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Learning Excellence and Development Team

LEADing Change in Learning and Teaching

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Abstract

Learning and teaching is an important component of university life – critical for students and also for those who teach. Our aim is to make this practice more enjoyable and effective for all involved, and at the same time to encourage a scholarly approach to the process. This volume of *Asian Social Science* is devoted to the work of a team of academic staff who have collaborated in making real improvements to their teaching and the learning of their students. In this article we will discuss the process of setting up the group, the pedagogical rationale, and the training and support given to all members.

Keywords: Professional development, Curriculum change, Case studies, Action research

1. Background

The Division of Economic and Financial Studies (EFS) is the largest Division at Macquarie University with around 4 000 postgraduate students, 9 000 undergraduate students and 300 full and part-time academic staff. The Division offers a mix of disciplines with five departments – Accounting and Finance, Actuarial Studies, Business, Economics, and Statistics. Students can focus on becoming specialist economists, accountants, actuaries, demographers or statisticians or combine other major studies to pursue interests such as organisational psychology, computing, environmental management, languages or other electives. The programs are accredited by the relevant professional bodies.

Faculty members are eager to improve the experiences of their students and, in 2007, the Dean allocated extra funds to assist the development of the learning and teaching process. Several models were discussed and, ultimately, the Learning Excellence and Development (LEAD) team was set up by the Division's Director of Learning and Teaching Studies (Leigh Wood) and the Associate Dean of Learning and Teaching (Peter Petocz), two positions with key responsibility for the learning and teaching process Division-wide.

There are numerous external pressures for academics to demonstrate that their teaching is effective. The Australian Government has set up a Learning and Teaching Performance Fund (LTPF) that is linked to measures of teaching, such as student retention, progression rates through degrees, graduate employment and pay, and students' assessment of their learning at university. University funding is linked to performance on the LTPF. For individual staff members, salary bonuses may be linked to being able to demonstrate the quality of their teaching, so there are extrinsic as well as intrinsic incentives to improve. Of course, the main reason for investigating teaching is to improve the experiences of our students!

For a non-Australian audience, let us explain how most teaching is carried out at Macquarie University (and generally in Australian universities). Students enrol in Bachelor degree programs straight from school and most degrees take three years (six semesters), four years for Engineering and six for medicine. Students generally enrol in four subjects per semester, eight per year, 24 for a degree, though there is some variation in the number of credit points per subject. At the end of the three years of study, good students are encouraged to take an honours year and then possibly move into graduate study.

Many subjects will have several large-group lectures per week and associated small-group tutorials. Some of the subjects at Macquarie University, particularly in EFS, have enrolments of over 1 000 students per semester and these are taught in lecture groups of around 500 (this is the size of the largest lecture theatre). The large-group teaching is supported by tutorials or laboratories (depending on the subject) and online learning managers, such as Blackboard. Other ways of learning, such as using peer tutors, are becoming more common (see the article by Dobbie in this volume for an evaluation of the peer assisted learning (PAL) program).

Another influence on teaching is the increased emphasis on generic and professional skills for graduates (see the articles by Evans; Kyng). Teaching is also influenced by the high proportion of international and local Australian students whose first language is not English. These forms a large cohort in undergraduate classes: 67% of the students in the Division of EFS speak a first language that is not English. Ways to use technology in teaching are also critical to student learning (see the articles by Sims; Kyng).

2. Theoretical approach

Firstly, the present project owes a distant intellectual debt to the 1991 *Teaching Enhancement Team*, a university-wide pedagogical project to improve the overall quality of learning and teaching at the University of Technology, Sydney, run by their Centre for Learning and Teaching (1992) under the leadership of Professor Ingrid Moses. Both of the authors of this paper were members of that team, and saw how its work re-vitalised the university's approach to learning and teaching matters and helped many academics 'kick start' their pedagogic research. The present LEAD project differs in many ways from the project carried out 16 years earlier, particularly with the targeted professional development and support given.

The theoretical underpinning of the LEAD project is action research methodology (Haggarty & Postlethwaite, 2003). This is any methodology that involves participative researchers who are attempting to make changes to their environment. It involves a cycle of deliberate activity: *Planning*, *Acting*, *Observing* and *Reflecting*, before reiterating the cycle. Essential elements of these steps are that they are incremental, practicable, comprehensive and reiterated. One of the leading proponents is Jean McNiff (see her online summary, 2002a, or book, 2002b). Action research has developed over the last two decades into an accepted and valid form of enquiry that focuses on a critical approach to practice, undertaken by practitioners within their own practice rather than by researchers outside the practice. McNiff writes: "research is as much about the process of answering questions as it is about the answers themselves" (2002b, p.3).

The participants in the LEAD project were given an overview of action research by Associate Professor Anna Reid from the Macquarie University Learning and Teaching Centre at an early meeting of the team. Not only did we see action research as an appropriate approach to this divisional change and renewal activity, it was also a possible methodology for component projects. Since many of the participants used quantitative methodologies in their discipline research, they were less familiar with an appropriate methodology for investigating their teaching. Therefore we felt that it was important to give them a possible model.

A critical component of any pedagogical change is the evaluation of such change, and we built this aspect into the LEAD program and its individual projects right from the start. Dr Ian Solomonides, also from the University's Learning and Teaching Centre, gave a presentation focusing on evaluation issues at the first full meeting of the team. He referred to the following papers.

Alexander (1999) reviewed 104 teaching development projects and he reports that in approximately 90% of cases the project leaders indicated that they had the intention of improving student learning outcomes, but only a third could report this as a concrete outcome since only this third actually evaluated learning outcomes.

Peat (2000) questions why we evaluate and identifies four *phases* of evaluation: *formative* (is *x* functional in its context?), *summative* (is *x* influencing learning outcomes?), *illuminative* (how is *x* really being used by the users?; are there unexpected uses or outcomes?), and *integrative* (how can *x* be put to best use in the curriculum and organisation?).

Finally, Olds and Miller (1998) suggested another way of thinking about (project) evaluation by attending to five discrete areas:

Table 1. Five areas of evaluation (Olds & Miller, 1998)

Research or evaluation question	Implementation strategy	Evaluation methods	Timeline	Audience dissemination
What are the project objectives? What questions are you trying to answer?	How will the objectives be met? Which project activities will help you meet each objective?	How will you know the objectives have been met? What measurements will be made? On whom?	When will the measurements be made?	Who needs to know the results? How can you convince them that the objectives were met?

3. Process

We developed the program to support any staff who wanted to make changes in their curriculum and teaching. Because learning uses many media (online, face-to-face, software, texts and peer learning) we did not restrict the project team to academics. We invited all members of the Division – administrators, technical staff and academics – to apply to join the team. In future iterations of the project, we will examine ways to include students at this planning and selection phase rather than simply as end users of the learning development process.

3.1 Selection of team members

The EFS Teaching Excellence Plan was distributed to the Division and staff were invited to join the Learning Excellence and Development (LEAD) team and propose a project. The majority of the projects aligned with the EFS teaching plan – indeed the plan assisted staff to choose a suitable project in their area. We allowed a free choice of projects and no project was rejected, though some were reworked or amalgamated when several people proposed similar plans.

In all, 15 projects were supported, with participants from all academic departments (ranging from early-career lecturers to experienced professors) and including technical and administrative areas. Each team member was supported by a more experienced developer. The projects ranged from an investigation of feedback to students, a web statistics project, mapping of graduate capabilities and the introduction of concordance software for postgraduate students. One project evaluated the peer assistance program run by the Division. A complete list of projects is in Appendix A.

3.2 Monthly meetings for professional development

Participants were invited to attend monthly meetings where professional development on relevant topics such as evaluation, action research methodology, project management, ethics and writing pedagogical journal articles was given. We stressed the importance of evaluating educational change, so evaluation was the first area to be discussed. Meetings were friendly and informal, with refreshments supplied, and most included time for participants to give progress reports and ask questions or get comments from colleagues. Yet the meetings were serious about helping participants define realistic projects, investigate the background, select an appropriate approach and work through the process of implementing changes.

3.3 Project planning

We took the simplest approach to project planning by using a GANTT chart (a sample for one of the projects is presented in Appendix B). Participants were all given a chart to adapt for their project. This was the worst-performing aspect of the whole LEAD experience. Participants found it difficult to plan or stick to a plan. There were constantly more pressing problems to deal with: for academics, there will always be pressure on time to review and research, and time management should be taught and practised by all.

3.4 Ethics applications

Because the teaching developments were to be evaluated and the results published, human ethics approval was required under Macquarie University and Australian government policy. Further, it was an important goal of the project to discuss ethically appropriate behaviour in pedagogical (and other) research, which usually involves students who are in an unequal power relationship with their lecturers. The Division has an ethics officer, who came along to one of the meetings to answer questions, and the university has an ethics committee that carefully checks all proposals and discusses any potential problems with applicants before giving its approval to the project.

For some of the participants this was the first time they had had to develop an ethics application. Technical research in their discipline often would not require any ethics approval (for example, mathematical research on properties of statistical estimators), but moving to pedagogical research required new skills. This process was therefore a useful way to learn about research in other disciplines – and to add another dimension to their own research.

3.5 Peer support

Each participant was allocated an experienced colleague to work with them on their project. Dr Ian Solomonides (from the Learning and Teaching Centre), Peter Petocz and Leigh Wood each worked with several groups (see Appendix A). Even participants who were very experienced in research found that having another colleague regularly phoning or emailing helped with their motivation and progress. Towards the end of 2007 we also formed pairs to review the articles being published in this Journal.

3.6 Budget and staffing

Each project was given a budget of $A3 000 (around $US2 500) though some groups also secured extra funding from other sources (such as Project 1, which required the development of a virtual laboratory). The money was available for a range of support, such as research assistance, conference attendance and teaching support (for example, grading of student work), but it was specified that it could not be used for participants' teaching release (we did not want to remove

committed teachers from their actual teaching work with students). Many academics in the Division do not normally have access to funds for research assistance and are used to working by themselves. They do not have access to a pool of research assistants (RAs), nor are they familiar with the procedures for employing them. To streamline the process, one of the project co-coordinators, Leigh Wood, employed several research assistants for the overall project, who were then used by individual participants.

The majority of the allocated funding was spent on these RAs to help with the execution and evaluation of projects: they ran focus groups, administered surveys (often for ethical reasons the lecturers could not administer these themselves), performed literature reviews and generally helped with the collection and analysis of data. Eight part-time RAs were used, most of whom were recent graduates. They worked hard and contributed a huge amount to the project.

3.7 Withdrawals and obstacles

Not all participants have completed their projects, and some will need several more months to do so. One participant (Project 15) was unable to allocate time to do the project due to staff shortages in her area. Another (Project 3) was promoted and found that he did not have enough time to allocate to the project, though it was completed by a research assistant. Two projects (1 and 8) had technical bugs that are still being sorted out: they are working in prototype but have not been tested with students. One of the projects (Project 2) had problems with ethics approval and so is not reported in this volume. Projects 5 and 13 are proceeding well but not ready for reporting at this stage.

3.8 Writing and dissemination

We felt that it was essential that changes in practice should be evaluated and disseminated. This means that we needed to examine the literature around each project and to place our changes in a context. Each participant was supported in writing up their teaching development by a research assistant, who also helped with the literature review; an experienced colleague who reviewed their full paper; and after that a review partner chosen from the team. Finally, the papers in this volume were refereed by a panel of internationally acclaimed experts in learning and teaching. At each stage in the review process, feedback from reviewers was returned to the authors and changes made. Papers were then edited by an experienced journal editor. Not all projects were sufficiently complete to be able to be reported in this volume.

As well as publishing their papers in this volume, participants will be encouraged to share their findings with their colleagues. The first opportunity for all participants to present their work as a group was the LEAD seminar at Macquarie University (in February 2008), though by that time some had already presented their ideas at other prior conferences. Other opportunities will follow at future conferences and in professional journals.

4. The projects

4.1 The virtual laboratory

The aim of the project is to allow off-campus access to specialist software through a web browser. Students who require software for their subjects either have to buy a licence for home use or have to come to campus to use the laboratories there. Technical hitches have meant that this project is not complete, though it is working in prototype.

4.2 Generic skills in accounting

This project aimed to develop writing skills in a second year accounting Information Technology subject. Many of the students were speakers of languages other than English and it was felt that they needed assistance with their technical writing. Students were given extended weekly writing tasks which were marked and returned quickly. The marking was very onerous for the teaching assistants and the improvement in results for the students was not significant. This teaching intervention seemed not to be successful and is not reported in depth due to problems with ethics clearance. A different approach to developing writing skills needs to be considered.

4.3 Mapping graduate capabilities in marketing

In retrospect, this project could have been more ambitious. A research assistant was able to map graduate capabilities in a week and disseminate the results to the department involved. The RA took all the published subject information and created a spreadsheet which clearly showed which capabilities were over-assessed and which were under-assessed. This was done by listing the graduate capabilities required and mapping capabilities assessed in the learning tasks against these capabilities. A more difficult task, which was not done here, would be to validate the graduate capabilities with those actually required by graduates.

4.4 Evaluation of peer assisted learning

Peer assisted learning (PAL) has been used in the Division for some years and there is interest in expanding the program to include more subjects. However, PAL is expensive to run, so an evaluation of the current program was undertaken to advise on ways to improve or expand it. The evaluation uses qualitative measures (focus groups of students and peer leaders) to assess the effectiveness of the program.

4.5 Training teaching assistants

Examples of subjects from around the globe were collected and a curriculum was designed that would be suitable for the subjects taught by our Division. Due to the long planning cycle for new subjects, this will not be introduced until 2009.

4.6 Online quizzes for Operations Research

Many students are enrolled in this subject and the problem was the need for quick feedback to students on test results. Online tests using randomly generated questions have solved this problem and have resulted in higher pass rates and more positive responses from students.

4.7 Student learning approaches

Previous studies have shown that students' learning approaches often become narrower over the course of a university degree. This project aimed to investigate whether this was true for our students and, if so, to propose curriculum strategies to broaden learning approaches. In particular, it was speculated that students whose first language was not English would have a narrower approach in general to learning. This supposition was not found to be true, and the only significant difference was found between undergraduate and postgraduate students.

4.8 Developing a statistical package

This project was developed in response to difficulties with teaching large class sizes and the perceived teaching advantage of using individual data for student assignments. The package developed will provide students with an individualised assignment. It is being trialled over the summer courses (January/February in Australia) as there are smaller numbers enrolled in these. During the standard year (in both Semesters 1 and 2) there are usually 1 000 students enrolled, so the risk of trialling software using such a large group was considered to be too high. As this project is not complete the results are not reported in this volume.

4.9 A transformed approach to teaching statistics

What can you say about statistics in two minutes? Two hours? Two days? This project has developed and trialled an online textbook for students who are new to statistics. It takes a layered approach to move deeper into statistics theory and its applications, positioning the subject in a way that connects with students' life experiences.

4.10 Integrating a sociological approach to accounting

The common perception of accounting is that it is dry and full of numbers. This project looked at the integration of sociological concepts into the study of accounting education, with an emphasis on the themes of social construction and social power. The purpose was to raise student awareness of the nature and functions of accounting in contemporary society. The evaluations were positive.

4.11 Reading skills in accounting

This project sought to integrate academic literacy skills into an elective intermediate accounting subject. It was based on setting academic reading and writing tasks through a series of graded published articles, with the aim of preparing students for their senior year and for the workplace. The evaluations were positive.

4.12 Spreadsheets in actuarial science

This project also examined graduate capabilities. Students, graduates and employers were surveyed about their use of spreadsheets in actuarial science, and it was found that curriculum changes to include a greater use of spreadsheets would assist graduates as they move into industry.

4.13 User uptake of a quick vocabulary tool for graduate students

Many graduate students in Australia have a first language which is not English. This project observed user uptake of concordancing software aimed to assist them with the usage of specialist vocabulary in the writing of their literature reviews. With the small group of graduate students used in this study, the results have been encouraging. The results are too preliminary to be reported here.

4.14 Feedback to students

Feedback has been identified as an area where students are often dissatisfied with their university studies. This project used focus groups to find themes, and a survey was designed around these themes to identify students' preferences. The survey was administered to 1 000 students and the results have already been used to refine policy and practice.

4.15 Learning in lectures

This project aimed to video-tape small segments of lectures and use these to assist students to learn better in lectures. Due to staff shortages in the area of student support services, the leader of this project was unable to allocate sufficient time to the project and so it was withdrawn.

5. Outcomes and future directions

Nine out of the 15 projects that began in 2007 are reported in this volume and five others will be completed in another six months. This is a good success rate for the time period and shows how a targeted program including support can make a difference.

There was a range of positive outcomes for both students and staff:

(1) Demonstrated improvements in learning for most projects (some are still in progress)

(2) An enjoyable and focused way to participate in professional development and learn new skills

(3) The participants learnt about evaluation of their own practice, ethics processes and writing papers about pedagogical improvement and practice – the articles in this edition are the demonstration of such writing

(4) The participants learnt to work with research assistants and budgets

(5) The participants learnt to overcome the typical constraints and glitches in any project

(6) The participants felt valued by the Division and the University

(7) One participant has enrolled in graduate study (PhD) because she enjoyed the experience so much

(8) Four conference papers have been presented at international conferences and journal articles are in preparation.

Another important outcome is the team-building aspect and the connections formed amongst the participants. It is very easy to work only with your close colleagues in the same department, working in offices close to you. The LEAD project encouraged mixing across departments and levels, and also between academic and non-academic staff – an illuminating and enjoyable experience. We all learnt about the challenges and excitement of other areas. We also learnt that problems that seem to exist only in our teaching area are in fact often common in other areas. Dissemination of project outcomes and cross-fertilisation meant that teaching developments in one area could be considered and implemented in another.

A University-wide seminar was conducted on 22 February 2008 where each participant presented their innovation to the university community. Publication in this volume of *Asian Social Science* has been a great incentive to write up results and disseminate them to a wider audience.

A second team, LEAD2, will start in July 2008. We have found that a one-year cycle (two semesters) is likely to be too short for planning, implementation and evaluation of a learning development, so LEAD2 will run over three semesters, starting in July 2008. We are looking at ways to incorporate more student input, and perhaps to allow students to participate in the proposal and selection phase. It may be illuminating for staff to see what kinds of projects are proposed by students.

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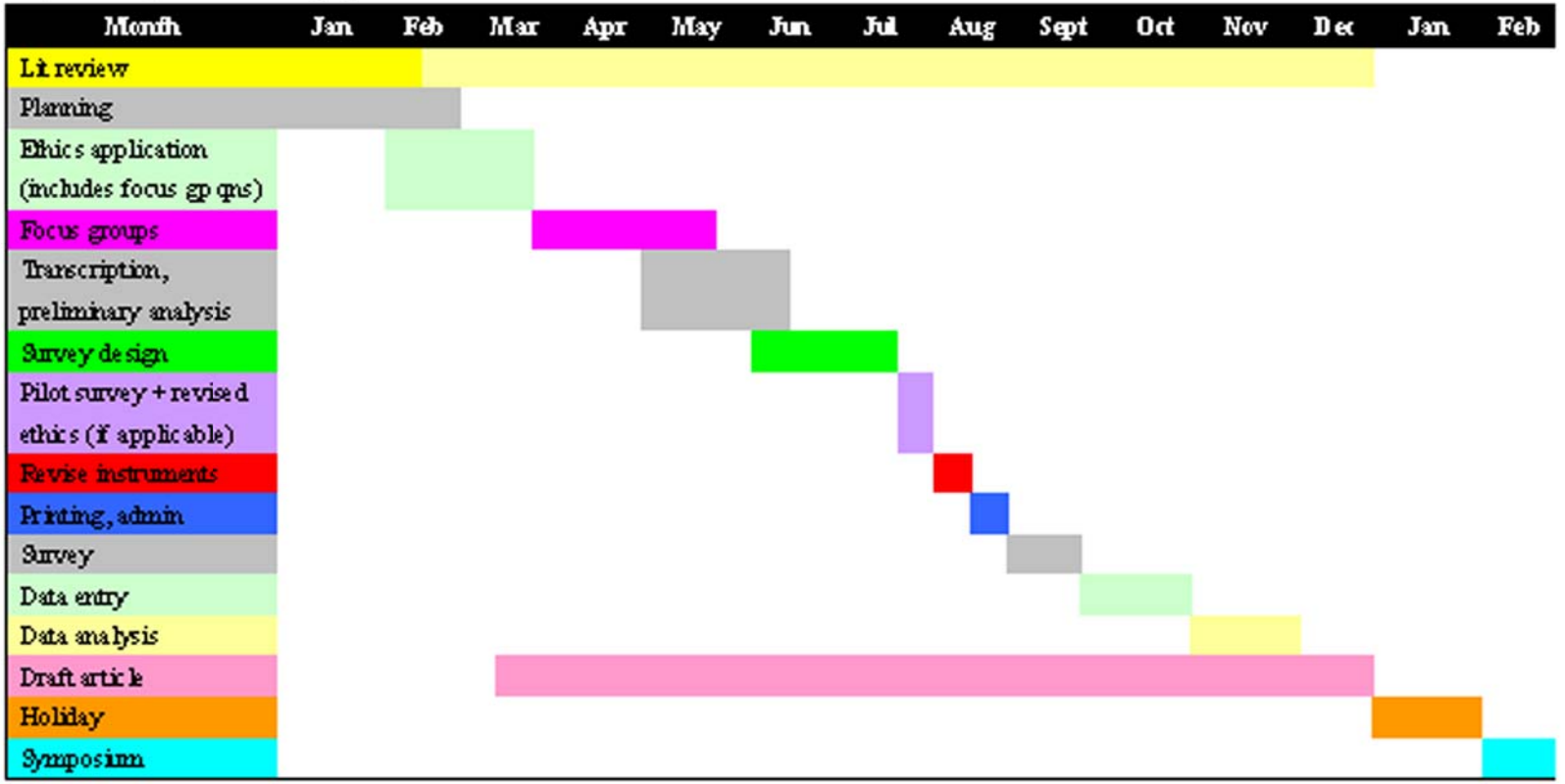
Appendix A. LEAD projects, project leaders and support personnel

	Project	Department	Support
1	Implementation of *Virtual Laboratory*: Using the Division laboratories remotely	Division IT	Ian Solomonides
2	Generic skills: Exploration of generic skills in accounting	Accounting	Leigh Wood
3	Mapping learning in Bachelor of Commerce – Marketing	Business	Leigh
4	Evaluation of peer assisted learning	Economics	Leigh
5	Developing a pool of qualified undergraduate teaching assistants	Actuarial	Leigh
6	The development of online quizzes for operations research	Statistics	Peter Petocz
7	Approaches to learning statistics: Cross-cultural learning behaviour among university students	Statistics	Peter
8	Evaluation of the *WebStat* statistics learning package	Statistics	Ian
9	Developing a 'transformed' approach to teaching first year university statistics	Statistics	Peter
10	Integrating sociological and related concepts into the study of accounting	Accounting	Ian
11	Reading accounting theory and research: A guide for students	Accounting	Leigh
12	The effectiveness of Microsoft Excel as a tool in teaching and learning financial and actuarial mathematics	Actuarial	Leigh
13	Quick Vocabulary Tool for non-English speaking background higher degree research students and staff	Division	Ian
14	Effective and efficient feedback to students	Division	Leigh
15	Learning in lectures: Using video	Division	Ian

Appendix B. Project management tool for project 14



Notes: *Literature review continues through project, but main thrust at beginning

*Drafting articles and reports starts early and continues through project

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Digital Infrastructures, Higher Education and the Net-Generation of Students

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Abstract

Students currently in higher education in the industrialised world have unprecedented access to web-based technologies and tools, and are likely to have engaged with online activities throughout their educational experiences. More widely, there is increasing pressure on universities to provide flexible learning environments and access to resources. This is keenly felt in the computer laboratory, where once dedicated, stand-alone machines provided software packages for students to work on during timetabled sessions. In recognising the move away from such patterns, Macquarie University is developing software and infrastructure to enable distributed access at any time to students, thus making a conceptual and physical shift from so-called 'Local Area Networking' to 'Wide Area Networking' and enabling greater freedom of access. The initiative is from within the Division of Economics and Financial Studies (EFS), but is applicable to students of any discipline in any university. This paper describes the development and discusses some of the implications for learning and teaching.

