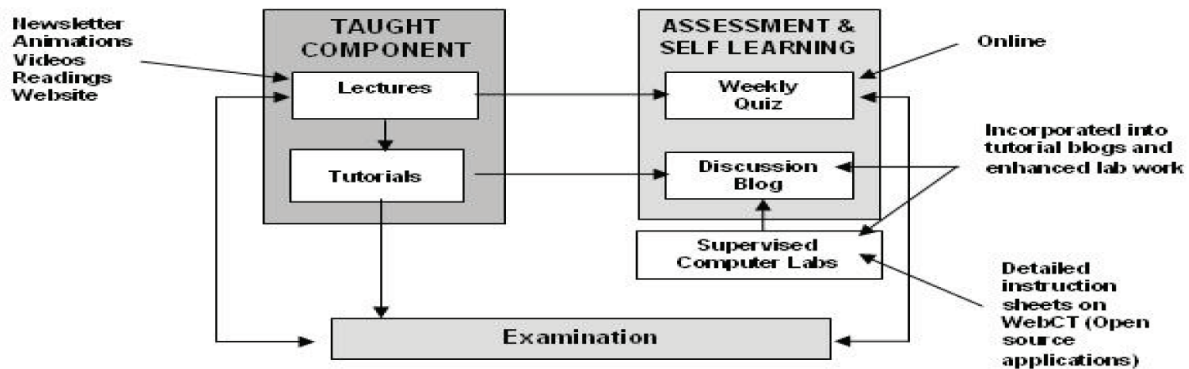


Figure 2. Course Framework Adapted for Extramural

Evaluation and Ongoing Development

An effective ongoing development path is essential for engaging students in an IT foundation course. This requires a continuous cycle of reviewing course outcomes, listening to feedback and addressing issues that arise. This process has been undertaken both formally and informally and feedback from both staff and students has been continually reviewed and used to inform ongoing development of the course.

Student Feedback

The foundation course has now been delivered four times since its development; in summer school, twice internally and once in extramural mode. This has provided insights from a considerably different range of student cohorts, which has been beneficial in reviewing improvements and adjusting course content. For example, initial feedback was from summer school students who are not a typical cohort for this course. They tend to be more senior students from a range of disciplines using summer school to complete their degrees. Their learning capabilities and techniques are more advanced than those of the usual first year student. Informal feedback was very valuable as the students tend to know the members of staff and interaction was more relaxed enabling discussion on points of issue.

Outcomes from the summer students included confirmation that the quizzes were a useful formative learning tool and that the software applications covered in the lab sessions were interesting and stimulating. Feedback on the latter informed the rewrite of the task sheet for one software application, which was held to be unnecessarily complicated. Adjustments were piloted on two non-technical university general staff members who had taken the course in summer school. They had found the course to be an immensely useful and confidence building experience and were very positive in their newfound ability to understand IT issues and use computers more effectively.

Ongoing student feedback from the internal deliveries has been collated from our own surveys and from formal university questionnaires. We have an open door policy that, while time consuming for staff, ensures that students find the team approachable and are able to raise any concerns. Comments from informal WebCT-based surveys have been the most useful. Feedback confirms that students are very exam focused. The majority is concerned that the lectures should not stray beyond the reading material and confirmed the usefulness of the quizzes for formative learning and revision purposes.

Several students remarked on the benefits of an interactive, less structured format to the lectures used by some staff and this has provoked some thought to moving the lectures to a seminar room more conducive to discussion. To date the number of students precludes this approach although lecturers strive to retain some interaction within the formally structured lecture theatres. In contrast, the interactive tools provided for self study on WebCT, although highly regarded by non-IT students, were not frequently accessed.

Feedback on tutorials has been mixed. There is a high element of non-participation by those who can see no reward from attending (i.e. assessment marks) and a small proportion have indicated that 'discussion is boring'. Nevertheless, attendance remains at a constant level and more students attend the tutorials than the lectures. Together with other feedback we have taken the figures as a positive sign that a significant proportion of the class is interested in contemporary issues associated with IT. The majority of topics have evoked lively discussion within groups so that even those unwilling to talk to the whole class were happy to participate on a more personal scale.

