# Beyond Content: Engaging Students in Foundation Information Technology Courses

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## Abstract

Major restructuring of ICT degrees at Massey University, Auckland required the Information Technology (IT) Discipline Group to develop a first year foundation course for the newly formed IT major. 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. A further challenge in delivering such courses is meeting individual needs in large classes and effectively preparing students for second year study. This is against a background of a cohort increasingly wired into social networking, virtual environments and mobile multimedia.

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 was first delivered over summer school 2007 and feedback from students and staff collected. We examine the effect of the different delivery methods (online quizzes, flash animation, practical labs and discussions) on attendance and assignment quality. We further discuss the adjustments we have made for internal delivery and preparation for future delivery of the course in extramural mode.

This reflective approach enables us to continue developing the course to engage students and to provide the foundation for second and third year IT courses. We have also attracted considerable interest from staff and students from other Colleges who find the approach compatible with their needs for a basic understanding of current information technology.

*Keywords*: IT education, IT foundation courses, IT course development, Tertiary ICT courses

## 1    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 concept 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, for example, object orientated programming do not address the key challenges of falling student numbers, high failure rates and designing appropriate introductory courses. Introductory courses for CS and IT must be broad ranging both in content and target audience yet need to effectively deliver technical content.

A major restructuring of ICT degrees at [ institution name], 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 p63). 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.

Course development has been a collaborative exercise within the discipline group. An early decision was taken to use interactive elements in the delivery of content to encourage student participation and meet the demands of the tertiary sector for more exciting and innovative course delivery. This paper describes the path we have followed and using an action research approach we have been able to reflect on student and staff experiences to inform further development of this foundation course. We believe that our experiences in foundation IT course development may be of relevance to other tertiary institutions who may be faced with similar challenges.

## 2  Issues and Challenges

The key challenge that we faced in the first stages of planning was identified as meeting the requirement to teach appropriate content while delivering content in an effective manner.

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 that IT courses need to address both the foundational elements of the subject matter but also the applications of the technology (Shackelford & LeBlanc, 1998. p.128). This approach is 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 is 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) addresses our second issue of effective course delivery that enhances learning and advocates 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 & 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. There are several anecdotal reasons for this 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.

## 3  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 allows for 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 this has not been regarded as a research project, but rather as an integral part of the academic workload. However, we have used the principles of action research (Susman & Evered, 1978 in Hunter, 2004) to inform our cyclical assessments of the progress of the course 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.

## 4  Computer Applications and the Information Age

The title of the course is aimed at describing the content while avoiding connotations of a business orientation (Business Information Systems is taught in a separate faculty). At the same time we were keen to attract students to the idea of subject matter beyond the technical. Consideration of the technology content of the paper was in part determined by the requirement to prepare the Information Sciences (IT) students for further study. This was informed by the second and third year offerings as shown in Table 1.

Determining the content of the soft skills elements of the paper was ongoing over a period of several months as staff collated material from national and international publications (e.g. NZ Herald, CIO magazine, ComputerWorld, Guardian, Wired). The accumulation of material enabled us to gain a firm grasp of the issues that

were being discussed within the industry and across society as a whole.

**Table 1: Framework of Courses Offered in the IT Major**

| 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 |
| | *Non Information Science Students* | |

Four components were designed into the structure of the course to fit with the learning paradigms (Turner, 1998) as follows:

- Quizzes. This component emphasises discovery learning by encourage 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 of the students and related to each of the four delivery components. The course framework is shown in Figure 1.

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 (see References) 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.
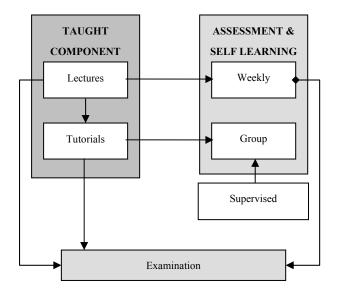


**Figure 1: Framework of the course**

## 4.1 The Quizzes

To encourage the students to read around the topic before the lecture, and to aid formative learning throughout the semester, a weekly online quiz has been introduced. The quizzes encourage the students to read material to gain a grasp of the concepts and theory for the relevant topic. Multiple choice and short answer questions are posted on WebCT for one week preceding the lecture and can be answered by reading the nominated chapter. In the case of additional topics a Web search or accessing nominated readings is required. Sufficient time is given to enable students to scan their sources as they work through the questions. After the initial week of semester (when a practice test is posted) an average of 75-85% of students have completed the quiz in both deliveries of the course.

## 4.2    Lectures

The lecture schedule loosely follows the contents of the book although we supplemented the material with expertise from members of staff in the first delivery of the course at summer school, 2007. This is to ensure that all topics covered in subsequent years of the IT major are broadly addressed. The practice has been retaining in the second delivery in Semester 1 and 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.

**Table 2: Foundation Course Lecture Themes**

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

Lectures cover material from the readings used in the quizzes, and the theory is expanded with the use of case studies.  Where questions in the quiz indicate difficulties the material is enhanced and explained within the lecture. Interactivity within the lecture is encouraged using impromptu voting on queries, asking for examples of technology use and other opinion seeking. This level of interactivity is to be extended as we develop the facility to use mobile phones for querying during lectures. Additional material in the form of podcasts, flash and other animation modules are loaded onto WebCT to enhance learning, particularly of the more technical elements of the content. Videos were made of all lectures in the summer school delivery of the course and it is intended to edit these and make them available 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 plans to extend the range of tools are in hand.