Keywords: Engagement, Remote access, Distributed learning

1. The changing use of educational technology

Technology has not just changed the tools we use in daily life – it is changing social habits, behavioural norms and expectations – (Oblinger, 2006, p.5)

In the quote above, Oblinger refers to changes in the expectations of students born after 1990; those who have come to be known as the 'net generation', 'millennials of the net generation', 'neo-millennials' and so on. These students are familiar with and rely on the Internet; they are 'net savvy' and "comfortable and confident in online environments" (Lorenzo, Oblinger & Dziuban., 2006, p.2). In these environments they expect to be able intuitively to operate the interface or software tool in order to achieve their particular goal, or to explore the digital environment. Moreover, these students are used to a certain immediacy of access to information, where and when they want it, placing new demands on IT services and professionals within higher education institutions. Dede (2005, 2006) anticipates a 'location and physical infrastructure' dimension to neomillennial learning, suggesting that resources such as computer labs that accomplish specific activities in specific locations will in the future be distributed over space and time, and that the notion of 'place' will be dispersed to "fragmented, fluctuating habitats" (Dede, 2006, p.16). He describes these as 'multi-purpose habitats' rather than specialised locations. Within these distributed and non-specialised locations, it is expected that 'Web 2.0' (O'Reilly, 2006) online applications will be easily shared and will enable interaction with software, people or information, wherever one has access to the Internet. The technological and social changes described above mean that higher education institutions have political and economic choices to make about how they respond to these new challenges, opportunities and dilemmas, as suggested by Wager (2005):

Matching institutional practice with technical features is another decision point; most likely there will be a mismatch. Should institutional practice match the capabilities of the IT system, or should custom IT solutions be developed to meet the service needs? With the former, changing the institutional culture is at best difficult, and at worst divisive. With the

latter, the institution loses the leverage of maximizing future system growth and enhancements unless corresponding modifications are made to custom software modifications. (Wager, 2005, p.18)

There is evidence (Krause, Hartley, James & McInnis, 2005, pp.41-46) that the majority of Australian students (90%) have adequate access to computers and that there is an "almost universal" use of online materials, "with 95 percent of first years saying they used web-based learning and course materials" (Krause, 2005, p.5). Coates (2006a) expresses some concern that these students are being, "treated as unproblematic 'users' rather than 'learners' engaged in the complexities of constructing their knowledge … [and that] we do not know much about how undergraduate students engage online with activities and conditions likely to promote learning and development" (Coates, 2006a, p.2). We do know, however, that Australian university students spend less time in private study than they did a decade ago, with an average of 16 hours class contact and 11 hours private study (Krause, 2005, p.5). The corollary must therefore be that if there is anything we can do to make access to laboratory-type work easier, more seamless for the student, and afford the students an online environment conducive to their learning, then we may be enabling better engagement with the learning required in the limited time that is available.

The technology itself has changed; what were once 'stand-alone' computers, each with their dedicated software, became networked into a 'local area' (or LANs) then with the development of other applications and wireless technologies have become 'wide area networks' (or WANs). The opportunities afforded by such technology can be capitalised on so long as the human interface has integrity and ease of use. This move toward the WAN is more indicative of the humane and reflexive use of technology called for by Norman (1999) when he suggested that, at its best, computing technology can afford:

New modes of interaction, of learning … Products in the world of information technology have suffered far too long under the existing technology-centred designs. It is time for a change, time for a human-centred design philosophy. People are not machines, they have very different requirements (Norman, 1999, p.261).

In this case the technology has enabled a new pedagogy, one much more appropriate to today's student and that enables access to study materials and tools whenever and wherever students wish. This leads to a recommendation, that the technology should meet the needs of the user rather than the user having to conform to the needs of the technology. In turn, another recommendation might be that the technology should be as unobtrusive as possible; and another, that the modes of learning be fully understood and explored to maximise the benefits afforded by the new remote-access opportunity. This may of course have implications for the design of curricula and teaching methods.

2. Remote access in the context of Macquarie University

At Macquarie University, there are about 1 650 student computers spread across 60 student computing laboratories of various sizes. These support the computing requirements for a total enrolment exceeding 31 000 students, of whom just over 11 000 are postgraduates and approximately one-third are international students. These computing laboratories are used both for classes and individual student study. Most are dedicated resources in so far as they contain the relevant software applications required for students to complete their coursework. The University maintains a wireless network that covers a large portion of the outdoor area surrounding academic buildings, and provides basic Internet access for students who bring their own laptops onto the campus. A significant proportion of the dedicated student computing laboratories are managed by the various academic Divisions within the University.

The Division of Economic and Financial Studies (EFS) is one of the largest academic faculties within the University. It has an enrolment of approximately 13 000 students, including about 3 000 postgraduates. It has a higher ratio of international students than the University as a whole. The Division provides around 450 student PCs, spread over ten student computing laboratories of various sizes. These are all dedicated computing laboratories containing the software applications required for EFS students, and are used jointly for classes and individual study.

As software licensing arrangements for many of the required applications often restrict access to within the University environment, typically students have been required to travel to campus to undertake the computing requirements of their coursework. At popular times this may result in them having to compete for the resources. A further limitation for students is that large student numbers generally entail large class sizes, and several EFS Units have enrolments in excess of 1 000 students. Hence the Division is keen to embrace technology to improve its students' learning experience and engagement.

As a consequence of the above, some educational objectives and imperatives are starting to emerge. Remote access to software applications and data that are currently available only on campus and from specialised, discipline-specific computer laboratories would make the access to material more efficient. Further, this accessibility should encourage learners to engage with the material at a time and location they perceive to be most conducive to learning and their material needs at any given time and space. The objective is to utilise web browsers to provide this accessibility with the imperative that students would be able to access whatever software program they wish, and indeed have multiple applications open in different windows if so desired. The EFS Virtual Lab therefore has the aim of enabling students to access computer laboratory applications on any computing device, from any location, at any time. Whilst this initiative

and innovation is being developed in EFS and at Macquarie University, the software could be used by students of any discipline within the University; and potentially by any university seeking to distribute and enable remote access to computer-based applications.

3. An emerging solution and product

Given the contexts described above, a Product Design Specification (PDS) for the EFS Virtual Lab was developed. Consultations with students suggested that they would welcome the external availability of previously in-University-only software applications, but that the specification should primarily focus on the benefits for students. Such a user-centred approach is not surprising and the specifications we derived included the ability to:

(1) access all EFS student software applications, personal and shared data from any location;

(2) provide access at any time to all software required for their coursework;

(3) obviate the need to travel to campus to undertake individual study;

(4) offer on-campus access to software from any (rather than a dedicated) computing laboratory;

(5) enable units of study, regardless of their national or international location of delivery, to be supported by and with the same access to the required software.

When taking the developer and University perspectives into account, there were a number of additional primary technical performance and security specifications:

(1) accessible from any computing device that supports a web browser and a Java Run Time Plug-in (such as laptop, PDA and so on);

(2) printing and file saving can be performed locally;

(3) performance times comparable to those on campus;

(4) a scalable system for a potentially large number of users;

(5) encrypted information transfer; and

(6) password and authentication protected.

To meet these specifications and to extend computer laboratories beyond the confines of the University, a number of technology components have been integrated. Software drives the integration of server-based applications, web interfacing and the sessional information seen by the student. Each student sees only his or her session, which is managed transparently and independently by a server. To gain access the student connects to the Virtual Lab website, part of the University's web pages. This opens a secure 128bit encrypted connection and once authenticated a Java applet runs and presents a menu of applications available to the student. This happens at the beginning of each session and, unlike ActiveX controls, nothing is stored on the student's computer. Essentially this means that any computer terminal anywhere in the world can be used to access the menu of applications made available by EFS. To conform as closely as possible to the design specification, the requirements made at the user end of the system have been kept to a minimum. This implies avoiding the need for any software or configurations required specifically in order for the user to access the Virtual Lab and thereafter to access the applications they want. The Virtual Lab architecture is represented in Figure 1.

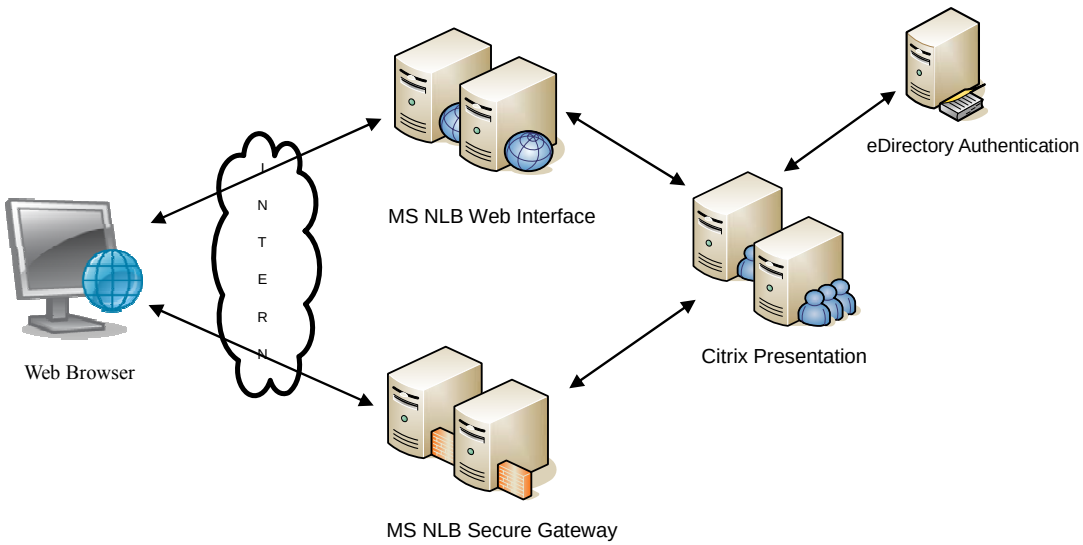

Figure 1. Schematic representation of the EFS Virtual Lab

At the time of development, a Citrix solution was selected. Citrix enables users (in this case students) to access applications hosted on another computer, that is, two physical servers each running Citrix Web Interface and Citrix Secure Gateway. Behind these servers is a 'Citrix Farm', currently containing two Citrix Presentation Servers, which are incrementally scalable to cater for any increase in demand. This means that several users can access the same application at the same time. The only requirement is that the users have a web browser (such as Internet Explorer, Netscape, Mozilla Firefox and so on) that supports a JAVA Run Time Plug-in at their end (that is, on their computers). In effect the students would be accessing the application from the server but it would not be downloaded onto their computer, even though the application would appear to be behaving just as though it were resident on their computer. There is a downside, however, in that choosing local printers and file locations is not clearly identified – so some familiarity is required by the user – but this problem will be addressed in subsequent versions. All of the processing is performed at the server end. The server hardware is duplicated and clustered for load-balancing and redundancy thus optimising availability and performance and ensuring the applications will still be available in everything but the worst-case scenario. When the student starts a session, the screen images are generated by a VMware ESX Server and are delivered by a Citrix Presentation Server in an encrypted state to the JAVA Plug-in on the student's machine. Java in turn presents the images to the student through a web browser as described.

Of course, security is an issue with any distributed computing practices. In the case described here, authentication and thereafter access to networked directories is provided through Novell eDirectory. Students use a web browser to establish a connection to the Web Interface Server via the specified URL (Uniform Resource Locator). As part of this process a secure SSL/TLS (Secure Sockets Layer/Transport Layer Security – cryptographic protocols) connection is established, and all information transferred from this point is encrypted. This preserves the security of the student's login details. Thereafter, the student sees a login page, into which they enter their username and password. When authentication is established, information flow is reversed and the Web Interface Server populates the web page with the list of resources. In this case, it is an icon for the EFS Virtual Lab. Students click on the icon, and a Java pop-up box will appear on the screen (if the Java Plug-in is not installed, students will be prompted to download it). From this point, all information flowing between the students' browsers and the Presentation Server is directed via the Secure Gateway. After a few seconds the Java pop-up box will disappear, and students will be delivered a virtual version of the EFS Student Laboratory, complete with applications, just as if they were on campus.

4. Evaluation

The project has two principle evaluation needs – an evaluation of the design solution from a pragmatic (how does it work?) perspective as well as a user-needs and characteristics perspective (how are the students using it and to what effect?). At the time of setting out the Product Design Specification (PDS), an evaluation matrix (Appendix 1) was developed that cross-referenced evaluation-type questions against data collection methods (see Georgia Technical College, 2007). This will inform the impending evaluation and has helped to focus design decisions throughout the development of the product. At the time of writing the distributed system has undergone technical evaluation, and we are at the very early stages of user evaluation.

To provide a comprehensive and realistic assessment of the success of this project, several evaluation methods have been considered. These include, amongst other things, expert review, implementation/user logs and system tests aimed at measuring how closely the technical requirements are met; together with observations, user interviews and user questionnaires aimed at measuring how closely student expectations are met.

User evaluation will be based on the perceived benefits to students emanating from the PDS. These are classified into four broad groups: Availability, Security, Performance and Design; and evaluation questions were formulated under each of these headings. Several relevant data collection methods were considered and, utilising the Georgia Technical College (2007) approach, an appropriate set of data collection criteria was established (shown in Appendix 1).

Availability is measured through technical evaluation via standards, testing and performance logs. These indicate whether the deployment meets the flexibility requirements of the PDS. Moreover, user confirmation provides feedback on how students value this. Similarly, performance is technically evaluated via standards, expert review, testing and anecdotal records. Measuring student expectations is, however, probably the most critical factor, as student perception of performance has an important influence on their perceived benefits of the whole product (Jordan, 2000).

Security tests and expert review reveal whether the installation has been configured to appropriate security standards, and that data encryption has been correctly deployed. Also, student feedback is sought to confirm that they are required to enter their username and password prior to gaining access, and that files copied between local and network folders are readable after transmission.

Design functionality includes characteristics such as intuitiveness, ease of navigation, consistent 'look and feel'. Expert review confirms whether the technology has been optimally configured in this respect. Already, some shortcomings have been described with respect to intuitiveness related to local printing and saving functions, and this has been

reinforced by anecdotal evidence. These are expected to subside as students gain familiarity with the application. Student input will be sought to determine the degree of difficulty faced, and to offer ideas that will assist students to accommodate this.

It has been assumed that associated benefits to students, such as increased flexibility and personal organisation, will enhance their learning experience, as suggested by several authors (such as Coates, 2006a, 2006b; Krause, 2005). As the application matures, students will be invited to assess and evaluate the affordances (Norman, 1998) offered by the EFS Virtual Lab. Several academics have indicated that their students would be keen to take part in user evaluations enabling a rich evaluative framework relative to the matrix in Appendix 1, the outcomes of which will be reported in a later paper.

Herrington, Reeves and Oliver (2006) have discussed the benefits of technology in freeing the (distance) learner from the constraints of time and place and thereafter have attempted to describe synergies between the learner, the task and the technology using a bipolar model similar to that in Figure 2.

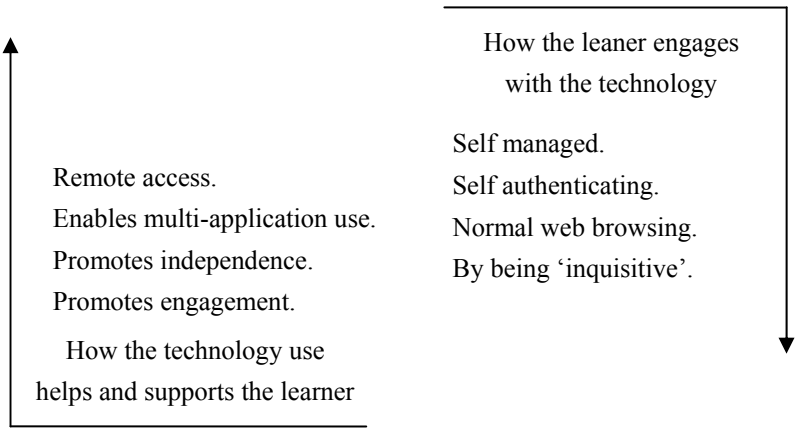

Figure 2. Synergies between Technology and Learner Engagement (After Herrington et al., 2006)

Figure 2 is constructed by balancing the perceived benefits (by the student of the technology) against the ways in which the students support and uphold the use of the technology. Initial discussions with the students trialling the system have revealed that they appreciated the ability to access their (multi) applications remotely and that this encouraged them to engage in more independent activity than they might normally otherwise commit to. It was the ability to explore the system and to work as and when they chose that most encouraged this independence. These perceptions are, however, based on some other precursors, namely the ability to do certain things such as open files, authenticate oneself as a user, and to generally drive the system to some personal self-satisfaction.

Results from this project have demonstrated that the concept of the EFS Virtual Lab, as specified in the PDS described earlier in this paper, is achievable through current technology, albeit with a slight limitation. Nonetheless, further research is required from a user perspective. The Evaluation Matrix approach was a useful tool in the evaluation process. We intend to make further use of it as we attempt to define the significance of the Virtual Lab to our students' learning experience, and measure the uptake rate.

Of course, one of the issues related to distributed learning is the downturn in opportunities for face-to-face working and collaboration. The student engagement literature places a positive emphasis on opportunities for collaboration and time spent on campus and within a community of learners. At first glance, the innovation described here could be seen as counter-productive in that it removes the need for students to be located together at the same time to undertake learning tasks. To overcome this problem and to reconceptualise the nature of learning (and learning support) in this environment, it is intended that some form of social-networking tool will be provided alongside and from within the EFS distributed website. This should provide the potential to encourage a virtual community of enquiry (Parsel & Duke-Young, 2007). Such a community of enquiry is ideally supported through discussion boards where students interact with each other for the purpose of learning collaboratively, and from the build-up of knowledge within the community. In short, the community of enquiry becomes a self-supporting network as students share practices, successes and failures with their peers. This affords more self-regulatory feedback in the hope that students become less reliant on the teacher for feedback and control.

5. Conclusion

We have described a product to our knowledge unique in higher education, which can be used to deliver software

applications required by students to do their course-work, anywhere in the world at any time with minimal user system requirements. Clearly this affords a number of opportunities for the various users, by no means limited to students of EFS or Macquarie University. The University is able to free up and increase access to space traditionally dedicated to stand-alone and LAN computer terminals, which are often tied to a particular discipline area. Many universities, including Macquarie, make extensive use of LAN-based technology to control and manage student access to the various computing-laboratory resources across campus, as this is the most effective technology for small, homogeneous, well-defined geographic areas. This is a widely adopted practice in teaching institutions as it provides greater opportunities for standardisation and access control. By implication, this necessitates students having direct physical access to computing laboratories. In contrast and in using the solution described here, a WAN technology is designed to cope with heterogeneous access over broad geographical areas. Information providers have little control over configuration of the equipment through which the information is provided. Hence, they are primarily concerned with the integrity of information flow rather than the associated equipment and computing hardware. This is particularly evident with the Internet, which is the most overt example of a WAN. It is in this paradigm that the EFS Virtual Lab resides, and therefore significantly differentiates it from the standard student computing-lab methodology.