In regard to the practical lab component, a small number of more IT experienced students regard the lab tasks as 'too easy'. Nevertheless, a surprising number said it was the first time they had used many of the different types of applications they were introduced to, and that they have enjoyed using them. Lab tutors can see students building

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confidence as they learn new applications and many students are encouraged to learn more about the applications on their own. For example, we found that several students have set far higher goals for themselves in their group assignment (which involved website design, creation and content) than required.

Finally, feedback from extramural students has provided food for thought for ongoing development. Staff contact was highlighted as a key requirement for a positive learning experience. To this end, the welcome letter that was sent to all enrolled students before the beginning of semester was held to be very important to a positive beginning. Staff contact within a given timeframe was also highly valued and to this end the dedicated email proved very useful.

We overestimated the usefulness of the videos, as many of the distance learning students rely on dial-up Internet connection and were not able to access them. Where students were able to download they contributed to feelings of "inclusion in the course". Other animations and Learn-it-Online activities were accessed over 140 times over the semester (on average 3 times per student) and rated as very useful. The written guides for the quizzes, labs and tutorials were overwhelmingly seen as helpful and highlight the importance of communication for extramural students albeit in a written form. Quizzes were regarded as helpful to the learning process although comments ranged from "ridiculously simple" to "the mark is too low for the amount of time they take" indicating again the breadth of skills found in any one student cohort.

Staff Feedback

From a staff perspective the challenge is to deliver an IT foundation course in as interesting a manner as possible and this had led to the inclusion of case studies and real world examples in lectures. The tutorials and practical components of the course have been the most time consuming to prepare. The tutorials are the most difficult to deliver as the staff are largely technically trained and not accustomed to an open, interactive discussion format in the seminar room. Tutorials are designed to challenge and even provoke the students to think in different ways and discussions often move in valid but unanticipated directions about which the staff member may feel less informed. It can be difficult for staff to maintain a neutral stance on various issues to ensure that students do not feel that their viewpoint is less valid or wrong, if discussion is to flow freely. On some topics it can be hard to get discussion started and staff must be prepared to accept that the students may know more on some issues than they do. There is also a fine balance between welcoming the new perspectives shared and keeping the discussion on track.

In contrast the lab component is more structured and staff are able to focus on ensuring all students reach a minimum level of competence in the software applications. While the majority of students are able to achieve the level required, there are a few who require extensive help to understand how to accomplish the tasks set. The course team

has tried to encourage a system of peer-to-peer tutoring in the labs to enhance learning opportunities particularly for the less skilled students. To date this has not proved successful even where students have been introduced to others with high levels of aptitude and peer-to-peer help continues to be based in friendship groups.

A next challenge for the development team is delivering the course as part of the core programme for other schools and faculties. Decisions are yet to be made as to whether the courses are tailored to specific subject areas or delivered as a generic IT course. Resources suggest that the latter option will be the most viable, and feedback will be used to further inform development in coming semesters. Further thought will need to be given as to whether we deliver the course to the student cohort as a whole or whether we tailor components such as tutorials to fit students studying other majors such as sport science or construction.

Specifying Learning

The final stage of the action research process is to document the knowledge and identify what we have learned. While this is the final stage, the process is a cyclical one and ongoing learning and development are essential to keep the course current and relevant. While we believe that the basic framework of the course meets the requirements we set out to achieve, there are some areas of specific learning that requires us to re-think and consider modifications to the course.

Interactivity in learning

As anticipated, interaction in the learning environment enhances the engagement of students with the course content. This is particularly important in a first year foundation course that influences future engagement with a major. The development team is now discussing how to bring the lectures and tutorials closer together to capitalise on students' positive attitudes to more interactivity in learning. This will require consideration of such issues as class size, cultural differences and varied learning styles.

One example of the potential to enhance interactivity arises from learning gained in the extramural delivery. We dispensed with the group work assignment and introduced an online blog to which students contributed. Although most students did complete the required entries, there was little sustained discussion. However, recommendations from the literature suggest that a social space, such as a virtual café, can produce more sense of belonging in a virtual cohort (Day, 2008). The university's planned change to a more user friendly learning management system in 2009 is anticipated to support the creation of a virtual café for the courses. We believe that this will enhance the blog discussions and create more interaction between the students.