## 4.3    The Tutorials

The weekly tutorials are loosely related to the lecture topics, but are used to encourage students to think beyond the boundaries of technology to consider the wider implications of our networked world.  The tutorials 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 are 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.

## 4.4    The 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.

## 4.5    Assessment

As indicated in Figure 1, there are four elements to the total assessment for the course that are drawn from the learnings of each of the components.

The quizzes assess knowledge of facts, theory and concepts drawn from the themes of the subject area. There is a total of 10% of the assessment mark assigned to the 10 quizzes.

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. It accounts for 60% of the total assessment and contains 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 a group assignment that enables the students to display a knowledge of socio-technical issues, web design and practical expertise. It  incorporates the web page creation component of the lab, the usability and design lecture and discussion content from the tutorial. Groups of 4 to 6 students are tasked with designing a website on a chosen theme and group members are required to address different aspects of the issues that arise from the selected topic. Group marks are awarded for the home page, although each student is required to create an individual page which carries over half of the marks.  Content and design are equally weighted in the double marking. 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.

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. A total of 15% is assigned to the lab tasks.

## 5 Feedback and Ongoing Development

A reflective approach is need when addressing issues arsing from feedback and discussions if staff are to continue to guide the course along an effective development path.

Feedback from the course has been both formal and informal covering the delivery at summer school in 2007/8 and the first 9 weeks of internal delivery in Semester 1, 2008. Ongoing contact with the students has provided valuable comments while all members of the discipline group have been involved in some part course delivery.

### 5.1 Student Feedback

Summer school students were not a typical cohort for this course as they tend to be third year students from a range of disciplines using summer school to complete their degrees. Therefore their learning capabilities and techniques are more advanced than those of the usual first year student. Nevertheless, we have received good feedback from the few students who completed the formal survey forms.

There was confirmation that the quizzes were a useful formative learning tool and that the software applications covered in the lab sessions were interesting and useful. Feedback also 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. These members of staff said that they had found the course to be an immensely useful and confidence building experience and was very positive in their new found ability to understand IT issues and use computers more effectively.

Ongoing student feedback from the delivery of the paper in Semester 1 has been largely positive. 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. Results from an informal WebCT survey posted in Week 9 of semester have given us preliminary feedback on the running of the course. The survey covered specific views on the lectures, the tutorials and computer labs as well as the assessment methods. Feedback indicates that students are very exam focussed. They appreciate the lectures that cover the material from the book and the majority of responses were concerned that the lectures should not stray from the format of the themes. (The majority of students are not willing to learn material that will not be included in the exam.) The interactive element of the lectures was remarked on by several students and this has provoked some thought to moving the lectures to a seminar room more conducive to discussion in the next semester.

In contrast, the interactive tools provided for self study on WebCT, although highly regarded by non-IT students, were not frequently accessed. The quizzes are seen as an excellent way of encouraging students to read the relevant chapters of the book, although some students did not accept the preparation focus of the quizzes and wanted to do the quiz after the lecture as a test rather than as formative learning.

Feedback on tutorials has been mixed. There is an element of the class that do not participate because they can see no assessment marks directly associated with attendance and a small proportion have indicated that 'discussion is boring'. Low attendance of students is currently seen as an issue for all tertiary courses and whereas 75% of the class attended the first three tutorials, this number has remained just below half the total students in the last few weeks (i.e. beyond the point where there is a direct relation to assessment marks). Nevertheless, we have taken the figures as a positive sign that attendance remains at this level after the group assignment has been completed. Indeed, more students attend the tutorials than the lectures and together with feedback comments, indicates 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

Regarding the practical lab component, a small number of more IT experienced students felt that the lab tasks were too easy for them. Nevertheless, a surprising number said it was the first time they had used many of the different types of applications they are introduced to, and that they have enjoyed using them. Lab tutors can see students building confidence as they learn new applications and many 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 we have asked for in the assignment instructions.

### 5.2 Staff Feedback

From a staff perspective foundation IT courses are seen as challenging. They are time consuming to design and run, students have a vast variety of skill levels, the content matter is broad and the language used full of acronyms, abbreviations and jargon. The challenge is to deliver the 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 tutorial component has proved to be 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. This is one area that staff are examining the possibility of peer to peer tutoring within the first year.

## 6    Ongoing Development and 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, once the framework of the course is established it is anticipated that ongoing development will not be so demanding. The decision has been taken to run the course through its four planned modes (two internal deliveries, extramural and summer school) collating staff and student feedback before making any decisions as to major adjustments.

 Taking a reflective approach to ongoing development will enable 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. 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.

Other issues that have arisen from reflections in the initial stages of delivery include consideration of the interactive tools that have been developed for WebCT. These have not proved popular with IT students, although other 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 may increase their value to interested students.

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. We are starting to discuss 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.

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.

Finally, we are now adjusting the course for delivery in extramural mode. The use of videos, podcasts and animations are anticipated to be of interest to distance learning students. Feedback from these students will provide an additional resource for further evolution of this 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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