The innovation described here enables access to the software used by EFS students from anywhere within the University, either from other University computing labs or over the wireless network. At a time of increased pressure and demand on such resources, this becomes particularly attractive and useful for the University's facility management. It also enables flexibility and accessibility for the students and this is seen as beneficial, given the rising need for students to accommodate other elements into their student life such as part-time working or at-a-distance education. Here then, we have a significant conceptual difference from a 'lock it down' LAN viewpoint to an 'open it up' WAN perspective. This reflects how an institution's choice of network technology can influence its IT delivery, and hence affect the way in which students interact and engage with IT as part of their learning environment. This approach could be applied across any institution and to any students (and staff) wishing to access software remote from a campus. Of course, the technology is only part of the system of implementation. Elsewhere we need to make well-informed decisions about how to introduce such changes to working practice and to assess the impacts they have on associated pedagogies.

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Appendix 1. Evaluation Matrix

	PERCEIVED BENEFITS FOR STUDENTS	DATA COLLECTION METHODS						
		Expert Review	**Implementation/User Logs**	**Tests**	**Anecdotal Records**	**Observations**	**User Interviews**	**User Questionnaires**
	Availability:							
1.	Can be accessed from any computing device that will support a web browser, and a Java run time plug-in	x				x		
2.	Students can remotely access all EFS student software applications, and personal and shared data, from any location (including Internet Cafes).		x	x		x		x
3.	Printing and file saving can be performed locally.		x	x		x		x
4.	Potentially provides students with 24x7 access to all software applications required for their coursework.		x	x		x		x
5.	Students are not required to travel to the campus in order to undertake individual study.						x	x
6.	Potentially enables students to work from any Student Computing Laboratory on campus. *(This will enable the University to offer these resources to students in a more efficient and flexible manner.)*	x	x	x				x
7.	Units can be packaged and delivered either locally or internationally in exactly the same format, as students (either local or international) will have the same access to Student Computing Lab resources. (Benefits to distance and international students.)	x	x	x		x		
	Security:							
8.	All data transfer is encrypted.	x		x				
9.	Students must successfully authenticate themselves before gaining access.		x	x				x
	Performance:							
10.	Performance times are comparable to those of existing EFS Lab PCs.	x		x	x	x	x	x
11.	The system is scalable, so that it can be expanded readily to support the needs of a large numbers of users.	x		x				
	Design:							
12.	User experience must be intuitive				x	x	x	x
13.	Must be consistent with current Computing Lab "Look & Feel" (branding)	x					x	x
14.	Ease of navigation				x	x	x	x
	Associated Benefits:							
15.	Flexibility				x		x	x
16.	Personal Organisation				x		x	x
17.	Comprehensive Functionality				x	x	x	x

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Peer-Assisted Learning in Accounting

A Qualitative Assessment

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Abstract

Since 2003, Macquarie University has operated a peer-assisted learning (PAL) program in several accounting units. This paper presents the results of a qualitative assessment of that program. The data were collected via a series of focus groups with student participants and student leaders involved in the peer-assisted learning program. The focus group discussions were transcribed and analysed. The results suggest that peer-assisted learning at Macquarie generates significant academic and non-academic benefits for all those involved. The analysis did, however, reveal a number of ways in which the program could be improved. Two areas stand out in this respect: first, it is essential that the program is suitably supervised by relevant academic staff. Second, the quality of the training given to PAL leaders is crucially important.

Keywords: Peer-assisted learning, Qualitative analysis, Focus groups

1. Introduction

The peer-assisted approach to student learning has been adopted by many institutes of higher education worldwide. It is utilised to facilitate learning in various fields, including economics, accounting, bioscience, law, vocational learning and medical education (Tariq, 2005; O'Donnell, 2004; Howman, Bertfield & Needleman, 2002; Sullivan, 2002; Evans et al., 2001; Coe et al., 1999; Playford, Miller & Kelly, 1999; Topping et al., 1997). In countries such as the UK and the USA, peer-assisted learning is a popular method of assisting students with subjects such as mathematics and chemistry (Atkins, May & Marks-Maran, 2005).

In Australia, universities are providing greater support and resources to peer-assisted learning (hereafter PAL) programs as a means of coping with the increased pressures on undergraduate teaching that have arisen over the past twenty years. According to O' Donnell (2004), these pressures stem from factors such as higher enrolments, increased numbers of international students and reduced government funding. Several Australian universities, including the universities of Queensland, Southern Queensland, Wollongong and Tasmania, now have established PAL programs. At Macquarie University in Sydney, PAL has been used in a number of accounting and economics units over the past several years.

So what is PAL? According to one author, "Peer learning can be defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions. It involves people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by so doing" (Topping, 2005, p.631).

The 'peers' who direct PAL sessions are students who have successfully completed the subject in the recent past. They have received training in non-directive leadership skills, and understand that their role is to facilitate learning, rather than to act as surrogate lecturers or tutors. Their role is not to re-teach the material covered in lectures and tutorials. The emphasis in PAL is on **how** to go about studying a particular subject. The emphasis is on thinking, reasoning, analysing, organising and problem solving (Congos & Schoeps, 1993, pp.2-3).

So while PAL does aim to help students improve their results and to 'pass the exam', the emphasis goes beyond this. O'Donnell puts it thus: "PAL programs also focus on developing a set of transferable capacities which then assist in improving grades in the targeted course and elsewhere. These competencies include independent learning, deeper learning, general problem solving, researching information, critical thinking and other generic skills" (O'Donnell, 2004, p.10).

In line with this, there is typically no prescribed content for a PAL session. Students bring along the things that they are interested in understanding. PAL leaders are meant to encourage students to formulate questions out of the things that they find confusing or unclear; this is what is meant by non-directive leadership. When a specific question has been formed, those in attendance are asked to help construct an answer. PAL leaders attempt to stimulate interaction, to use group work, and to develop problem-solving activities (Congos & Schoeps, 1993, pp.2-3).

Of course, for PAL to succeed it is necessary for academic staff to monitor the program. Indeed, Topping (2005) argues that the effectiveness of PAL often depends on whether the program is organised and implemented well. A key issue here is maintaining the right balance between the legitimate aspirations of students to pass the exam, and the broader pedagogic aims of PAL; a point that is made by O'Donnell (2004, p.10) in his assessment of the Macquarie experience. As will be seen in Section 6, this is also an important point to emerge from the research reported here. This paper contributes to the ongoing monitoring of PAL by undertaking a qualitative examination of the experience of PAL at Macquarie University.

The rest of the paper is structured as follows. The next section of the paper reviews the relevant literature. In Section 3 the operation of PAL at Macquarie University is described. In Section 4 the specific objectives of this study, and the methodology employed, are discussed. In Section 5 the qualitative feedback obtained from the focus groups is outlined and discussed. In Section 6 the implications of the analysis for learning and teaching at Macquarie University are examined. Section 7 offers some concluding comments.

2. Literature review

2.1 Academic benefits of PAL

Research suggests that PAL programs can produce significant academic and non-academic benefits for students and PAL leaders (Ginsburg-Block, Rohrberk & Fantuzzo, 2006; Tariq, 2005; Atkins et al., 2005; Playford et al., 1999). The University of Queensland, for example, reports having had success with peer assisted study (PASS) programs in science, economics and business subjects (Playford et al., 1999). The researchers found that students who attended PASS tutorials in a first year science subject were 87.9% more likely to obtain a grade of credit to high distinction. Their study also revealed that PASS students perceived the group study sessions as being more effective than isolated study (Playford et al., 1999).

Playford et al.'s study also provided evidence that PASS fostered a deeper understanding of the subject matter. Facilitating deep learning strategies is optimal as it enables the students to develop a superior understanding of the subject and its interconnections with associated topics (Biggs, 1993; Atherton, 2005). Peer-assisted type tutorials may achieve this by encouraging students to become more active and independent in their learning. In addition, at Macquarie University for example, the PAL program tends to focus on the most significant and important areas, relate previous knowledge to new knowledge, link theoretical ideas to everyday situations and experiences, as well as organise and structure the PAL tutorial content into a sensibly complete concept. Such methods have been theorised and defined as "deep learning" approaches (Marton & Säljö, 1976; Ramsden, 1992; Biggs, 1993).

A more recent study by Atkins et al. (2005) examined the success of a PAL-based mathematics aid program at Kingston University in the UK. The program aims to facilitate learning and understanding among undergraduate students taking a mathematics or statistics subject. The study involved interviews with students who had attended the program. Students reported that overall the program helped them to obtain higher marks in their assessments as well as a greater in-depth understanding of mathematics topics.

A study by Finlay and Faulkner (2005) also demonstrated the academic benefits of PAL in a less-structured environment. They developed several reading groups for a third year Exercises and Sports Science subject and for a Masters level Media Studies subject. Each group comprised 3-5 students. The main aims of this project were to a) encourage students to engage with a broader range of literature, b) promote critical thinking around issues specifically related to their subject area and c) to facilitate active learning through "peer-learning" and shared understandings. A survey of the students who engaged in the reading groups revealed generally positive experiences. The students expressed the view that they had gained greater critical insight and thus deeper understanding of their subject areas, as well as time management skills.

Overall, these findings suggest that PAL programs can foster significant academic progress with regards to improved grades and greater understanding of the material at hand. It would appear that students who attend PAL also have the opportunity to develop valuable skills such as deep learning strategies, critical thinking, time management and

communication skills.

2.2 The PAL tutorial – an ideal learning environment?

The unique setting in which PAL is delivered may be a significant factor contributing to the beneficial outcomes it produces. The setting for PAL aims to be a more relaxed one than that of a formal lecture or tutorial. For students, it would appear that this stress-free and peer friendly learning environment is one of its major attractions. A recent study by Tariq (2005) surveyed 114 undergraduate bioscience students at the University of Central Lancashire in the UK. The study revealed that the majority of students found PAL to be an extremely valuable experience, with 85% stating that they enjoyed the comfortable and less formal environment of the PAL session. The students perceived that this relaxed atmosphere allowed greater freedom to ask questions than in staff-led tutorials, and this further assisted them in developing a deeper understanding of the topics being covered. The study also found that students valued the opportunity to discuss ideas and questions with students and peers who had the same level of understanding. They were pleased as well when examples of exam questions were provided as this gave them an indication of what to expect at exam time (Tariq, 2005).

Similar findings were established by Finlay and Faulkner (2005), who found that the main benefit reported by students who engaged in a peer-learning reading group was the "space" the group provided to share their ideas, knowledge and theories with one another. According to Boud, Cohen and Sampson (1999), this uniquely relaxed environment facilitates one of the most important aspects of PAL, that is, reflection and examination of the subject with peers, and the development of expressive and receptive communication skills.

The environment that PAL intends to achieve is one in which students are encouraged to engage in an active learning process involving discussions and interactions. The availability of such learning opportunities is particularly important when compared to the less engaging and passive learning environments that commonly exist in lectures and tutorials, which may in turn be directly attributed to the ever-increasing numbers of students enrolling in university.

2.3 Additional benefits of PAL

While it appears that PAL can help students achieve significant academic gains, there are also beneficial non-academic outcomes to attending such programs. These outcomes include social development, self-concept and positive changes in attitude (Ginsburg-Block, Fantuzzo & Rohrbeck, 2006; Fantuzzo & Ginsburg-Block, 1998). This is important when we consider findings from research studies that have shown that links exist between academic achievement and factors such as self-esteem, self-concept, friendship and social skills (Eccles, Roeser, Wigfield & Freedman-Doan, 1999; Parker, Rubin, Price & DeRosier, 1995). A recent meta-analysis examining the socio-emotional outcomes of PAL interventions with elementary school students found that such programs can result in positive social, self-concept and behavioural outcomes. Furthermore, significant positive associations were established between these social and self-concept outcomes and students' academic achievement (Ginsburg-Block et al., 2006).

Similar findings were established in Tariq's (2005) study examining feedback on PAL from 112 bioscience undergraduates. The study found that the majority of students not only reported PAL to be a valuable and positive learning experience (80%), but that many students also found the experience to be confidence building (69%). By the end of the program, 74% of the students felt more confident, and 82% felt more knowledgeable in regards to their numerical and problem-solving abilities (Tariq, 2005).

PAL programs may also be helpful in areas such as social integration at university. They provide an environment for students not only to discuss academic issues but to forge friendships with classmates and peers that may become long-standing and important relationships throughout life. As mentioned earlier, such factors can have significant effects on academic achievement. For international students, PAL may provide an important opportunity not only to make friends but perhaps to integrate more readily into Australian society, and share their experience with students who have previously, or are currently, undergoing the same changes and similar process.

2.4 Benefits to PAL leaders

Typically, leaders are paid to run the PAL sessions and attend weekly lectures in the subjects they are tutoring. The leaders undergo training sessions by the PAL co-ordinators regarding how to organise, open and lead sessions, as well as managing class assignments, tasks and group discussions (Playford et al., 1999; Tariq, 2005). Some studies have found that leaders also benefit greatly from the experience, for instance the sessions can provide an opportunity for them to develop an even greater understanding of the material they are tutoring. Furthermore, there is an opportunity for the leader to develop various skills such as leading a group, organising materials and sessions, time management, teamwork, monitoring student's progress, communicating and public speaking (Playford et al., 1999). Studies have also found that PAL can have positive effects by increasing the self-esteem and self-confidence of the leaders (Howman et al., 2002; Saunders & Gibbon, 1998).

3. PAL at Macquarie University

At Macquarie University, PAL has been used in the following accounting units since 2003 − ACCG105 Introductory

Financial Accounting; ACCG200 Fundamentals of Management Accounting; ACCG201 Organisational Planning and Control; ACCG251 Accounting and Information Systems; and ACCG253 Financial Management. These are all large first and second year units and can have very high failure rates. For each of these units, there are numerous PAL sessions which run at different times throughout the day and evening. Prior to the commencement of the academic year, new PAL leaders attend a two-day training course. The course is run by the Resource and Information Centre, located within the Division of Economic and Financial Studies. On the first day of the course students are trained and advised on the essential components of the program and cover topics such as: the role of the PAL leader; the PAL leader and the student; how to open, lead and close a session; and how to ensure good communication skills and provide feedback to students. The training also involves learning how to prepare and run group activities and quizzes for students, as well as how to answer questions and assist them in their preparation for exams. During this training workshop, the new leaders are also required to prepare a simple mock session. On the second day of training, experienced leaders also attend to give feedback on the new leaders' mock sessions and provide insight into aspects of being a leader, as well as to remind them of some of the basic PAL rules and responsibilities. At Macquarie University, the major responsibilities of the PAL leader include: attending pre-semester leader training session; attending leader meetings; attending at least 50% of the unit lectures; leading at least two sessions per week; being on time and prepared for each session; and maintaining student attendance rolls.

4. Objectives of this study and methodology

Since its introduction in 2003, PAL has grown in popularity at Macquarie, particularly among international students. The literature reviewed in section 2 of this paper would suggest that PAL is associated with positive outcomes for both students and leaders. There has been to date one serious attempt to provide a quantitative and qualitative assessment of PAL at Macquarie, presented by O'Donnell (2004). The current paper attempts to add to this literature, in this case focusing on providing qualitative evidence. Specifically, the paper aims to provide some qualitative evidence regarding the academic and non-academic benefits of the program at Macquarie. Qualitative data was collected via focus group sessions with PAL students and leaders. The transcripts were analysed for themes, feedback and overall ideas with regards to the benefits of the program, its strengths/weaknesses, and where it can be improved.

Three focus group sessions were held with students who had attended PAL in Semester 1 of 2007. Participation was voluntary and students were informed that the aim of the focus group was to gather feedback regarding their experience as well as information to identify the direct and indirect benefits. Overall twelve PAL students participated. The focus group sessions ran for 25 – 40 minutes depending on the size of the group. The first group comprised three students, while the second and third focus group comprised seven and two students respectively. The students were asked the following questions: 1) What do you think are the goals of PAL? 2) How did PAL help you with your learning? 3) Would you recommend that other students come to PAL sessions? Why/Why not? 4) How do you think PAL can be improved?

A separate focus group was also held with several PAL leaders to obtain feedback regarding their experiences and to gain insight into the possible benefits of participating as a leader in the program. The leaders were asked the following questions: 1) What do you think are the goals of PAL? 2) What are your overall thoughts about the usefulness of PAL to students who participate in it, and to you as a PAL leader? 3) Do you feel that the training you received prior to your becoming a PAL leader was adequate? In what ways, if any, could the PAL training be improved? 4) What benefits did you personally gain from your involvement in PAL? 5) How do you think PAL can be improved?

5. Findings from the focus group sessions

5.1 Student focus group sessions

5.1.1 Academic benefits of PAL

Most students made statements that suggested they had an understanding of, and an agreement with, the broad pedagogic aims of PAL. Most students stated that it aims to facilitate learning and a deeper understanding of the subject matter. The following quote is typical of the responses of many students to this question: "I think the PAL is to help the student when learning the difficult subjects and in tutorial and lectures there may not be enough time to ask questions or understand more clearly but PAL can help them to in-depth learning the subject". Students stated that they believed the program aims to clarify their understanding of the topics by providing extra help in addition to the standard lecture and tutorial. The development and practice of problem-solving skills was another benefit perceived by most students in the context of deeper learning: "In the PAL session they give questions and help us to solve the problem and in that way students can learn more and better than in the lecture".

The majority of students stated that PAL helped them to learn mainly by allowing for question time, which is often unachievable in large lecture and tutorial sessions. This was noted clearly in several student statements: "In tutorial and lectures there may not be enough time to ask questions", and, "When I participate in a tutorial I don't have time to ask questions". Consequently many students choose to attend PAL because "there is more opportunity to ask questions" and

they feel "free to ask any question". An additional point many students mentioned was that the leaders were generally able to create a friendly, warm and relaxed environment wherein students feel comfortable asking questions and the leader can address and, "outline the difficulties that most students face". Many students further stated that they felt they could relate to the leader due to the leader's student versus academic status. That the program creates an environment in which students have the time and the confidence to ask questions and engage in discussion with leaders and fellow students, was a consistent theme in the transcripts. It seems that much of its positive impact is due to this.

There were, however, a number of comments which indicated that some students viewed PAL's goals more narrowly: "Because there are a lot of exercises in the book but PAL can highlight which one is the important one so you don't have to study the whole material". Students also noted that it provides information on "how to answer questions during examinations", as well as opportunities to gain, "examples and extra practice for exam questions". Another illustration of how some students perceive the goals in more narrow terms came when students were asked how the program could be improved. In response to this, some students suggested that the sessions should be "more structured" with "more sample answers to exam questions". It is not surprising that students who attend PAL may want both deep learning as well as practical help with content and technique aimed at improving their grades. The effectiveness depends, however, as O'Donnell notes, on getting the right balance between these objectives. If the balance were to shift away from the broader pedagogic aims of PAL, towards the shorter term goal of improving results in the unit at hand, the sessions could be, "reduced to tutorials or cram sessions" (O'Donnell, 2004, p.10). Maintaining the right balance is a real challenge for the program and for the leaders, who are at the coalface of the program. This is perhaps the single most important finding of this paper.

Interestingly, when students were asked whether PAL had helped improve their grades there were mixed reactions. Some students stated that they were unsure as to whether or not it directly influenced their overall mark, but were confident that it helped them with regards to studying and understanding the material; for example one student stated: "I don't think that PAL can help me to get a higher grade but to some extent it really helped me in my study. I think to get a higher grade or not it really depends on yourself". This highlights the fact that most of the students interviewed believed that intrinsic motivation plays a key role in doing well at university. Students need to study, and prepare for exams, and by just attending PAL a student will not pass the unit or get a high mark. This was also noted by another student who commented that he knew, "some students who do good in PAL and still fail". On the other hand, some participants were certain that it had a direct effect on their grades, particularly in their second year accounting units: "Yeah, we thought we would only get a pass grade but we got above credit and distinction grades … yeah … so we think it's (PAL) great!"

When asked whether they would recommend PAL to others, all twelve students stated that they would definitely recommend it and that many of them already had done so. A few stated that they would specifically recommend it if they knew someone who was struggling with the unit and coursework. Some of the main reasons that students gave for recommending PAL included: the close/friendly environment makes it easier to speak up; small-group learning facilitates question time and student discussions compared to large tutorials and lectures; the group leader is approachable and friendly, and you can discuss and communicate like friends; and the leader can also see problems from a student's perspective.

5.1.2 Non-academic benefits of PAL

Throughout the focus groups students also mentioned several non-academic benefits of PAL. They stated that one of the benefits is that it is a good place to get to meet new friends: "Yeah, I met three new friends from last semester's PAL group and we still keep in contact". This suggests that such a program can play a positive role in the integration of students into university life, helping students to form long-term friendships and bond with one another, as noted by one student who said that when she and her friend are at a PAL session they, "like to make some friends and enjoy conversation and discussing problems". Interestingly, all of the students who attended these focus group sessions were of Asian background and classified themselves as "overseas" students. This suggests that PAL may be of particular importance to students who attend Australian universities from other countries as it provides a significant opportunity not only to develop their knowledge in particular subject areas, but also to build friendships and share their experiences with others. The PAL session may also help international students integrate more successfully into Australian society through their interactions with the leaders, who are usually local students. Many students noted that their, "PAL leader is just like a friend".

5.1.3 Suggestions to improve PAL

Students were quite forthcoming with regards to providing suggestions and ideas on how the PAL program can be improved at Macquarie University. The most popular ideas included having such a program for third year units and increasing the length of the session. As already noted, many students also suggested that the sessions should be more structured with more sample answers to exam questions and more theoretical-based questions. Another popular suggestion was that all the sessions should run at the same level and should keep up to date with the material being

covered in current lectures. Several students also suggested that the leaders receive more training that focuses on areas such as teaching skills, language and communication and leadership skills.