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Extramural issues

Other issues that arose from extramural delivery included the poor quality of connectivity for many distance learning students, making access to online materials problematic. We see it as essential that an IT course such as this is delivered online, supported as necessary by reading material. Students experiencing poor Internet connection were unable to download video clips, podcasts and in some cases animations. It is now planned to film shorter versions of internal lectures in dedicated sessions to improve the quality of the video. These will then be made available together with other downloadable material both online and on DVD to support students with poor connectivity.

Peer-to-peer learning

One area that still requires some thought is the failure of students to engage in peer-to-peer learning. We had hoped to encourage more peer-to-peer tutoring for the computer applications to encourage those with good skills to mentor those with less experience. It may be that organisation of specific sessions is needed to encourage a more 'club-like' atmosphere within a dedicated timeslot. Alternatively, if funding for students tutors can be found, they may form the basis of a learning group to encourage the less skilled students.

In the tutorials we want to increase the collaborative and peer learning experiences and encourage greater participation. This is particularly important for some overseas students who have less experience of open class discussions. To achieve this we are placing more emphasis on the assessment of tutorial content, reflecting feedback that suggests that students remain very exam-focused. The weighting of short answer questions within the final exam has been revised, and greater emphasis has been placed on examining a balance of content from both tutorials and the lectures.

Skill levels

An important challenge, identified early in the process, was that of different skill levels amongst the student cohort. For example, while some students find the quizzes irksome and overly simple, others have found them time consuming and difficult. However, the majority of feedback has been positive and we have retained the format of this formative learning tool in each of the deliveries.

In the same way, the lab components have proved challenging to a number of the students who have indicated that they appreciate the breadth of application types they are exposed to and have a great sense of achievement from successfully completing the tasks. The importance of the written lab guides for extramural learning was emphasised in the first delivery and there is a commitment to ensure these stay current and informative. The benefit of using open source applications has been identified for extramural students, which entails detailed download descriptions in the lab guides. Commercial applications that are used in second and third year courses will continue to be used for

internal deliveries of the course.

Resources

The development and delivery of foundation IT courses is recognised to be time-consuming for staff. In the current commercial climate of tertiary education there is a widespread decline in university resources across all disciplines. Staff student ratios in universities are nearing 20 to 1 and the focus on large-class first year courses adds to the difficulty of developing quality courses. Staff have to find a balance between the need to engage students with interactive, current and flexible courses and the demands of research and administration. While we will continue to develop resources time restraints have limited how much can be achieved each year.

Conclusions

The preparation and delivery of a new foundation course for IT has been a time intensive and challenging exercise. The decision not to take an 'off the shelf' approach to the course has meant that the core development team has taken on a heavy workload. However, now the framework of the course is established ongoing development is not so demanding of the staff. Taking a reflective approach to the process has enabled us to move the course forward while balancing the demands of learning outcomes with those of student needs. This will be particularly challenging as the course is being considered as a core element of other disciplines' first year programmes.

Other issues that have arisen from reflections in the first year of delivery include consideration of the interactive tools that have been developed for WebCT. These have not proved as popular as anticipated with IT students, although less technical members of the course have gained considerably from having free access to them. These supplementary materials may provide the key to increasing the skill levels of the non-IT students. Creating self study guides to accompany the animations and podcasts to increase their value to interested students remains a goal as resources allow.

The tutorials have proved more popular with students than with staff, as they are time-intensive and beyond the comfort zone of some members of staff. However, they bring a key element of socio-technical study to the foundation course that is beginning to be reflected in second and third year courses. Summer school will continue to run as a team effort with all members of staff committing to the delivery of the course. This reduces the workload on individuals and keeps all members of the group in touch with the key role of the foundation course.

At this stage of development we believe that the key to engaging the students is to go beyond content and continue to promote many different modes of interactivity to facilitate a successful learning experience for the broad target audience of an IT foundation paper.

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