5.2 PAL leaders focus group session

5.2.1 Goals and benefits of PAL

The leaders were in agreement that the main goal of PAL is to facilitate a deeper learning and understanding of the subject at hand, and also to achieve better grades. The leaders saw their role as being to provide direction based on their own past experiences and to help students develop basic skills, such as problem solving and answering exam questions successfully. The leaders noted that the major benefit of the program was that it made a level of discussion and question time available that is often not available to students in lectures and tutorials. The leaders noted that it is very much student-driven and, as noted by one leader: "We try to have more discussions and more questions and what makes it so special is that people sometimes ask quite basic questions … that they don't really dare to ask in tutorials or lectures". The leaders stated that it is through group learning and group discussions that the main goals are achieved. The leaders also agreed that attending PAL can improve student grades and their self confidence with regards to their knowledge. The leaders also noted that their role was a crucial one. As one leader put it: "PAL leaders are sort of that link between the tutor and the lecturer and the subject".

When questioned about the personal benefits they gained from their involvement in PAL, the leaders stated academic, social and emotional benefits. It enabled them to make friends, and they found it an enjoyable and relaxing experience. Some leaders stated that it helped build their confidence as well as developing key skills such as presentation and communication, including with people from different backgrounds and cultures: "I have a lot of new friends, I present much better than before and I speak much better English and now I am more confident too!" The leaders also stated that it provided an opportunity to refine their knowledge of the subject and key topics: "Another useful thing for me is refining topics and key points that I may have forgotten about when I was studying the unit". Two of the leaders felt strongly that the experience looks good on their resumés and job applications. Overall the student leaders were very pleased with the benefits and outcomes of the program for them.

5.2.2 Suggestions to improve PAL

While all of the leaders who attended the focus group were happy with the PAL program and its past and current achievements, they were in agreement that certain improvements need to be implemented to ensure it will be even more efficient and successful. The training received by the leaders was a major issue. Three of the leaders had attended a PAL leaders' training workshop two years previously and were not satisfied with the level of training provided. They stated that the workshop was too short, did not allow enough time for practice via mock sessions and they were not provided with enough feedback from superiors with regards to their performance: "We did have some small exercises but we didn't have enough time to prepare for them". The leaders also stated that during the training too much time was spent going over policies and procedures. They expressed the view that, "It would be better if they increased the time for mock sessions rather than going through the policies and procedures".

Interestingly, the PAL leader who had been trained last year stated that his "experience was so much different" from the other leaders. The training this leader had received involved a three-hour focus group that included discussions addressing particular issues, such as what the leaders will experience during their sessions; how to deal with shy and quiet students versus talkative and active students; what you should and should not do; as well as tips on how much time the leader should spend on materials and how to direct questions and raise discussions. This leader stated that he found this training "quite useful and practical". There was not much time spent talking about policies as the leaders were expected to read the handbook on this material. Overall, the leader believed that the three hours of training were spent quite well.

The contrast in these two training methods is clearly obvious. While the more recent method of training PAL leaders at Macquarie University seems to be more useful and practical, there is still much room for improving the training procedure and all of the leaders were in general agreement with how to implement such changes. The leaders suggested that more comprehensive training is definitely needed. Additional workshops, a greater level of feedback as well as more opportunities to practice and do mock sessions were other suggestions. The leaders also agreed that a helpful activity would involve having a superior/teacher sit in on their sessions occasionally to provide feedback to the leader regarding their tutoring skills and knowledge of the subject, with a view to highlighting the areas needing improvement.

The leaders stated that another challenge is the availability of rooms for the sessions. A lack of rooms can limit the number of sessions, resulting in bigger class sizes, which defeats the program's small-group learning strategy. The leaders also felt that additional sessions are definitely needed for certain units, for example some accounting units can have up to 1 000 enrolled students resulting in large PAL sessions. Three of the leaders strongly believed that the sessions should be longer and ideally extended by half an hour: "Like an hour and a half maybe, an hour for the exercises and thirty minutes for the discussions, that would be ideal". This was something that students also asked for.

The leaders also suggested that the program needs to be better advertised, as this is usually done via the first few lectures of each semester − those students who choose not to attend lectures (opting to listen to lectures via the internet) may be completely unaware of the PAL initiative. Some of the leaders also believed that as well as attending lectures, attending tutorials should form part of a leader's responsibilities. One leader stated that the rationale behind this idea is that attending tutorials further enhances the leaders' understanding of the material/topics they are required to cover in their sessions.

The leaders also felt that more coordination is needed between the actual lecturer in charge of the unit and the PAL leader with regards to what material is presented to students in the sessions and what topics/areas should be covered: "Coordination between the PAL leaders and the lecturer is needed and that the materials given out to students (in PAL sessions) are properly controlled … what I mean by control is that it's actually correct because sometimes there tends to be materials that are issued out to students that aren't entirely the right answers!"

6. Implications for learning and teaching

While PAL has been very well received by both leaders and students, it is clear that there is room for improvement and development in certain areas of the program. The two major areas worthy of further investigation relate to the monitoring of the program by academic staff, and the training of the leaders. We turn first to monitoring. To the best of our knowledge, a formal protocol for monitoring PAL by academic staff does not exist. The first task in relation to this is to conduct research about what actually happens in relation to this vital function. The research reported in this paper suggests that good monitoring is essential for two reasons: first, there is an ongoing need to ensure that the right balance is maintained between the competing objectives that students have for PAL. Without active involvement in the program by academic staff, there is an implicit expectation that it is up to the leaders to "get the balance right". This would be an unreasonable expectation. Second, the research reported here suggests that both students and leaders are asking for more staff involvement in PAL as a means of ensuring the quality of the program. The leaders in particular are asking for more supervision, feedback and general quality control. Again, it seems reasonable to expect that in the absence of appropriate monitoring by academic staff the overall quality of the program could suffer. We believe that it may be necessary to make the involvement of staff in the program more formal, and that a proper protocol should be developed for monitoring PAL. In recognition of the importance of this role, and of the added workload that it will entail, we think consideration should be given to including this monitoring work in the Department and Divisional Workload Models.

Several suggestions were made by leaders regarding the training they receive; these suggestions have merit and should be addressed. In addition, in light of the discussion about maintaining the right balance between the various expectations that students have for the program, it is clear this is something that should be given extra emphasis in the training sessions. Some additional implications of the research reported in this paper include giving consideration to extending PAL sessions to other units, particularly at the third year level. The way the program is advertised should be explored as well to see if the current practice is optimal. Both the students and leaders requested that the sessions run for ninety minutes, which could be explored further.

Much has been learned from the opinions and feedback provided by the students and leaders who participated in this study. The findings from this paper will be presented to the appropriate learning and teaching committees, the Dean of the Division, as well as Heads of Departments.

7. Conclusion

Overall the focus group sessions revealed that PAL has both academic and social benefits for students and leaders. Both groups believed that the main goal is to facilitate learning and understanding among students through group learning and discussions in a relaxed student-friendly environment. For students, the main academic benefits of PAL included the development of a deeper understanding of the subject, basic problem-solving skills and insights into how to successfully answer exam questions. For the leaders, an additional academic benefit included the development of communication, language and presentation skills. Both students and leaders stated that it also provides an invaluable opportunity to ask questions and discuss issues with classmates, which is often not available in the large lectures and tutorials. All of the students and leaders agreed that this question time is perhaps one of the most important aspects of the PAL program. There were a number of leaders and students who believed that it improved their confidence and self-esteem and was generally very beneficial. Many students and leaders also stated that it provided an opportunity to build friendships and this suggests that the program may play an important role in facilitating the integration of students into university life as well as with the transition from high school to tertiary education.

The research reported in this paper highlighted several areas where improvement could be made to the Macquarie University program; nevertheless, it gives rise to a general sense of accomplishment. This is perhaps best expressed by the fact that every student who participated in this project stated that they would happily recommend the program to other students. Furthermore, ten of the twelve students who participated in this project expressed their desire for more sessions, especially for their third year units. This strong demand for such programs within the Division of Economics

and Financial Studies at Macquarie University suggests that other divisions and departments within the university, indeed at other institutions, may benefit from instigating these programs. It is also clear that feedback should continuously be obtained from students and leaders. Such feedback can then be analysed as part of an effort to ensure the availability of an effective PAL program.

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Online Quizzes for Operations Research – A Case Study

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Abstract

A student's success in mathematically-based disciplines is directly related to the quantity and quality of the tasks provided, and to the feedback given on their efforts. With a class of several hundred students it is often impossible to provide enough assessable work, and to give detailed and timely feedback. In response, the Department of Statistics at Macquarie University has implemented online randomised quizzes. Students must pass each quiz with at most two errors, but the number of attempts is unlimited. Consequently, an assessment task becomes a learning tool, requiring students to practice techniques until mastered. Feedback is immediate.

At the end of Semester 2 in 2007, students completed a survey about their response to the quizzes. The results indicated that over 81% of participants liked the quick feedback and, furthermore, over 70% of survey participants believed the quizzes helped them to understand the concepts being taught.

Keywords: Operations Research education, Online randomised quizzes, Student survey, MacQTeX

1. Introduction

1.1 Background

Economics, accounting and statistics students in their third year at Macquarie University undertake the unit Operations Research II (STAT379), which has as a prerequisite, Operations Research I (STAT279), a second year unit. On average 500 students enrol in STAT279 per semester, while 150 students elect to do STAT379, on average, per semester. For several years, the coursework component of both units consisted of a class test, weekly homework exercises (which were marked on attempt only), and for STAT279, two paper-based multiple choice quizzes. There was a heavy weighting towards the final examination. In both units the failure rates had typically been higher than desired. Because of the large enrolments it was difficult to provide more assessable work and useful feedback to support the students' learning. Staff felt that these difficulties were affecting both students' engagement with the material and their approach to study.

This is a common problem faced by university mathematics educators, and Groen (2006) and Keady, Fitz-Gerald, Gamble and Sangwin (2006) are among those who have developed computer-aided assessment as a solution. Groen found that students showed no preference for online assessment over traditional methods and that open-access conditions led to improved marks. For the staff member there were also efficiency benefits for marking, administration and resource use. These authors point out those economies of scale can mean that the more students who use a computer-aided system, the more worthwhile it becomes. Keady et al. recommend that the management goal for these systems should be keeping them simple, and note that increasing popularity of these systems will lead to continuing improvement.

Jacobs (2005) proposes that visual presentation can assist with learning difficult mathematical concepts, which computers and web-based applications can provide particularly when allied with interactive tools and animation. This paper deals with the development of an online differential equations course with graphics and interaction as key features of the course. Online assessment tasks were also developed, in the form of, "randomized multiple choice quizzes and

randomized worksheets" (p.765), where students were prompted to repeat question types until they can answer correctly. In a further paper, Jacobs (2006) states that the computer and web tools available can, "enhance enjoyment and satisfaction as well as presenting a broad visual overview to improve conceptual understanding" (p.1). Online assessment can be combined with the teaching mode to benefit the student's understanding. Online modules were created for two courses, "using a student-centred, interactive approach that adheres to the fundamental constructivist guidelines …" (p.2).

The success of blended learning methods (online and face-to-face) was investigated by Kaczynski, Wood and Harding (2007, in press) using a radar chart method of analysis, based on self-assessment of learning alongside a range of qualitative research methods. The authors found that online delivery should be used with caution since, "excessive online content appears to more rapidly overwhelm the student." (p.14).

1.2 Online quizzes used for learning, not assessment

In the past, paper-based quizzes were used in STAT279 to assess students' progress during semester, but STAT379 had no quizzes at all. The paper-based quizzes were used simply as an assessment tool, and as a way to ensure that students mastered some material part way through the semester. There was a considerable lag time (two to three weeks) between submission and return of the marked assessment task. Therefore, the paper-based quizzes were of no use in identifying struggling students early in the semester. Moreover, any feedback on the students' performance or on students' ability to cope with the subject matter generally came too late, making it impossible for them to address and rectify problematic areas. Furthermore, the paper-based quizzes created a heavy marking and administrative workload for academic staff. These difficulties prompted the search for an alternative solution, and so the possibility of using an online quiz system was explored.

The requirements for the type of quiz system were twofold: that students would gain proficiency and understanding of the topics presented, and that staff would be freed from large amounts of marking and administration. The former requirement led to a preference for a system that functioned as a tool for formative, rather than summative, assessment. Such a system would allow students multiple attempts at a quiz, provide feedback on their responses, give detailed solutions, and have a variety of question types other than simple multiple choice. The system chosen, MacQTeX, satisfied all these requirements and also included sophisticated randomisation, a text-entry question type, as well as two variants of multiple choices. Furthermore, MacQTeX is produced within the same university, facilitating customisation of the system and liaison with the developers. Details of the system will be given in Section 2.

During Semester 1, 2006, the paper-based quizzes in STAT279 were replaced by online quizzes, which were designed as a *learning tool* for students rather than simply a way to assess their progress. In order to emphasise learning rather than assessment, the students were expected to work on the quizzes until mastered. To make sure students participated fully a token weighting was given to the quizzes, based on a pass but not on the actual mark. Students were allowed to attempt each quiz as many times as they needed in order to pass it. A quiz is considered passed if the student makes at most two errors, where the quiz has between 12 and 20 questions or question parts. The randomisation feature of the online quiz system ensured that students were always presented with a different version of the quiz. After submitting their answers to a quiz, students were instantly provided with fully-worked solutions to the problems and feedback on their performance. This instant feedback enabled students to study the solutions and methods prior to making another attempt at the quiz. With the online quizzes, students' progress and workload were more evenly paced throughout the semester than had previously been the case. Furthermore, the online quizzes were shown to boost students' problem-solving skills and understanding of the subject matter noticeably (Griffin & Gudlaugsdottir, 2006).

Following the successful implementation of the online quizzes in STAT279, it was decided to design a similar set of quizzes for STAT379. Students progressing to STAT379 had indicated to lecturing staff that they had found the STAT279 quizzes in the previous semester very useful, both as an aid to their understanding of the concepts and as a means of consolidating their knowledge and techniques. A small set of online quizzes for STAT379 was trialled during Semester 1, 2007, and a larger improved set was implemented the following semester.

The design, writing and testing of the quizzes for STAT379 was funded by the Division of Economic and Financial Studies, which offers the unit. The development of new questions involved identifying the types of routine problems that would benefit the students, leading to increased technical facility and sound understanding of the underlying statistical theory. Appropriate scenarios which allowed sufficient variety and scope for randomisation had to be designed, and the quiz system itself was extended to allow for several methods of scoring answers containing multiple text-entry fields.

During the last week of Semester 2, 2007, students enrolled in both STAT279 and STAT379 were invited to participate in a survey. This was designed to provide information on students' reactions to the quizzes as an aid to learning, and to assess the usability of the system. Participation in the survey was entirely voluntary and students' responses were anonymous. In total, 375 STAT279 and 84 STAT379 students participated in the survey. This gave participation rates of 76% and 53% for STAT279 and STAT379 respectively. Results from this survey will be presented and discussed in Section 4 of this article, as well as being referred to in Section 2.

The outline of the article is as follows: in Section 2, a description of the MacQTeX online quiz system is given, including a brief outline of certain technical aspects of the system. The implementation of the online quizzes and the design of the student survey is outlined in Section 3. The results from the survey are presented in Section 4 and, following on from that, the effect of the online quizzes on teaching and learning is discussed in Section 5. Section 6 contains concluding remarks.

2. The MacQTeX online quiz system

2.1 Quizzes

The MacQTeX online quiz system was developed in the Department of Mathematics, Macquarie University, and has been used for several years by that Department. The quizzes do not require students to install any special software, and are accessible at any time and from any location.

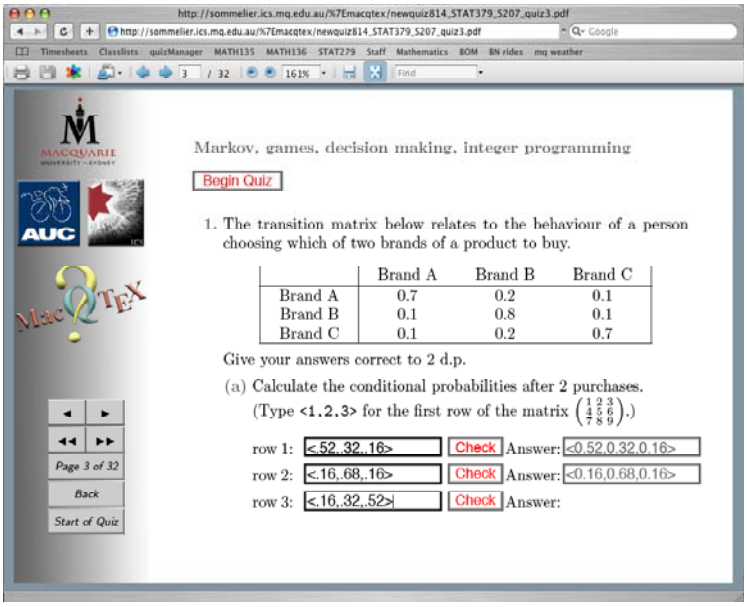

Figure 1. A typical multi-part quiz question , for which the student has chosen to check the answer before continuing

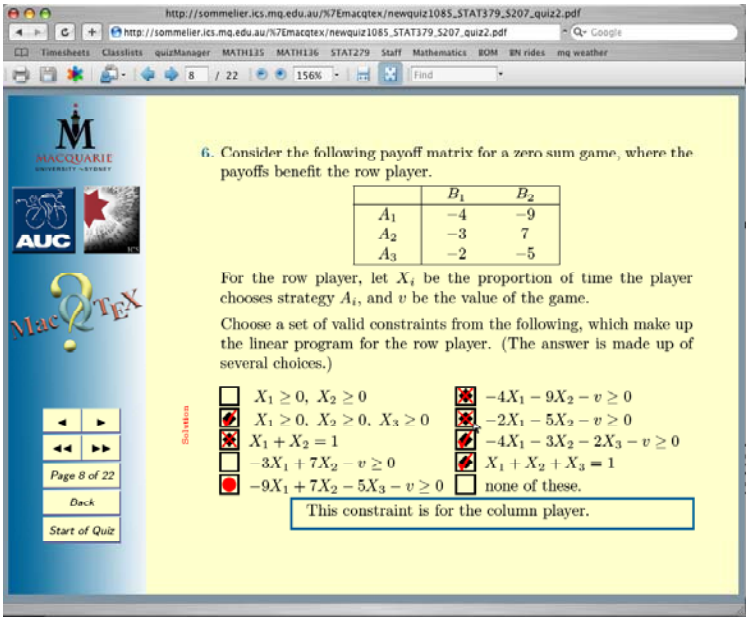

Figure 2. A multiple response question in a quiz that has been submitted and marked.
The correct and incorrect answer choices are indicated, and a hint is displayed to explain why the selected answer choice is wrong.

The quizzes are presented as interactive PDF documents, containing form fields similar to those one would see on a standard web page. The question types include multiple choice, multiple response (the correct answer is comprised of

several choices) and fill-in-the-answer. The last accepts numeric, text or mathematical expressions as input, with the ability to interpret mathematical expressions and recognise those that are equivalent. Multiple response questions are particularly suited to helping students remember definitions, or to interpret output from data analysis software. Examples of a fill-in and a multiple response question are shown in Figures 1 and 2 respectively.

All processing of answers and calculation of scores is self-contained. This provides much faster operation than in many other quiz systems, which contact a server for every action the student takes. A further advantage of client-side processing is that a student may review and change answers at any time until the completed quiz is submitted to the server. Of students surveyed, 80% (STAT279) and 86% (STAT379) responded that they liked this feature.

Various parameters in the questions are randomised, so that students may attempt many versions of the same quiz, thus gaining valuable practice. The randomisation can apply not just to numeric parameters, but also to the form of mathematical expressions, such as the type of function or dimensions of a matrix, and to scenarios relating to data sets. On completion of a quiz, it is marked automatically and fully-worked solutions become available, giving students immediate feedback. The solutions are not simply models, as all calculations are performed with the specific random parameters used in the questions. An example involving graphics can be seen in Figure 3. According to the student survey, the level of detail in the solutions was considered sufficient by 74% (STAT279) and 70% (STAT379) of participants.

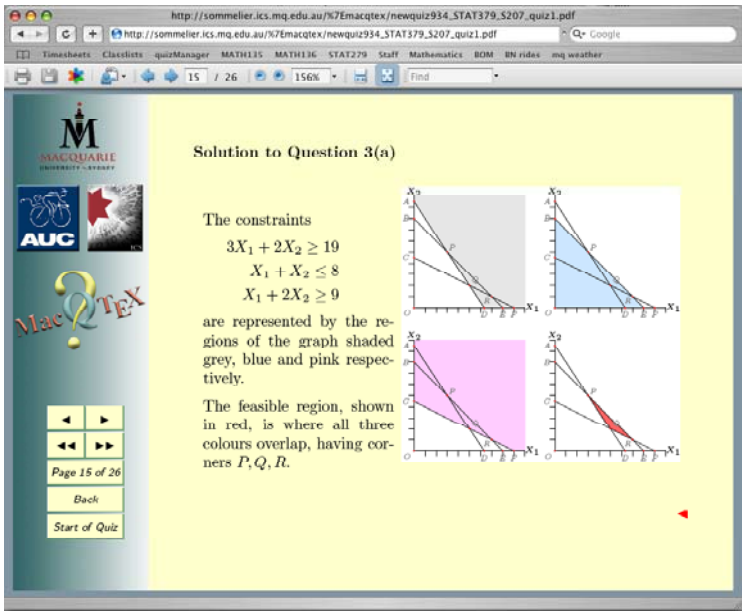

Figure 3. An example of a fully worked solution.

The graphs are generated using the specific inequalities shown in the question as constraints.

For any multiple choice or multiple response question that the student has answered incorrectly, hints become available indicating what was wrong with the particular answers chosen. In many cases these hints are designed to prompt the student to think more deeply about the problem or to recall certain facts, rather than simply pointing out the specific error that may have been made. A hint is shown in Figure 2, and appears when the cursor is passed over the incorrect answer choice.

Questions with several parts, all of which use the same random parameters or data set, can also be generated. Since the answers to such multi-part questions are interdependent, a student may choose to check his/her answer to an early part in order to be sure of using correct information for subsequent parts. Once the preceding answers have been revealed, they may no longer be changed. This feature was considered useful by 80% of survey participants in both units.

2.2 Quiz management tools

An extensive set of quiz and class management tools is available to staff through a simple web interface, as is the setting up of new quizzes. To create a new quiz, a lecturer simply chooses the questions from a catalogue of existing questions and decides on the colour scheme and level of server interaction. Quizzes come in three flavours: the first records all students' activity, including scores, on the server; the second records only quiz downloads but not scores; the third functions without server interaction, and is intended for use on a CD where JavaScript in a web page would randomly choose which version of the quiz to present.

After the questions have been chosen, a sample quiz is generated and presented for checking. Once satisfied, the lecturer then triggers the generation of the first set of randomised quizzes. When these are almost used up by the

students, another set is automatically generated. Quizzes are encrypted, ensuring that the answers and solutions are inaccessible in Acrobat Professional.

Expiry dates for the quizzes can be set if desired, and can be changed at any time during the semester. Pass marks for quizzes can be chosen, otherwise the default is full marks for a pass. Generally one or two errors are allowed to ensure that students who may mis-type an answer to a fill-in question still have a chance of passing the quiz without undue frustration. Students who miss the deadlines can have their access reinstated for a certain number of days. A student who has not passed a particular quiz can be granted a pass at the discretion of the lecturer, for example in the case of illness or misadventure.

Class statistics are available in both numeric and graphic form. Numeric displays include numbers of downloads, submissions and successful attempts. These counts represent both total activity and numbers of individual students who are active. Average and maximum numbers of attempts are also included. Graphic displays of usage patterns include overall usage, daily and hourly averages, overall activity for each quiz and numbers of incorrect responses for each question. These can be seen in Figures 4 and 5.

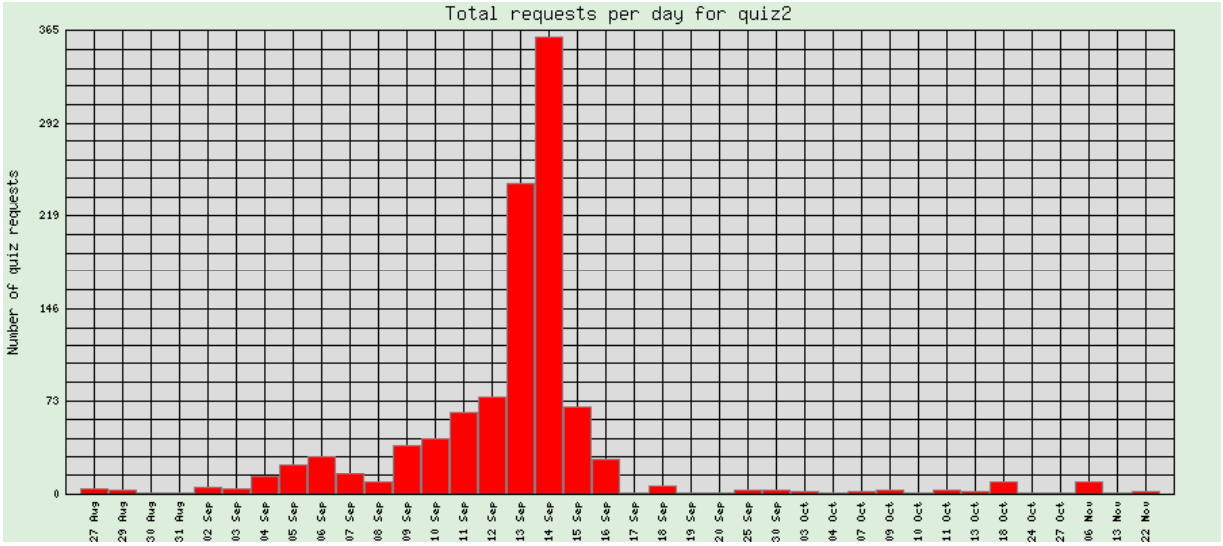

Figure 4. A graph of quiz activity. No prizes for guessing the due date of this quiz!

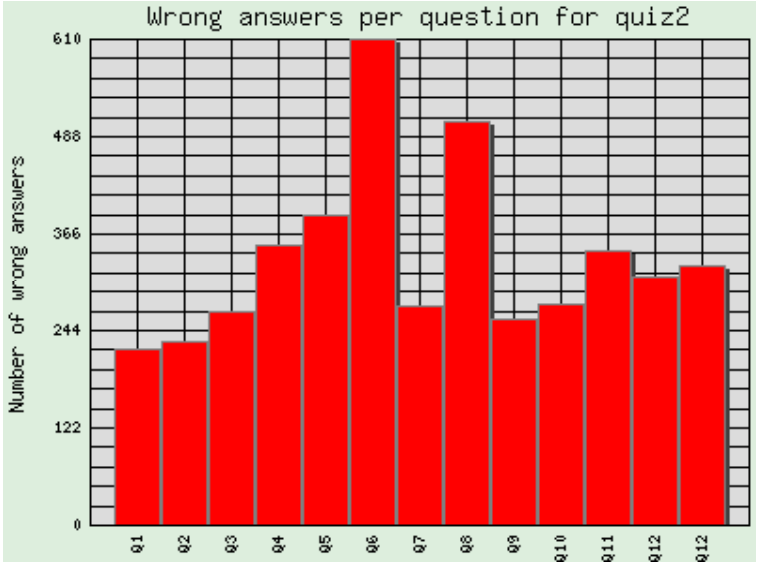

Figure 5. It is useful to know how difficult the students are finding each question in a quiz. In this quiz, Questions 6 and 8 seem to have been challenging for students. When this is due to the material in the question, further class time can be devoted to the topic. If the students are simply struggling with the fill-in syntax, this can also be clarified in class.

Each student can view his/her personal quiz log as a web page. This shows pass status and best score for each quiz;

access details; scores and answer choices for every attempt at each quiz; times taken for perfect scores; and records of access being denied or reinstated. Class summary statistics can also be dynamically displayed on the unit website.

2.3 Quiz production and delivery

The MacQTeX quiz system runs on a Mac OS X server, but could be installed on any other UNIX platform. It uses free software only, including PERL, mySQL and the mathematics typesetting engine pdfLaTeX. Class lists, student records, quiz activity and various parameters such as pass marks, expiry dates and question lists are stored in mySQL databases. The quiz delivery, quiz management and randomisation are all controlled using PERL. The random parameters are programmatically generated on the fly for each quiz, not selected from a database, which differentiates it from many other quiz systems.

PDF was chosen as the format for presentation because it allows the inclusion of JavaScript controlled form fields, similar to those common on standard web pages. The presentation of mathematics on web pages is generally unsatisfactory, whereas with PDF there is complete control over the layout and appearance. There is the added advantage that pdfLaTeX can be scripted to generate documents containing complex JavaScript functionality.

2.4 Quiz question design

The amount of variety in the random parameters of a question is best determined by educational considerations rather than by the limitations of programming practicality. The former, in most cases, often leads to a simplification in the latter anyway. The decision as to whether a question should be fill-in or multiple choice will be guided by the complexity of the mathematical expressions needed for text entry, the possibility of writing appropriate distractors for multiple choice, and whether a multiple choice form of the question would make the correct answer too obvious. On the other hand, multiple response questions are very useful for checking recall of definitions, interpretation of graphs and output from statistical packages.

Certain cases of a particular question may present greater difficulty to students than others. Hence the randomisation can be designed so that these cases occur more often, thus providing students with extra practice. A problem in which a simple case is taught first, and more complicated cases later, is better programmed as several different questions. In this way students are able to practise and gain confidence with the straightforward case before tackling the more difficult cases.

In developing randomised questions, the random parameters must be chosen so that the tedium of any numerical calculations does not overwhelm the concept that the question is intended to reinforce. On the other hand, unfortunate choice of parameters can sometimes lead to a trivial case of the question so this must be avoided. The complexity of mathematical expressions to be entered as answers should also be kept to a minimum.

Once generated, mathematical expressions must be filtered so that fractions and surds are reduced to lowest terms; instances of silly notation such as $1x$ or x^0 are removed; and an appropriate level of factorisation is carried out. This is important as students should be encouraged to present their solutions using succinct and precise mathematical language. In text that describes the problems, the grammar must be adjusted to account for plurals and so on. In addition, the tolerance of precision required for fill-in answers can be adjusted to allow students some lenience in the manner of rounding their decimals. The use of decimals and certain other forms of mathematical notation can even be prohibited in particular questions, if desired. (For more detailed descriptions for any of the aspects outlined above see Griffin, 2005; Griffin, 2004; Griffin & Moore, 2003.)

3. Quiz implementation and survey design

3.1 Use of online quizzes

During Semester 2, 2007, 493 and 160 students were enrolled into STAT279 and STAT379 respectively. The online quizzes formed a compulsory part of the semester coursework, contributing a small percentage of the marks in their final grades for the unit. For STAT279 there were four quizzes, with three for STAT379. Each quiz contained four or five multi-part problems. For both units, the first quiz was on assumed knowledge with the remaining quizzes being on new material covered during the semester. Students were able to do all the quizzes as many times as they wished and they were considered to have passed a quiz if they had two errors or less in a quiz with from 12 to 20 questions or question parts.

Table 1. Participation rates for each quiz in STAT279, in which 493 students were enrolled

	Quiz 1	Quiz 2	Quiz 3	Quiz 4
Students who downloaded	473	478	477	466
Students who attempted	473	475	474	464
Students who passed	460	463	468	433

Table 2. Participation rates for each quiz in STAT379, in which 160 students were enrolled

	Quiz 1	Quiz 2	Quiz 3
Students who downloaded	156	153	150
Students who attempted	156	152	149
Students who passed	151	146	144

Tables 1 and 2 show the participation and pass rates for the online quizzes for STAT279 and STAT379. As expected, these rates drop off towards the end of semester as students become too busy with work in other units. In addition, the decrease represents the presence of students in the units who are not really serious about performing well, some of whom drop out of the unit but do not formally withdraw their enrolment. Most of these non-participating students do not sit the final exam.

3.2 Design and administration of the student survey

In order to gain a clear understanding of student's perception of the online quizzes as a learning tool, students from both units were invited to participate in a survey. The survey was designed to provide information on:

(1) the extent to which students felt that the quizzes enhanced their learning; and

(2) students' perception of how easy the MacQTeX online quiz system was to use.

The survey contained 23 statements and participants were asked to indicate their level of agreement to each of the statements on a five-point Likert scale: *Strongly agree*, *Agree*, *Neutral*, *Disagree*, *Strongly disagree*. The option of *Not Applicable* was given as well. In order to simplify the results, they are presented below with the *Strongly agree* and *Agree* categories combined into one "Agree" category, as the proportion of responses in these categories was consistently very much higher than in the other three categories. Similarly, the *Disagree* and *Strongly disagree* categories have also been combined into one "Disagree" category. For all statements a very small percentage responded with *Strongly disagree,* so combining this with the *Disagree* category is not misleading.

The survey was administered in the tutorial classes for both units during the last week of the semester. Participation in the survey was voluntary and the responses were anonymous. It was administered by a person who was not directly involved in the design of the online quiz system or this research. The students were given approximately 10 minutes to complete the survey.

4. Survey results

As previously mentioned, altogether 375 STAT279 and 84 STAT379 students participated in the survey, giving participation rates of 76% and 53% for STAT279 and STAT379 respectively. In general there was strong agreement in the responses to the survey statements between students from the two units.

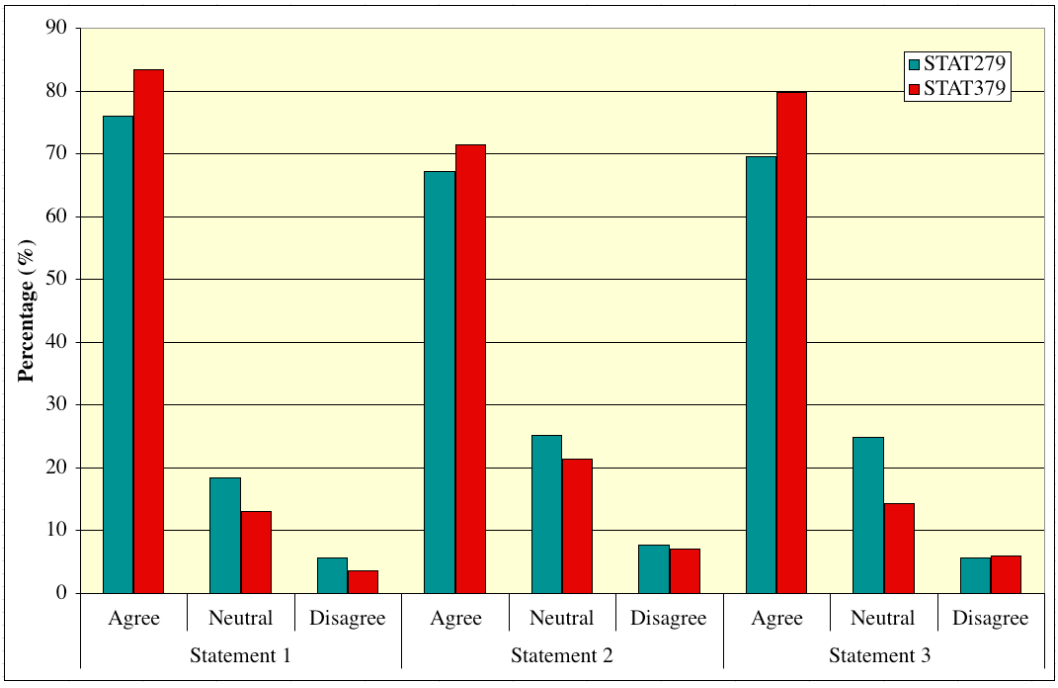

Figure 6. Effect of online quizzes on students' perception of learning and understanding of unit content.

The survey contained three statements that were designed to assess the students' view on how the quizzes assisted them with the learning and understanding of the subject matter.

Statement 1: The quizzes helped me understand the concepts in this unit.

Statement 2: The quizzes helped me learn how to express my solutions in a clear and logical way.

Statement 3: Doing the quizzes has helped me to remember the processes for solving particular problems.

Figure 6 shows that more than 70% of participants agreed that the quizzes helped them to understand the concepts in the unit; to learn how to express their solution in a clear and logical way; as well as to remember the processes for solving particular problems. The percentage of participants who agreed was slightly higher for STAT379 than for STAT279 for statements 1 and 2, and 10% higher for statement 3. This may indicate that students in their third year have a more mature and structured approach to study.

Of the survey participants, 81% percent of STAT279 and 88% of STAT379 liked the way the quizzes provided them with quick feedback on their progress. Furthermore, 61% of STAT279 and 70% of STAT379 survey participants thought that the benefits they gained from the quizzes were worth the extra workload they created.

There were five statements that assessed students' views on their study habits in relation to the online quizzes. These statements were included in order to gain insight into the way students behave in relation to study planning, time management, deadlines and exam preparation. The responses are summarised in Table 3. The results were somewhat surprising, as 63% (STAT279) and 69% (STAT379) of survey participants indicated that they began work on the quizzes well before the due date. This is contrary to the impression gained by staff that students habitually start work late on their assessment tasks. It is also not entirely borne out by the quiz logs, which show that quiz activity on the due date and the previous day is much higher than at any other time, as shown in Figure 4. There is the possibility that the sample of students attending classes in the week of the survey represented those who were generally more organised and conscientious, or that students' idea of "early" is not the same as that of staff.

Table 3. Percentage of students that agree and disagree with the following statements

	Agree (%)		Disagree (%)	
Statement:	STAT279	STAT379	STAT279	STAT379
The timing of the Quizzes helped me organise my study in this unit	58.2	64.3	7.9	14.3
I started work on the Quizzes well before the due date	63.1	69.1	10.3	8.3
I usually re-attempted Quizzes I had already passed, to improve my understanding	55.5	43.2	16.9	25.9
I used the Quizzes as revision for the final exam	50.7	46.1	13.6	17.1
I frequently worked on the Quizzes with other students	29.0	25.7	40.0	47.3

The lower percentage (46%) of STAT379 than STAT279 (51%) survey participants using the quizzes for final exam revision is most likely due to the timing of the exams in the two units. The STAT279 final exam was scheduled in the week following the survey, whereas the STAT379 exam was two weeks later, so STAT379 students are unlikely to have started exam revision at the time of the survey. Again, the quiz logs do not really support this, with only a small amount of quiz activity leading up to the exams. It could be that at the time of the survey, many students had the intention of using the quizzes for revision but eventually did not.

The low percentage of survey participants indicating that they collaborated with other students on the quizzes is also surprising. This was unexpected since the cohorts contain a large proportion of students whose first language is not English, and it is known from observation and conversation with these students that one of their study strategies is to work together, particularly where interpretation of a scenario described in words is involved.

In response to the statement, "It was helpful to be able to do the quizzes as many times as was needed to pass", 79% of all the survey participants agreed.

As there was a large number of international students having English as their second language undertaking these two units, there has been some concern that the wording of the problems presented in the quizzes may have been too complex. The statement in the survey that assessed students' views on this matter revealed that 71% of STAT279 and 83% of STAT379 survey participants thought the questions presented in the quizzes were worded in a way that was easy to understand. Furthermore, for both units overall, 81% of survey participants thought that the difficulty level of the problems was "just right".

5. Implications for learning and teaching

Online quizzes, such as those used in STAT279 and STAT379, are intended to enable students to gain proficiency at solving routine problems. Without such proficiency it would be much harder for them to learn to perform the more complicated techniques and algorithms required in the statistics discipline. Having provision for automated routine exercises allows for the use of more interesting problems in written assessment tasks, which now need not contain the routine exercises.

Both units require students to use and be proficient with statistical packages such as QuickQuant. They must know how to set up problems and give detailed interpretations of the output. With the inclusion of the online quizzes, students are also required to demonstrate their ability to perform similar calculations by hand, thus encouraging deeper understanding of the processes involved. In addition, the quizzes include synthetic QuickQuant output, which the students must then correctly interpret.

The survey results show that the unlimited number of attempts students can have at solving the quizzes, the instantaneous feedback on their performance, as well as the full solution that is provided after submission has taken place, encourage self learning. It has been observed that students are more likely to attempt a quiz again within a short period of time if a detailed solution is provided. Furthermore, students' scores have been observed to improve rapidly from one attempt to the next. When asked, both in the survey and informally, students said they learned a lot about analytical skills, problem-solving techniques and the subject matter generally from looking through the fully-worked solutions.

It has also been found that weaker students typically repeat a quiz many times before attaining the required passing level. Therefore the unlimited number of attempts provides these students with valuable practice they would otherwise not have been able to obtain. Students often submit a quiz without attempting any questions before making a real attempt at the quiz, in order to study the solutions so that they can learn the material.

The assumed knowledge quizzes for both STAT279 and STAT379 were designed to give an indication of whether students have the required background knowledge and technical skill to provide sufficient foundation for the unit subject matter. By requesting students to attempt these quizzes within the first three weeks of the semester, lecturing staff are able to identify struggling students early on and assist them with catching up on the background material. These students are then invited individually to discuss their difficulties with the lecturer, who may then provide them with further study materials according to their needs and follow up on their progress later in the semester.

The online quiz system can also provide lecturing staff with an immediate indication of the level of understanding the students have reached on the subject matter taught during the semester. Written assessments, such as assignments or class tests, have been used commonly to identify topics that are causing difficulties for students. Lecturers running units with large enrolments may find this impractical. Large units often involve many markers where variation in marking, as well as a lack of overview, can make it very difficult to identify such topics accurately. The time taken to manage the distribution of marking and the return of work to students makes any feedback less effective, as students' memory of the processes they used to solve the problems has faded.

This time lag also makes it difficult to obtain any reliable statistics on student performance. The online quiz system used for STAT279 and STAT379 provides graphs (such as the one presented in Figure 5) that enable the lecturer to see immediately whether an individual topic is problematic for students. After ensuring that it is not the question itself or the programming that is at fault, actions can be taken in order to clarify the subject matter for the students. This clarification can be implemented during lectures, tutorials or by using electronic bulletin boards. In order to assess whether the lecturers' intervention was successful, follow-up questions on the same topic can be included in a quiz later on in the semester.

Academic staff involved with the marking of other assessments tasks (such as class tests and final exams) for both STAT279 and STAT379 have commented on a noticeable improvement in students' attempts at solving routine problems, as well as in the way in which they tackle the more involved and complex problems. It appears that students have gained a better appreciation of how to break a problem down into a sequence of tasks and how to express their solution in a structured and coherent way. Furthermore, there has been a noticeable improvement in the pass rates in both units; this cannot be entirely attributed to the online quizzes, since there have been other changes to the unit assessment requirements and delivery of lecture and tutorial material.

6. Conclusion

The introduction of online quizzes into both STAT279 and STAT379 was highly successful. The verbal feedback from students was positive, and their wishes on entering STAT379 to have quizzes similar to those used in STAT279 indicated that students found the quizzes useful. This impression was clearly supported by the survey.

The effect of identifying struggling students early in semester is difficult to quantify, but it most certainly made a

difference to the experience of certain individuals. Without the prompt intervention of teaching staff these students may well have failed, or simply dropped out of the unit. These are students who either found the material very challenging, whose motivation was poor, or who have had difficulties in their personal lives affecting their study. The individual attention given by staff was most appreciated, and assisted them in overcoming their problems and succeeding in the units.

It was fortunate that an existing quiz system was available so that it was possible to introduce it over a short timeframe, without the worry of technical problems or significant usability issues. STAT279 was the largest unit which has used the quizzes, and the system was sufficiently robust to function smoothly with the onslaught of students rushing to complete their work just before the deadline.

As with any voluntary survey, there were some limitations to the student survey that was conducted for this study. The timing of the survey may have affected the participation rate somewhat. As mentioned earlier, the survey was conducted during tutorials in the last week of the semester. A number of students indicated to lecturing staff that they chose not to attend tutorials during this last week as they preferred to spend the time finalising assessment tasks for other units. Furthermore, the students who do attend tutorials during the last week of the semester could be said to be the more conscientious, organised and structured in their approach to their learning. The timing of the survey may therefore have created some bias in the outcome.

The MacQTeX quizzes are available for public access online at http://www.mq.edu.au/quizzes. Any quiz is accessible by entering *guest* as the Student Id. Acrobat Reader 5.0 or later is required. An installer for Mac OS X is also available for download on:

http://sommelier.ics.mq.edu.au/MacQTeX/about/downloads.html

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Approaches to Learning in Statistics

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Abstract

In the last decade, Australian higher education institutions have become a destination for many international students, mainly from South East Asia. If their educational culture is quite different to the Australian educational culture, then their approaches to learning might be different to that of local students. The aim of this pilot study was to investigate the approaches to learning of students in statistics units and relate these to background variables such as country of origin, gender and work commitments. This study is significant because there are many international students at Macquarie University and no data of this type has been collected for our students in the past.

Our analyses showed that there were no significant differences in the approaches to learning of local and international; and male and female students; however, we found a significant difference between undergraduate and postgraduate students, with postgraduates more likely to adopt deep strategies to learning.

Keywords: Learning approaches, Learning strategies, Learning motives, Statistics education; Internationalisation

1. Introduction

Statistical thinking is becoming almost a generic skill which could be used by many professionals such as accountants, marketing managers and medical practitioners. In many universities statistics courses are studied as service courses by students majoring in a range of other disciplines. Moreover, the study of statistics provides ideas and methods that could be utilised by students in order to better understand their environment at university and beyond (Garfield & Ben-Zvi, in press). Utts (2003) emphasized that educated citizens should understand basic statistical concepts so that they can detect any misuse of statistics by policy makers, physicians and others.

With the increased amount of data collection due to the improvement in computers, the importance of quantitative skills is increasing. Unfortunately, Australia is facing a skill shortage in mathematics and statistics graduates who could be doing these analyses (Australian Academy of Science, 2006). One reason for these shortages might be statistics being considered a difficult subject by students.

For both statistically literate citizens and statistical professionals, it is important that they use a deep approach to their learning which will stay with them for life. Hubbard (1997), based on the research of Gal and Ginsburg (1994), and with no quantitative data, states that for many students statistics is, "merely a hurdle to be overcome on the way to obtaining a degree". If so, could the students be using a surface approach to their learning?

While Scheaffer (2001) suggests that it is important to utilise correct educational strategies that encourage deep learning approaches, such as active learning and problem-based learning by using authentic data in tutorials and emphasising the statistical thinking, the results of Gordon's study (1995) indicate and emphasise the impact of the students' personal experiences, motivation, perceptions, expectations, achievement goals, and the 'sociohistorical' context on their approaches to learning. Gordon calls for research into student learning approaches in statistics, rather than solely into the methods used to teach statistics.

With over 4 600 international students studying "onshore" at Macquarie and approximately 120 studying "offshore", the Division of Economic and Financial Studies accounts for approximately 60% of Macquarie University's international "onshore" students and 20% of its "offshore" students (DEFS, 2006). The Department of Statistics offers courses to all

students in the Division, therefore it is important to identify the learning approaches of students coming from other cultures compared to local students so that academics can help students to maximise their learning experiences and outcomes through making deep learning the only alternative.

Cross-cultural studies of general learning approaches of students have been investigated by a number of researchers to identify any possible differences between Australian and Asian – mainly South East Asian – students in a number of different disciplines, including accounting and engineering (Biggs & Watkins, 2001; Kember & Gow, 1990; Ramburuth, 2001; Volet & Renshaw, 2001; Ginns, Prosser & Barrie 2007; Gow et al., 1994; Kember, 2000; Smith & Smith, 1999; Smith, 2001; Cooper, 2004; Biggs, 1991). We were not able, however, to find any cross-cultural research into the learning approaches of statistics' students in the literature.

The research, both within and without statistics education (Gordon, 1995; Gow et al., 1994; Kember, 2000; Ramburuth & McCormick, 2001), has shown that there is a range of variables affecting students' approaches to learning. These variables include teaching approaches, learning theories, assessment methods and students' prior learning experiences and perceptions. Our study is a pilot study, designed to explore students' approaches to learning statistics from the students' perspective by utilising Bigg's Study Process Questionnaire (SPQ) (1987a).

2. Literature review/Background

It is evident from the extant literature that there is only limited research into students' approaches to learning in statistics. A number of studies investigate teaching approaches and learning theories in statistics education (Garfield, 1995; Keeler & Steinhorst, 1995 & 2001; Hubbard, 1997). Garfield (1995), on the basis of previous research (educational and psychological), highlights the importance of teaching approaches and learning theories in statistics education and how academics can support students' learning. In particular, the author argues for the implementation of activity-based courses, widespread use of cooperative learning groups, and the pedagogical theory of constructivism. This is further reinforced by Keeler and Steinhorst (1995), whose study of a cooperatively structured statistics course illustrates the impact of teaching and learning approaches imposed by the teacher. The authors' reported results indicate that not only did a larger percentage of students successfully complete the course, but those who did received higher grades compared with an earlier traditional offering of the course. The authors' later study (2001) examined an introductory statistics course, which was activity-based, cooperatively structured and located within a constructivist framework. The learning approaches of the students in this study are given in a very generalist manner, with the authors' approach reflecting a, "continuing belief that students learn better and retain more if they engage in learning activities that require them to think and process information rather than to passively listen to lectures". It is not reported in either study, however, how a cooperative learning approach or an enquiry-based approach (teaching approaches) impacted on the students' own approach to learning in statistics and whether it promoted a deep approach to learning in statistics.

There are many research articles comparing the learning approaches of Asian and Australian students in other disciplines, but few in statistics. One such research article is published by Cooper (2004) and concerns a comparative longitudinal study (using SPQ) of Australian and Malaysian Chinese students at RMIT University. It identified differences in the learning approaches of the two groups studied, for instance it was observed that Chinese male students consistently scored higher on the deep scores, despite outscoring Australian students on the surface approach scores. Cooper argues that the consistently good academic results of the Chinese students adopting surface approaches to learning do not support the hypothesis of a negative correlation between surface approaches and academic performance. The author suggests that, from a cultural perspective, memorisation should not be treated as rote learning, as the, "process of memorisation contributes to understanding and can be distinguished from mechanical memorisation" (p.294). The relatively small sample of Chinese students in the authors' study demonstrated that they could perform academically, whether adopting surface or deep approaches to learning.

Kember (2000), in addressing the common misperception of the 'Asian rote learner', observed that students often move between surface and deep approaches depending upon the nature of the assessment task and/or course requirements. Kember's observations are based on the results of a survey (Kember & Gow, 1991) of 4,863 students from Hong Kong and Australia, in which data was collected using Bigg's SPQ. Kember also observed that the approach students adopt will be affected by curriculum design, assessment requirements, workload, teaching approach, and the students' perceptions of relevance and interest in the course. Furthermore, results from previous research indicate that curricula designed according to different pedagogies have markedly different impacts on the learning approaches of students. Gijbels and Dochy (2006) showed that there was a relationship between students' approaches to learning and their assessment preferences, where students who used a deep approach to learning preferred higher-order thinking assessment tasks and non-conventional assessment. On the other hand, Leung et al. (2006) showed that construction engineering students in mainland China were using more deep approaches than their counterparts in Hong Kong, even though the mainland Chinese students might lack resources and new teaching methods (such as action learning) that were available to students in Hong Kong.

Green (2007) showed that the appearance of a surface approach to essay writing by Asian students might be related to their lack of understanding the norms of Australian essay writing or, in other words, it is because of the cultural

differences between the educational systems. She concludes her article by suggesting that to eliminate possible misunderstandings or clarify the academic expectations, students from Asian cultures need to be offered academic skills before or during their studies in Australia.

Other researchers have found no differences in approaches to learning between different cultural groups. For example, Smith (2005) was not able to identify any differences between the learning approaches of a culturally mixed group of students in the United Arab Emirates. This research showed that the students used very mixed approaches to their learning, which may be due to a very multicultural learning environment or the use of the revised SPQ – R-SPQ-2F (Biggs, Kember & Leung, 2001).

The research into students' approaches to learning in different disciplines shows that there might be differences between local and international students. Some research also suggests that there may be differences between undergraduate and postgraduate students (Ling et al., 2005) as well as between male and female students (Elias, 2005). However, there is a big gap in the literature regarding the research into statistics students' approaches to learning. Although our study is a pilot study, it is designed to bring light into this area and suggest further research questions.

3. Method

We used Bigg's Study Process Questionnaire (SPQ) (1987a, 1987b) to identify learning approaches of statistics students along with an in-house developed demographic survey. The SPQ is a self-reporting survey consisting of 42 items on six subscales. There are seven items on each subscale. The six subscales are *surface strategy* (SS), *surface motive* (SM), *deep strategy* (DS), *deep motive* (DM), *achieving strategy* (AS) and *achieving motive* (AM). Three different learning approaches of students are calculated by summing up the strategy and motive of a certain approach, for example *Surface Approach score* is calculated by adding up surface strategy and surface motive scores (Table 1). Each item on the SPQ has a five-point scale ranging from (1) "this item is *never* or *only rarely* true of me" to (5) "this item is *always* or *almost always* true of me".

Table 1. Motive and Strategy in approaches to learning and studying (Biggs, 1987a, p.3)

Learning Approach	Learning Motive	Learning Strategy
Surface Approach (SA)	Surface motive (SM) is to meet requirements minimally; a balancing act between failing and working no more than it is necessary.	Surface strategy (SS) is to limit target to bare essentials and reproduce them through rote learning.
Deep Approach (DA)	Deep motive (DM) is intrinsic interest in what is being learned: to develop competence in particular academic subjects.	Deep strategy (DS) is to discover meaning by reading widely, inter-relating with previous relevant knowledge.
Achieving Approach (AA)	Achieving motive (AM) is to enhance ego and self-esteem through competition; to obtain highest grades, whether or not material is interesting.	Achieving strategy (AS) is to organise one's time and working space; to follow up all suggested readings, schedule time, behave as "model student".

The SPQ and demographic survey were administered before the mid-semester break in May 2007 in two separate classes, one second year undergraduate class and one postgraduate class. To eliminate any bias due to the lecturer being in the class during an anonymous survey, a research assistant (RA) was employed to oversee the process. After a short introduction by the lecturer about the study and inviting students to participate, the lecturer left the classroom and the RA administered the surveys. There were 65 students enrolled in the second year statistics course, Applied Statistics, where 39 of them participated in the study; while all 13 postgraduate students enrolled in the postgraduate Data Mining unit participated in the study. Even though the sample size is only 52, all students present at the lecture in each unit participated in the survey.

4. Results

The sample was reasonably evenly divided between male (43%) and female (57%) respondents. This split was significantly different in the two units, with 67% of the undergraduate unit being female and 25% of the postgraduate unit being female ($\chi^2 = 6.5$, $p = 0.011$). The average age of students in this study was approximately 23 years, with females having a slightly lower average age and males having a slightly higher average age. Most students were aged under 27, apart from two males in the postgraduate unit who were 31 and 46. Not surprisingly, the average age in the

postgraduate unit was higher than that in the undergraduate unit (27 years compared with 22). The proportion of students who were part time was significantly higher in the postgraduate unit (50% compared with 8%, χ^2= 11.3, p = 0.001). In addition, the postgraduate students reported working longer hours in employment than the undergraduate students.

The sample was split fairly evenly between students who identified themselves as an international student (53%) and those who did not (47%). The proportion of international students was not significantly different in the undergraduate and postgraduate units (χ^2 = 1.19, p = 0.276).

4.1 The differences between undergraduate and postgraduate students

The data suggested that the students in both postgraduate and undergraduate units showed a mix of learning approaches, with those having high surface approach scores varying from low to high deep scores. The comparative boxplot in Figure 1 shows the distribution of Motive and Strategy scores in the two units for the three dimensions of the SPQ. The undergraduate and postgraduate units do not show any large differences on either of the surface or achieving motive and strategy scores. It can be seen in Figure 1 that the students in the postgraduate unit do appear to have a higher median score on Deep Motive and Strategy scores than those in the undergraduate unit. Two sample t-tests were also used to test for differences in average scores between the undergraduate and postgraduate units on all of the motive and strategy scores. Only the comparison of the Deep Strategy score in the two groups was significant (p=0.002). It is interesting to note that there is more variability in the Achieving Motive and Strategy scores in both groups, compared with both surface and deep scores

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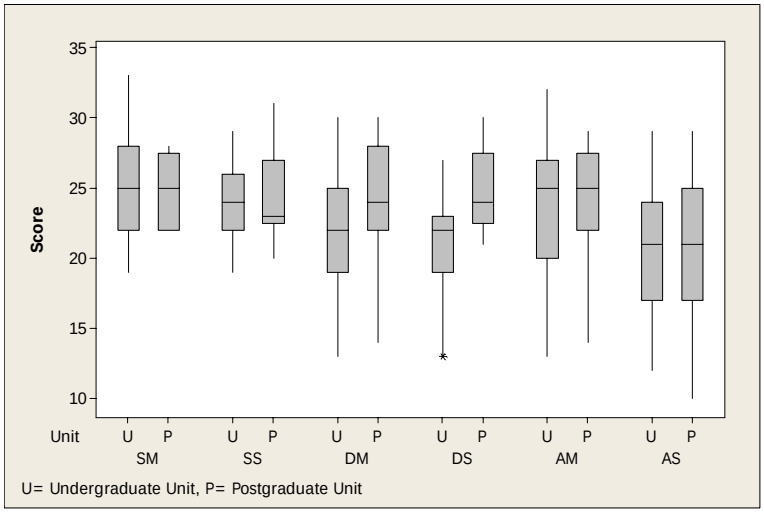

Figure 1. Distribution of Motive and Strategy scores by unit

The distribution of the Approach scores is shown in a comparative boxplot (Figure 2), and a similar pattern is seen there, that is, that the largest difference in the medians between the undergraduate and postgraduate students was on the Deep Approach scores. This comparison was the only significant one (p= 0.011).

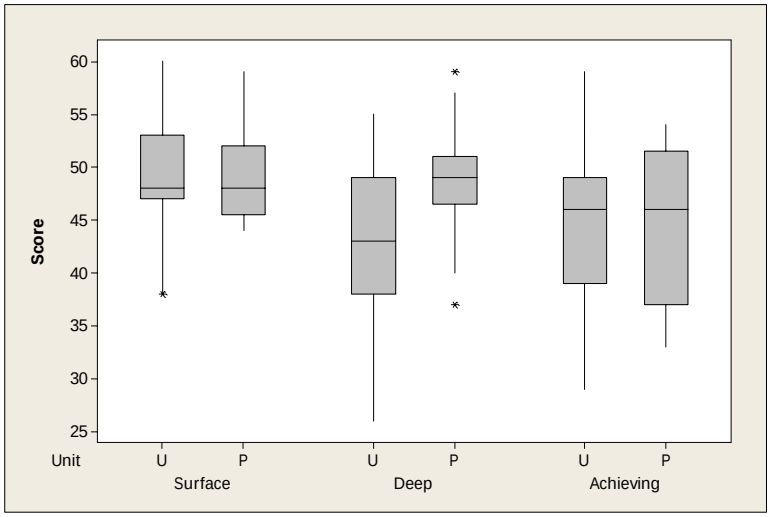

Figure 2. Distribution of Approach scores by unit

While the postgraduate students were spending longer in employment each week, there did not appear to be any relation between scores on each of the scales and the number of hours of employment.

4.2 The differences between international and Australian students

A comparison was made of Motive and Strategy scores, and Approach scores, for students who stated that they were international students compared with those who said they were not. No large differences were seen between the two groups. The largest difference was in Deep Motive scores, but this was not significant ($p = 0.055$). Once again the variability in Surface scores was lower than either the Achieving or Deep scores.

4.3 The differences between male and female students

No significant differences in Motive, Strategy and Approach scores were found between male and female students. Once again, the variability in the Surface Motive and Strategy scores is lower than in the other scales.

4.4 Relationship between the types of Motives, Strategies and Approaches

The relationships between the strategy, motive and approach scores for each of the three types were either positive or non-significant. That is, there was no evidence that students who had high scores on one strategy, motive or approach tended to have lower scores on another strategy, motive or approach. There was some evidence that students aligned their motives and strategies, as there was a significant positive relationship between these scores for both Surface and Deep scores, with a stronger correlation for the Deep scores. That is, students with a high score on Surface Motive were likely to have a high score on Surface Strategy, and similarly for the Deep Motive and Deep Strategy scores. This trend was not evident for the Achieving scores.

5. Implications for learning and teaching

It is now possible to provide information regarding our statistics' students learning approaches. Our findings are in line with other researchers who have compared the learning approaches of Australian and Asian students: there is no significant difference between their approaches to learning. Anecdotal evidence can be put aside since both groups of students had a mixed approach to their learning.

As our results suggest that the students within a unit have similar approaches to their learning, our next step will be to examine our teaching and assessment strategies to identify possible impacts on student learning approaches. Conducting the SPQ before and after particular assessment tasks may be one possible way of exploring the impact of the learning and teaching environment.

6. Conclusion

This article presents results of a pilot study aimed to identify statistics students' learning approaches in an Australian university. The only significant difference we observed in our sample was the difference between the Deep Strategy scores of undergraduate versus postgraduate students. Our findings are similar to Ling et al.'s (2005) results, where they found no significant difference between the learning approaches of Australian and Malaysian students. They also found a significant difference between Australian undergraduate and postgraduate students, where postgraduate students used more deep approaches and undergraduate students used more surface approaches to their learning.

A deep learning approach is generally considered to be the most effective since it creates opportunities for learning that lasts. Our students mainly used a mixed approach to their learning, regardless of their gender or origin (local or international). Further research is needed to identify the underlying differences between undergraduate and postgraduate students' approaches to learning, since both of the units that were subject to this research had similar assessment strategies and teaching methods – we are currently unable to state why there was a significant difference between the two groups. One possible explanation may be that postgraduate students often have an authentic work-related problem which immediately highlights the importance of a deep understanding of statistics. In addition, deep strategy and motive scores of students could be improved by a better understanding of why the students chose to use a mixed approach to their learning. However, that issue was not part of this pilot study.

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One in a Million: An Alternative Transformation of the First-Year Statistics Course

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Abstract

This paper describes the continuing development of a first-year statistics textbook, which is written with a primary focus on statistical ideas and statistical thinking and a secondary focus on statistical techniques. Such a "second-generation" transformed approach to statistical education has a number of practical benefits in terms of student engagement with statistics, and aligns with theoretical research on students' ideas about the discipline. As well as describing and exemplifying the content of the text, colleagues' and students' reactions to (earlier versions of) the book are presented, the challenges they raise are addressed, and future plans for the project are indicated.

Keywords: Conceptions of statistics, Reformed courses, Statistics education, Statistical thinking, Transformed courses

1. A new approach to the first statistics course

A central aim of an education in statistics is the development of "statistical bravery". Statistics is a practical discipline and any course should help the student to have "an intelligent go" at statistical problems which arise. Here are two examples of how the approach described in this paper has encouraged statistical bravery.

A student of a course based on the approach was consulted by two former bank managers who were running a grocery warehousing operation in the South Island of New Zealand. They wanted to know the cost of processing a pallet of goods. Knowing nothing about warehousing, but armed with statistical thinking and some simple tools, the student produced a satisfactory solution to the problem. Another student, a marketing employee, became brave enough to question the weekly company performance analysis. The conclusion was being drawn that a salesperson was performing poorly due to laziness; the student pointed out that this person was working a difficult sales region – more than likely the reason for poor sales figures for that individual. In teaching such outcomes should be our aim.

Here is the opening of the first chapter, to provide just a flavour of the text.

We all seek knowledge. Why? Knowledge turns mere observation of the world around us into understanding and understanding is a prerequisite for control. Francis Bacon (1561-1626) put this succinctly around 400 years ago when he wrote in Of Heresies in his Religious Meditations, "For knowledge itself is power". Knowing more about the world has lead to many of the improvements and comforts and pleasures which we now take for granted – from car paint to plastic toothpaste tubes, from computers to digital watches, from ATMs to stump cameras. The science of statistics assists in turning observation into understanding.

2. Theoretical background

In the early 1980s a section of the statistical community became increasingly dissatisfied with the traditional approach used in first-year university statistics education. This approach had served well since the 1950s, but had begun to reveal inadequacies. The traditional approach begins with an introduction to probability and distributions, followed by an introduction to inference and estimation, often taking a mathematical view of the material. A second approach, the so-called reformed approach, emerged as a consequence of this dissatisfaction in the mid-1980s. The reform consisted of a broadening of the syllabus, to include such topics as exploratory data analysis, time series, index numbers and an

introduction to Deming-based ideas of continuous improvement. Students' reaction to such courses, however, was often, "How do I know which technique to apply in a new situation?".

Reflection in turn on the inadequacies of the reformed approach lead to a call in the 1990s, primarily by prominent statisticians in the United States (such as Box, Joiner, Snee and Hogg, see for example Hogg, 1991), for a transformed approach to teaching statistics. Such writers argued that even the reformed course was not conveying the essence of the discipline. It was failing to put across to students the power of the thinking which should become second nature through a study of the science of statistics (for a retrospective view, see Garfield, Hogg, Schau and Whittinghill, 2002). The aim of transformed texts (such as Hoerl & Snee, 2002) was to teach statistics in the context of the need for problem solving; "improvement is necessary" was the starting point in that text.

The transformed approach has merit, since it sets the tools of statistics within the framework that motivates their use. This framework, however, can be broadened beyond the business context, the aim of the work described in this brief paper. The mantra of the text that has been developed is not that "improvement is necessary" but rather that "learning is necessary". Effort is then made to show how statistical thinking is relevant not only in the world of business, but also in the worlds of science, engineering and day-to-day life. The key differences between the three approaches are summarised in Table 1 (below).

Table 1. Characteristics of different approaches to teaching a first statistics course

Approach	*Characteristics*
Traditional	Mathematical focus, initially on probability and then inference
Reformed	Focus on displaying and investigating data, using computer packages
Transformed	Focus on statistical thinking and literacy, power of the statistical approach

Recent research in statistics education (Reid & Petocz, 2002) affirms the validity of this approach. Student conceptions of the discipline can be described using three hierarchical levels: the most limited consists of a focus on techniques (the "formulae and equations"), a broader level focuses on using data (analysing data and building models) and the most inclusive level is a focus on the broader meaning and its impact on life (the connection with personal and professional life). A course (and a textbook) that incorporates the broadest level is ultimately more successful at helping students learn. Garfield (2002) discusses the general topic of how students learn statistics, incorporating findings from psychology and pedagogy. She lists several "principles of learning statistics" that include the importance of active involvement in learning activities, a feature of the current textbook. The American Statistical Association's (2005) GAISE report also recommends the use of active learning and emphasises the development of statistical thinking and conceptual understanding rather than mere knowledge of procedures.

3. The project – a second-generation transformation of statistics education

The aim of this project was to push forward the development of a textbook, *One in a Million* (by Wood, Wasimi and Noble) to answer this call for a second-generation transformation of statistics education. The primary focus is on ideas and statistical thinking, consistent with the recommendations discussed earlier; the secondary focus is on techniques. For most students, their first university course in statistics is their only course in statistics, so the aim in such a course must be to create an awareness of the power of statistical thinking and techniques. This is more likely to occur if the course conveys the statistical way of thinking and applies it to real problems, demonstrating the power of the subject.

Hallmarks of this second-generation transformed approach, which comprise the overall philosophy of the text, are:

(1) "Outside-in" teaching, ever emphasising a unifying framework for the pattern of thinking in statistics. This is reassuring to the student, since whenever a new problem is encountered the framework of thinking provides a systematic initial approach to its solution, whether it be dealing with a difficult staffing problem or the scheduling of rubbish trucks. It begins with careful definition of the problem and proceeds according to the standard learning cycle.

(2) Use of real problems in a "question-theory-answer" pattern. One of the authors, in 1987, experimented by running a first-year university statistics unit based totally around real and current problems. The outstandingly positive reaction of the class provided convincing evidence that this must be a major component of any transformed approach to teaching (Wood, 1988).

(3) Introduction of traditional material only after the need for it is made apparent through the study of real problems. More traditional material (such as probability theory, distribution theory, confidence intervals and simple linear regression) is introduced in the second half of the course, and used to provide further insight into the real problems encountered earlier.

(4) Instructor accountability. If you only had 30 seconds to tell somebody about the essence of statistics, what would you tell them? Then suppose you were given an hour, what would you tell them? Then a day, what would you tell them? Thinking this way forces us as instructors to consider what is most important about our discipline. Surely this is the

order in which we should teach our students!

(5) Instructor honesty. Many statistical problems can be solved with disarmingly simple statistical tools. We should tell our students this and not pretend otherwise. We should amaze them about the power of simple methods, not impress them with the power of less-used sophisticated methods, at least in the first stages of the course.

It is important that students be given the confidence to "have a go" at whatever comes along – not only if it boils down to an application of the t-test. This is the payoff, for example, of the "30 second – what's most important" approach. In practice, every statistical problem has its own character and challenge, so is best tackled by an individual who sees the subject of statistics in a broad light. The approach aims to open the student's mind to the big ideas, but necessarily has to leave some of the details found in traditional courses for later study. In the authors' view, this is a liberating approach, not a stultifying one, and results in a brief text which is long enough to convey the important ideas.

4. The project in more detail and the Plan-Do-Check-Act cycle

Now we turn to more detail concerning the material developed. Central to statistical thinking is the use of the scientific method or Plan-Do-Check-Act (PDCA) cycle; this is discussed in the opening chapter and reappears like a chorus throughout the text. To quote from the text:

Believe it or not, you are quite familiar with the PDCA cycle. For example, special occasions often require us to wear a tie. Let's pause for a moment and contemplate the process of putting on a tie.

First we plan. We decide it's necessary to wear a tie and select the right one from our extensive wardrobe. Then we do something, we tie the tie – perhaps an elegant Half Windsor. Assuming a certain minimal vanity, we then check up on ourselves by glancing in the mirror to see if we are looking alright. Uh oh, we don't. The long piece is far too long and looks ridiculous. So we act, we decide to go around the cycle again. This time, with an intelligent adjustment, it looks great. Success is ours, thanks to almost unconscious PDCA activity on our part!

The central irony is that although we use the PDCA cycle routinely in trivial matters, we often don't use it in important ones. We all have a strong tendency to leap into the Do phase – keep a close eye on yourself in future! We also have a reluctance to use the Check and Act stages. Using the cycle once carefully is the first sign that you are learning something from reading this text. You should aim to make it an unconscious way of operating in all that you do.

Despite its apparent simplicity, the PDCA cycle can be a challenge to move around successfully – it takes a lot of effort, but the effort is well worthwhile. In order to make it easier to go around, it has been amplified into seven steps:

(1) Clarify the problem

(2) Understand the current situation

(3) Analyse causes – develop hypotheses to be tested or quantities to be estimated

(4) Formulate and implement a plan to test the supposed cause

(5) Check the results

(6) Act by standardising new knowledge

(7) Conclusion - project review and future plans.

The first three are subdivisions of the planning phase. For an excellent discussion of these seven steps see Kume, 1985.

It has surprised even the authors to see how well the PDCA cycle unifies the activity of statistical problem solving. Many, many problems are solved with simple tools, so Chapters 2 and 3 are devoted to the basic tools of statistical problem solving. Chapter 2 handles the snapshot tools for process improvement, while Chapter 3 introduces the tools for handling processes over time. In this way, Chapters 1-3 form a micro-book. By the time these ideas are digested the student will have a rudimentary collection of statistical tools that will go a long way towards solving problems in the real world.

This thinking is summed up in the learning cycle of Figure 1, which summarises the essence of statistical thinking. When we are confronted with a problem, we are concerned with learning about a situation (always part of some process, symbolised by the sequence of rectangles) in the PLAN stage of the learning cycle. We gather data at some critical point in the process, during the planning stage, and take it around the DO (often modelling) stage, the CHECK (is the model useful?) stage, and finally the ACT stage (where we decide that we have either learned enough for now and stop, or continue the learning cycle).

Modelling is a fundamental statistical activity. This is introduced as a way of thinking, in the context of estimating tourist arrivals, in Chapter 4. Experimentation is also a fundamental statistical activity. This is introduced, in the context of "hotting a Cortina" (modifying the engine so that the car goes faster), in Chapter 5. Sample surveys are introduced in Chapter 6. These second three chapters, together with the first three, create a mini-book. By the time all these ideas are digested, the student will have a repertoire of some of the most-used techniques in statistics (and, our experience indicates, the desire to learn more).

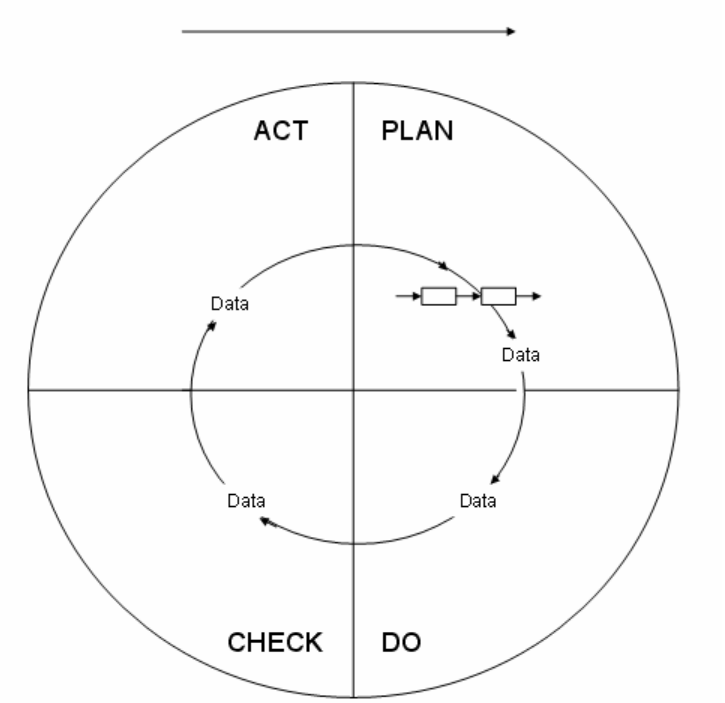

Figure 1. The essence of statistical thinking

The appetite is now whetted, through a practical, and largely unthreatening, arithmetic first half of the text, for more traditional material. The need has been seen for an understanding of probability, probability distributions and further modelling. This material makes up the latter, more conventional, half of the text.

The basic toolkit of exploratory techniques is extended in Chapter 7, to include stem and leaf plots, boxplots and more. Sample spaces, probability, random variables and distributions, the language of variation and the means for building statistical models are introduced in Chapters 8 and 9. Traditional model fitting is discussed in Chapters 10 and 11, first for questions about single populations, then for questions about two populations. Analysis of variance is left for a second course! Straight line relationships are discussed in the concluding chapter, Chapter 12.

In this way, quantitative confidence is developed rapidly. Chapters 1 to 3, thoroughly understood, create the rudimentary statistician. Chapters 3 to 6 add more sophisticated ways of thinking, while Chapters 7 to 12 introduce the foundations upon which the early chapters are built, together with some traditional material. The complete chapter summary is given in Table 2.

Table 2. Outline of the textbook's chapters

Chapter	Title
1	The Framework of Statistics
2	Basic Tools
3	Statistical Process Control
4	Time, Models and Prediction
5	Experimentation – Forcing the Pace
6	Sample Surveys
7	Exploring Data – The Beginnings of Data Mining
8	The Language of Variation – Sample Spaces and Probability
9	The Language of Variation – Random Variables and Distributions
10	Questions about a Single Population
11	Questions about Two Populations
12	Straight Relationships

The earliest version of the material was used as a basis for the main first-year statistics unit at Central Queensland University (CQU) in 1995. A revision was then used for the main first-year statistics unit at Massey University in 1998.

In order to solve substantial real problems, it is essential that students be introduced to a statistical package. Minitab has been used to date for data analysis and the presentation of results in versions of the course.

This book is devoted to ideas, not the usual array of techniques. At present the book is a draft only, available on request from the first author, and constructive comments (from typos to earth-shattering revelations) that might lead to improvement of the text are keenly sought. The text itself has already undergone a number of trips around the Plan-Do-Check-Act improvement cycle, and will doubtless do a few more before it reaches a publisher!

5. Evaluation, future plans and summary

Student evaluations of earlier versions of the textbook were conducted at both CQU and Massey University. Reactions were mixed, ranging from complaint that the material was too 'wordy' to expressions of relief that the course was sufficiently engaging to allow success. The emphasis on real problems received general approval, although some students found the emphasis on the fundamental nature of the PDCA cycle a too-much-used chorus. These evaluations have informed the development of the revised version of the book, although key features (such as the PDCA cycle) have been kept.

In addition, comments have been sought over the development period from statistics teachers, statistics practitioners and interested readers from the general public. It appears clear that no single text will ever satisfy the taste of all! These received comments, however, have been noted and the text revised periodically in an attempt to take them into account. Essentially, the development of the textbook itself has been based on a PDCA cycle (or actually, several cycles).

A secure website is being set up at Macquarie University that will make available the chapters to interested readers; feedback will allow ongoing development of the materials to take place, with a view to the future use of the improved material. It is also planned to make updated data sets available at this site, together with additional (solved and unsolved) problem sets and PowerPoint presentations. But of course the ultimate goal of the development is to allow a revised version of the textbook to be used with students at Macquarie University, and at that time further evaluations will be carried out to capture the views of students who are using the book to enhance their learning.

To summarise, the approach developed presents a transformed first-year tertiary statistics course, aiming to prepare students for statistical problem solving. It emphasises the purpose of statistics at all times: to solve problems, in context, using the ideas and methods of the science of statistics. A student should leave the course confident that a new problem can be approached with a way of thinking, not just a basketful of techniques.

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Integrating Sociological Concepts into the Study of Accounting: Yielding the Benefits of Team Teaching

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Abstract

In response to recent criticisms of business and accounting education, a team of educators introduced a new course in social and critical perspectives on accounting. The course sought to integrate sociological concepts into the study of accounting, with key themes of social construction and social power forming a core of the course. The express intention was to raise student awareness of the nature and functions of accounting in contemporary society. The core teaching strategy involved team teaching, which was used to enhance learning and develop higher order generic skills. Feedback from two diverse cohorts of students vindicated the approach undertaken and reinforced the importance of linking teaching and research in accounting programs. Change in accounting education can be directed towards regaining and rebuilding social relevance for a discipline too often associated with a narrow economic imperative rather than the broader public interest.

Keywords: Accounting education, Sociology, Team teaching, Student feedback

1. Introduction

Questionable ethics have been a part of the business landscape for as long as the corporate form has existed. Every decade in the second half of the twentieth century saw a string of accounting and corporate ethical scandals in Australia and elsewhere (see Clarke, Dean & Oliver, 2003; Bakan, 2004). Accounting and business crises arise with such regularity that there seems to be a cycle of corporate/accounting/auditing failure, followed by regulatory "reform" that amounts to a complex strategy of doing nothing to change underlying economic and business fundamentals that give

rise to scandals in the first place (see Fogarty, Helan & Knutson, 1991; Lee, 1995; Boyce, 2008).

It is incumbent on accounting and business educators to accept a level of responsibility for this situation and to take a lead in redressing it, because education in these areas delivers to students both disciplinary content and a certain culture of business and accounting practice (Ravenscroft & Williams, 2004; Humphrey, 2005; Waddock, 2005, p.145). Education has always played an important role in the development of business and social leadership (Gentile & Samuelson, 2003).

In response to the situation outlined above, the authors developed a new accounting course that sought to offer some renewal of the social and ethical worth of accounting education. The third-year elective course, entitled *Social and Critical Perspectives on Accounting*, was first offered in the second semester (August–November) of 2006 and again in first semester (March–June) 2007. Underlying the new course was a belief that sociological concepts have much to offer the study of accounting (and related fields such as audit), by assisting students (and educators) to understand the role of accounting in society as well as economy. This approach was designed to provide a means to enhance student understanding of the technical content of accounting gained from prior studies, with an associated aim to develop critical skills beyond routinised and instrumental knowledge. An overarching objective was to develop the intellectual capacities of students in examining, pondering, wondering, theorising, criticising and imagining alternatives in relation to accounting, in critical and creative ways (see Aronowitz & Giroux, 1993).

This paper presents the results of a case study of reflexive action research on the use of a team teaching approach within the Social and Critical Perspectives course. The paper deals, firstly, with the broad approach taken to the integration of sociological concepts into accounting education, in Section 2. This is followed in Section 3 with a discussion of the learning and teaching experience within the course. This includes an analysis of the core teaching strategy of team teaching, including a consideration of what happened in terms of student reactions to and outcomes from the team teaching model. Section 4 provides a reflection on the experience and discusses the implications of the findings.

2. What sociology offers the study of accounting

The influence of accounting extends beyond the sphere of corporate and other business entities – and recent scandals and ethical misdeeds – to the role of accounting in everyday life. In this sphere there has been a more recent questioning of the capacity of contemporary accounting education to adequately prepare students for full participation in economy *and* society (see Ravenscroft & Williams, 2004; Humphrey, 2005; Owen, 2005; Boyce, 2008). This discourse challenges the idea that accounting (practice, research, and education) is a neutral, technical discipline that can be abstracted from its social context. Moreover, accounting is recognised to be as much an ethical discourse as it is a technical discipline (Waddock, 2005).

An important aim of the Social and Critical Perspectives course was to provide a place where sociological concepts could be employed to critically examine the social role of accounting and a range of related social issues. It was designed to transcend both the traditional curricula and the mainstream accounting education change agenda, which remain largely rooted in the assumption that university education is and should be oriented almost exclusively around the need to prepare graduates for a future working life. This traditional vocational focus denies students wider educational opportunities that are afforded if education is related to the development of the whole person. In developing the new unit, the teaching team felt it was important to seek a balance between the humanistic, formative and vocational elements of education and to provide a space for active difference, debate, contestation and dissent (see Newman, 1996; Craig, Clarke & Amernic, 1999; Boyce, 2004). This emphasis is evident in an extract from the unit outline provided to students:

This unit draws on a significant academic discourse on accounting that has challenged the idea that accounting (and accounting research and education) can be abstracted from its social context. The unit takes a critical perspective, challenging traditional ways of thinking about the nature and role of accounting in society. Critical and social accounting analysis illuminates the sociopolitical and value-laden dimensions of accounting, problematising accounting as a social, political and situated practice. This is designed not only to enable students to more clearly appreciate the forces that shape accounting, but to place into perspective the consequences that accounting has in society and for the environment.

To achieve this broad aim, the teaching team turned to sociological concepts as a means through which to examine critically the social role of accounting, since sociology provides crucial tools for understanding phenomena of everyday life and associated social and political relationships. By extension, sociology has much to offer in the context of an attempt to renew the social and ethical relevance of accounting education. This is in part because sociology is "a generalising discipline" that provides concepts that relate to the real-life experience of social actors:

Sociology … concerns itself above all with modernity – with the character and dynamics of modern or industrialized societies … Of all the social sciences, sociology bears most directly on the issues that concern us in our everyday lives – the development of modern urbanism, crime and punishment, gender, the family, religion, social and economic power

(Giddens, 1996, p.3).

A sociological perspective on accounting facilitates a view beyond its constituent parts to include those used in performing accounting work. From this perspective accounting is:

… crucially concerned with the outcomes of accounting, the actual practice of, say, budgets which are imposed on subordinate staffs rather than negotiated with them, operating capacities which are rationalised as a result of an objective strategic management accounting exercise, or wage claims which are lost due to the downward revaluation of fixed assets or the need to provide for the rising level of default on Third World debt ... (Roslender, 1992, p.3)

Roslender (1992) utilised many papers from the accounting research literature to explain the relevance and implications of sociological concepts for accounting, and various forms of alternative accounting research are now well established in the literature (see Chua, 1986a, 1986b; Morgan & Willmott, 1993; Roslender & Dillard, 2003). Despite these developments in research and publication, sociologically-informed research remains largely excluded from the mainstream of accounting research (Baker & Bettner, 1997). As a result, the potential for sociological concepts to be utilised to both study the phenomena of accounting and to develop students' generic skills, such as high-level critical thinking, critical analysis and communication skills, remains largely untapped. This is despite the fact that the development of such higher-order generic skills is considered an essential element of university education generally and professional education specifically (see Accounting Education Change Commission 1990; ASCPA & ICAA 1996).

The Social and Critical Perspectives course drew on two principal sociological themes – social construction and social power – to form a thematic underlay for the consideration of a number of more specific topic areas. Overall these topics introduced students to the ideas that accounting is a socially constructed phenomenon; that this construction is particular and indeterminate (that is, it could be different); and that the construction of accounting in this way has particular effects and serves particular sets of interests.

2.1 Social construction

Three key aspects of the social construction of knowledge were utilised. First, the concept of social construction drawn from Berger and Luckmann's (1984) seminal work was used to analyse how accounting is constructed, used and understood in organisations and society. From this perspective, accounting takes the particular form that it does in our society not because it reflects a natural or immutable truth, but because it serves particular functions. In contemporary society, accounting is a powerful technology that occupies a prominent place in the process of social construction:

Only with accounting ... have economic concepts become coherent, comprehensive, axiomatic, codified, comparable, reportable, demonstrable, controllable and altogether account-able to the extent that we now know them …

... what constitutes our "economic society" is not a given external entity. It is an artefact that is produced through the association of external reality, government economic intervention, and public acceptance of readily available economic data, all of which are mediated by … accounting … (Suzuki, 2003, pp.69, 90)

The social construction of accounting in turn affects the broader process of reality construction in society – that is, accounting itself contributes to the construction of wider social realities and the way people make sense of the world. Particular manifestations of this are broadly based around an economistic view of society and the elevation and celebration of profit as a worthy end in and of itself.

Noting that the forms and purposes which accounting takes are an outcome of processes of social construction leads to a second critical area of consideration: the nature of key assumptions underlying accounting research and the sociopolitical view of accounting that emerges from a questioning of these assumptions. These assumptions include a general privileging of capital and profit over labour and the environment (drawing, for example, on Tinker, 1985; Catchpowle, Cooper & Wright, 2004; Ravenscroft & Williams, 2004; Gray, 2006). Exposing and exploring these assumptions, including their mutability, allows students to see the manner in which accounting is defined, constructed and practised to shape and create particular social realities.

The third element of accounting as socially constructed centres on the almost exclusive focus on numbers in conventional accounting thought and practice. Here, Chua's (1996) work on accounting as a monolingual language in a multilingual world allows students to see how the dominance of the "empirical/calculative tradition" in accounting results in an unnecessarily narrow view of what accounting is and what it could be. Although not seeking to ignore or downplay the importance of financial accountability, the broader view of accountability adopted requires that the de-facto dominance of financial and economic factors be challenged. From this perspective, students can begin to understand the implications of the power of numbers and to explore alternative forms of numbers and different types of account (such as narratives – Haynes, 2006) that could potentially privilege other factors, but also on how narratives and discourses within which traditional accounting practice is set have the effect of reinforcing the social status quo (Neu & Taylor, 1996; Christensen, 2004).

Consideration of these elements of the socially constructed nature of accounting and accountability created

opportunities for students to question the taken-for-granted assumptions of accounting and to develop an understanding of accounting's social and political significance beyond financial reporting.

2.2 Accounting and power

The second major sociological perspective underpinning the course concerned the interaction between social and political processes and accounting as a form of social power. This introduced the broad notion that, although accounting may contain many possibilities for emancipatory practice, it tends to produce one-sided constructions of reality that serve and legitimise narrow, particular social and economic interests (Tinker, 1985; Richardson, 1987; Tinker, 1991; Chua, 1996; Catchpowle et al. 2004). Students were exposed not only to the role of accounting as part of the "fundamental relationship between political and economic forces in society" (Miller, 1994, p.9), but also to how accounting calculative devices operate to shape and form the possibilities for action. This type of analysis extends to a consideration of the role of accounting in the creation and sustaining of unequal power relations and the associated production of social and economic injustices, including the distribution and redistribution of resources. In these settings, accounting is considered as both practice and discourse that affect the way people act, think and make decisions (such as Richardson, 1987; Chew & Greer, 1997; Boyce, 2000; Neu, 2000; Bush & Maltby, 2004).

The power of accounting also extends to the manner in which it conditions decision making such that only numbers and economic concepts are regarded as important (Boyce, 2004, p.572). The net outcome of the narrowness of this discourse is the systematic denigration, marginalisation and obscuration of alternative values, masking power relationships which create and sustain prices, incomes, wealth and resource allocations, and legitimisation of the status quo (Hines, 1989, p.63).

In summary, the course drew on significant bodies of research (from accounting and sociology) that challenge traditional conceptions of accounting and evoke for students the power of accounting to establish and nurture values, to legitimise actions, and to mask discrimination and injustice. Knowledge of the social functioning of accounting provided students with the opportunity to challenge the taken-for-granted neutrality of accounting, to imagine alternative forms of accounting and to see the potential role of accounting in the social *and* economic worlds (see Boyce, 2000; Ball & Seal, 2005; Cooper, Taylor, Smith & Catchpowle, 2005).

3. The learning and teaching experience

3.1 The student group

An administrative oversight led to the omission of the course from published university programs in 2006, resulting in a low number of student enrolments. Most students who took the course were late enrolees who had few other third-year elective course options available to them. Moreover, a decision to keep prerequisite prior study requirements to a minimum in order to make the unit available to a wide student group meant that most of the students who enrolled had generally poor academic records, and most members of the student cohort were from a non-English speaking background. The mean Grade Point Average (GPA) for the students enrolled in 2006 was 1.14 (on a four-point GPA scale where a score of 2.0 represents a clear pass average).

While the teaching team agreed that students should not be barred from participating because of their academic history, it was obvious that these students would face difficulty in a research-based unit that applied high-level generic skills (and set out to further develop these skills by building on an assumed established base). Accordingly, in the first lecture the study and assessment expectations of the course (twelve hours per week, with written essay/report assessment tasks) were clearly outlined. At the conclusion of the lecture, each student was asked to seriously consider her/his capacity to successfully undertake the course. This was not designed to scare off any students, but to ensure that those who proceeded with the course were realistic about expectations within the course. Of the original 50 students who enrolled, 25 remained and each successfully completed the unit – that is, completed all unit requirements and undertook the final examination (of these students, two failed to meet minimum requirements to pass the course, while six students gained Credit grades or better).

Although the teaching team took steps to adapt the content for the 2006 offering to make it relevant for the student group who enrolled, and presented it in such a way as to provide unique opportunities for these students, a decision was taken to adjust the entry requirements for the second offering in 2007 in order to ensure a relatively homogeneous cohort in terms of academic ability, as indicated by GPA. Therefore, a requirement was inserted into the prerequisites such that only students with a GPA of 2.5 or higher could undertake the unit. Another administrative oversight in 2007 again resulted in information about the course not being distributed to potential students, and only ten students enrolled, with eight students completing. This was a more academically able cohort, however, with an average GPA of 3.2 (ranging from 2.5 to 3.8). The group included a small number of non-English speaking background students, including two international students who were taking the unit as part of a one-semester Study Abroad program in Australia. In terms of final results, the 2007 cohort performed very well in all parts of the unit and all students gained clear passing grades. Six of the eight students earned Credit grades or better, including four High Distinctions.

3.2 Core teaching strategy – team teaching

As indicated earlier, a key aim was the development of critical-thinking skills and "consciousness-raising" in students about the broad dimensions of accounting. A large body of research has demonstrated that such outcomes are achievable through a team teaching approach which substitutes the notion of a single "expert" teacher with a range of experts (that is, a teaching team – see Coulson & Thomson, 2006).

As a practical matter, classes in 2006 were organised into a one-hour "lecture" and a follow-up two-hour tutorial, although the traditional lecture/tutorial organisation was effected in name only – the team sought to organise each class as an interactive seminar. For the second offering in 2007, to allow extra time for discussion, debate and explanation, class contact time was increased to include two, two-hour classes each week.

The staff selected a team approach to deliver the substantive content and to satisfy teaching and learning aims. The research and teaching backgrounds of course team members covered a range of topic areas, including environmental, social, critical, educational, Indigenous and criminological perspectives on accounting. To capitalise on this situation, each class was facilitated by two teachers and for each topic one staff member with experience or expertise in the substantive topic area led the session, supported by a second staff member. While this structure reduced individual autonomy for the staff members, this was more than compensated for by the building of collective autonomy, coupled with stronger and more well-informed teaching and learning engagements that yielded greater professional satisfaction. Indeed, each member of the team expressed appreciation for the opportunity to learn and to engage in areas beyond her/his specialist expertise.

The rostering of staff in the manner outlined above provided continuity *and* change for students during the course. Given the difficult and challenging content, it was sometimes refreshing to get a different perspective on the ideas under examination while avoiding the disruption of single-teacher rostering. This approach also spread the work among team members, so individual efforts could be more or less concentrated during the teaching period, assisting individual team members to maintain enthusiasm and energy both for this course and other academic tasks.

Assessment of student assignments throughout the course also utilised a team teaching approach with at least two staff members being involved in grading each piece of work. The main student assignments were an essay and a case study. For the essay, students were asked to summarise, discuss and critique a choice of articles from the research literature (selected from a list provided by the staff) and to write up their analysis in an integrated essay format. This form of analysis and writing was a new experience for many students, because the widespread adoption of multiple-choice and short-answer forms of assessment in many accounting courses meant that many had not previously had to write a significant essay as part of their coursework assessments.

Students submitted an initial draft of their essays, which were all independently read and commented on by two teaching staff. The two staff then discussed their comments with each other and provided each student with a single piece of detailed feedback on their draft essays, including an indicative grade. Students were then permitted to rewrite the essay to take the feedback into account. Resubmitted essays were then again independently read and graded by two staff members, who then came together to determine a consensus final grade for the essay for each student.

For the case study, students were asked to research and write about a contemporary issue, problem or case in the arena of social and critical perspectives on accounting. A wide range of topics was permitted, so long as students related their choice to the objectives and content of the course. Prior to submission, the general requirements for this assignment were discussed in class. As with the essay, student reports were independently read and graded by two staff members, who then determined a consensus grade for each report and provided each student with a single piece of feedback combining the grading comments of both teachers.

In addition to providing students with detailed feedback from a number of staff, the team teaching method yielded a number of significant benefits for both students and staff (see Letterman & Dugan, 2004, and Yanamandram & Noble, 2006, for discussion of the sorts of benefits that may be expected to flow from the adoption of a team teaching approach).

3.2.1 Student benefits

Direct interaction with research materials together with the input of several experts in sub-disciplinary or topic areas facilitated the development of students' analytical and critical thinking skills. Further, the engaged relationship between staff in the classroom encouraged students to participate and to question and seek clarification both from staff and fellow students.

Having two teaching team members in each class meant it was possible to encourage discussion through the use of (polite) interjections from the second teacher, asking key questions, raising difficult issues, and providing elaborations or alternative perspectives. Here was an active and practical demonstration of a dynamic model of inquiry that meant the written content of assigned readings was not unquestionable (see Letterman & Dugan, 2004). Over time, students

came to participate more freely in this process of questioning, discussion and debate. It is important to report, however, that this process was noticeably more difficult for the 2006 cohort of students, who had relatively poor academic records. As noted earlier, this cohort also included a significant number of non-English speaking background students. Although it is beyond the scope of this paper to examine the effect of language ability on student academic performance, we can note that the teaching team dealt with the difficulties of students by organising them into small groups for discussion of questions and issues. The two staff members present acted as roving advisors to assist and guide the group discussions. By the end of the semester, there was much more active discussion in these small groups.

A combination of cultural and language factors and student confidence may have limited the success of interactive discussions at the level of the entire class, as indicated by the more successful participation of the 2007 cohort of students who had much better academic records. A conclusion to be drawn from this experience is *not* that academically less successful students cannot participate in discussion, but that more work is required to develop their skills and confidence in this area. Indeed, it was rewarding to receive feedback from the majority of the 2006 students that they felt encouraged to offer explanations of their own understandings, and to critique the content of the articles under review.

From our experience, teacher–student and student–student relationships were enhanced under this model. Staff naturally demonstrated enthusiasm and passion for topics directly related to their areas of research expertise. This generated for students unique levels of engagement not previously experienced – classes were not only more challenging and interesting but more dynamic. Classes provided a space in which staff modelled not only collaborative team work but also variety in teaching and learning styles. Moreover, they provided the ideal setting in which to demonstrate the values underlying social and critical accounting and to encourage students to consider and reflect on their own values and those of others.

The more dynamic model of classroom activity also reduced the likelihood of adopting a "banking" model of education, in which students become "depositories" into which the teacher deposits chunks of knowledge, which students, in turn receive, memorise and repeat (Freire, 1996, p.53). The genuine collaboration between members of the teaching team and the associated dialogue with students reduced the possibility that teachers would engage in a monologue that students must passively absorb (Johnson, 1995; Thomson & Bebbington, 2005).

In this particular case, the social and critical themes of the course ideally lent themselves to a team teaching approach that challenged the traditional banking model. The classroom task for teachers was to help students engage with the material in such a way that it carried meaning for them, not as a series of unconnected and generally meaningless "dot points". This struggle with the literature continued for the duration of the unit but, by avoiding any tendencies towards banking education, the team teaching approach was more rewarding for both staff and students.

3.2.2 Staff benefits

For staff members, important benefits in collaborative team teaching came from an avoidance of an atomistic and isolated teaching experience, and the facilitation of better collegial relationships. The pooling of knowledge and resources is an obvious source of these benefits (Letterman & Dugan, 2004), but in our experience more is required. Each team member must be committed to the learning and teaching process in general *and* to the particular teaching engagement as an activity of intrinsic importance. This draws on the value of such a course for students (as outlined earlier in this paper), the benefits of the team teaching approach for students, and team member interest and commitment to the aims and content of the course. The ability of staff to effectively enact the interaction between teaching and research was a significant benefit because wider academic and educational commitments came together.

Another important element was the preparedness of the teaching team members to meet regularly to discuss topic content and relevant approaches to teaching. All staff worked collaboratively in the development of syllabus materials and each team member subjected their individual work to the critique of others, and offered constructive suggestions. The willingness of team members to contribute and advise others was essential and helped overcome the potential tunnel vision that can be a characteristic of specialisation in a particular area (see Letterman & Dugan, 2004). Several further benefits resulted from staff discussions, including integration of topics, exposure to and appreciation of colleagues' research expertise, and fostering of new teaching approaches. Overall, the level of cooperation resulted in enhanced professional relationships between staff members.

3.2.3 Summary of benefits

The experience of being a team member was rewarding for staff as a form of, "collaboration in designing a curriculum to improve students' intellectual capabilities and cultural sensitivity" (Harrigan & Vincenti, 2004, p.119). It must be recognised, however, that for some students the team teaching approach may represent a challenge to established patterns of learning, which may result in an experience of frustration and confusion. This is particularly likely to be the outcome if a comfortable and familiar "please the teacher" strategy is no longer viable in the specific context of the course being undertaken (see Harrigan & Vincenti, 2004). As discussed above, we made particular efforts to obviate

student frustration through the careful rostering and rotating of staff so that ideas and topics were integrated. In many instances the second staff member was able to draw on an earlier topic presented primarily by him/her, and to relate it clearly to the current topic (see Letterman & Dugan, 2004).

The diverse cohorts of students in the two offerings (2006 and 2007) also provided a benefit, albeit one that required new teaching strategies to be adopted, because it forced staff to be more flexible and adaptive in the way teaching materials were prepared and delivered.

In summary, our key aim in adopting the team teaching approach was to facilitate student learning and to mitigate the potential for unproductive resistance that often arises in critical educational contexts (Freire, 1996; Boyce, 2004, pp.578–579). Our experience, borne out by feedback from the students (formal and informal), suggests that these aims were achieved.

3.3 Student reactions and outcomes

To obtain feedback at the end of each offering, a member of staff not involved in teaching the unit administered a qualitative survey on behalf of the teaching team (a variation on the usual University procedures for gathering student feedback). Twenty students (80% of the total student group) completed the survey in 2006 and eight students (100% of the student group) in 2007. Survey results were made available to the teaching staff only after final student results had been processed and released to students.

To gain feedback on the unit overall, we asked students whether the unit developed their awareness of the role of accounting in society. In both 2006 and 2007, 100% of respondents (response rates to this question of 96% in 2006 and 100% in 2007) answered in the affirmative. Written comments indicated that students had expanded their view of accounting and come to see it as encompassing a wider variety of roles and phenomena in social and economic spheres, including both financial and non-financial factors. This took them well beyond considerations included in other accounting subjects, and one student said that the unit had led him/her to, "turn around the knowledge of my study of accounting".

We also asked students whether the concepts considered in this course were different to those covered in other accounting courses. Again, the overwhelming response from students was in the affirmative (85% of respondents in 2006 and 100% in 2007 – response rates of 100% to this question in both years). Written comments in response to this question tended to focus on the wider sociopolitical aspects of accounting that had been brought to light through the use of sociological concepts, as outlined earlier in this paper.

For the remainder of this section, we report student responses to the following question about the team teaching approach:

Did you like the team approach to teaching in this unit? Why/why not?

Overwhelmingly students responded positively to the team teaching model. In particular they acknowledged the expertise of each team member and how this exposed students to the possibility of multiple perspectives on topics.

In 20 responses to this question, the word "different" was used by students 12 times, providing an indication that the rostering within the teaching team to ensure both complementarity and diversity succeeded in encouraging students to consider a range of perspectives on the issues. A selection of these responses are reproduced below:

I like that the team approach as we discuss different ideas about social accounting.

Team approach to teaching is good because there are different opinions by the teachers.

… it is a discussion subject having other lecturers. We are able to get other perspectives to answer questions/topics that we are discussing.

Different people have different perspectives I can get different ideas from different people.

Associated with the presentation and discussion of different perspectives was the opportunity for students to be exposed to the range of research expertise within the teaching team. Students found this diversity of expertise beneficial, as typified by the following responses:

Lots of input of different perspectives/views as well as knowledge and expertise in different areas.

I like it because I can see the lecturer teaching that week's material are the ones with particular skills for that material.

Yes it was a great experience. I had the opportunity of learning from a very enthusiastic, didactic and motivated group/team.

Several other benefits of the team teaching approach were perceived by students. These included an appreciation of the level of organisation and preparation by staff and the creation of a comfortable classroom atmosphere (although one student indicated that he/she thought the team could have been more organised), as well as better student–teacher and student–student relationships:

It is the first time [we were] closer [to] the lecturer when we have classes like this.

I think the team approach is better because everyone can discuss the topic and get better ideas about the topic

… it allowed more interaction and allowed more learning [although] it became frightening when the topic is challenging to take in, and concepts that cannot be understood or are hard to understand.

… everybody feels free to participate and give ideas in the unit.

… it gives us a chance to discuss why the other answers are being done by the other group members, and their views.

Overall, the student view of team teaching is summarised by the following comment:

I like the team approach to teaching in this unit very much. Because the topics/concepts covered are very useful and helpful for us to understand what is happening to our society.

These results indicate that the team teaching approach was successfully implemented, in 2006. Results from the 2007 cohort of students echo these results, but provide a more nuanced perception of the benefits of this teaching approach:

They really know what they're talking about …

… offered more perspectives on the topics in class.

… the unit was really complex and the team was able to cover pretty much everything.

… it was a great opportunity to have a team which specialised in different areas to increase our awareness on those particular topics. Also, to have more than one perspective on the different issues raised.

… allowed interactions which created in-depth understanding of the course → given its difficult nature of concepts.

In conclusion, students were strongly supportive of both the team teaching mode and the content of the course. Some commented that the unit should be placed at an earlier point in the undergraduate degree, while one suggested that it should be made compulsory for all students!

4. Conclusions, implications and strategies for the future

Whilst calls for the reform of accounting education to deal with the post-Enron challenges of business ethics continue (such as Ravenscroft & Williams, 2004; Humphrey, 2005), the evidence suggests that similar calls in the past have been embraced rhetorically more than practically (Albrecht & Sack, 2000, p.58). Traditional accounting education programs remain severely deficient when compared with the broad ideals for education to develop the whole person and prepare students for full and meaningful participation in socioeconomic and political life. Business schools *do* have an influence on value formation, but the values developed and nurtured move *away* from those associated with customer needs, product quality and social issues, towards a heavy focus on shareholder value, and students seem to lose whatever pre-existing idealism they had (see Gentile & Samuelson, 2003; Waddock, 2005).

In considering appropriate directions for the future, Waddock (2005) raises serious concerns about the narrowness of accounting education when it neglects social and environmental issues. These concerns go beyond uncontextualised calls for generic skills development. They recognise that for such skill development to be both effective and meaningful, it must be situated in a context that envisions a deeper meaning for the content of accounting education. Ethics and integrity in accounting, business, and organisations more broadly must be considered to be an individual, organisational and social phenomenon that cannot be dealt with simplistically, formulaically or in an isolated fashion (Boyce, 2008). These considerations must be integrated with mainstream educational programs and this requires fundamental change in both curriculum and teaching approaches.

The results reported in this paper show that a team teaching approach can assist students to appreciate the social and critical dimensions of accounting education. These findings are probably applicable to students across the spectrum as the student cohorts we worked with, although relatively small in number, were diverse in experience and background. The experience of the teaching team suggests that it can be difficult to teach such a course to students with poor academic ability, but that these students can, nevertheless, handle such a course. In their feedback to the teaching team, many students commented on how the unit had offered them the opportunity to gain, "a new perspective on accounting" and how they had been extended in beneficial ways. Of course, all things being equal, academically more able students (such as the 2007 cohort) are much more able to handle this sort of material and deal with the literature on which it is based (see Kealey, Holland & Watson, 2005).

The introduction of the social dimensions of accounting much earlier in the undergraduate accounting program is an obvious way to deal with this situation. The strategy we have adopted to deal with this situation is the introduction of a new second-year course in 2008, to be called *Accounting and Society*. This course will have minimal entry requirements, and will provide a focus for the introduction and development of sociological and related concepts at a more basic level earlier in the accounting program. Successful completion of the course will provide an alternative route into the third-year course in *Social and Critical Perspectives on Accounting* for students whose performance shows they can

excel in this area even if they do not have an overall GPA of 2.5. Further work is required to develop and implement the broader integration of sociological and related concepts into the study of other accounting units.

The experience reported in this paper demonstrates how the infusion of sociological concepts into accounting education can provide the bedrock for change. For accounting education to regain and build social relevance it must however look beyond the narrowly economic phenomena that accounting is traditionally regarded as reflecting. The experience of accounting education reported here reflects Gramsci's (1971, p.418) insight that for *knowledge* to become *understanding* it must be connected with a feeling for the connection of knowledge both with lived experience and the socio-historical situation that contextualises that experience and produces that knowledge. Taking this approach, the ultimate aim of critique is, "to know oneself better through others and to know others better through oneself" (Gramsci, in Forgacs, 1999, p.59).

Accounting education can be designed to, "help enhance a wide spectrum of life-values, rather than serving to 'narrow down' or technicize" (Giddens, 1996, p.266). Although the experience examined in this paper is just one effort at a local level, it represents an approach that seeks to get on with the job and not wait for accounting authorities or accrediting agencies to make the changes for us, as educators. Educational change can only happen in classrooms, and with the teachers and students who populate them. The effort reported in this paper connects with a broad reform agenda in accounting education in a number of ways. It has been specifically designed to utilise sociological concepts and knowledge as a way of generating better understanding of the diverse range of phenomena associated with the practice of accounting. By taking a broad approach to the education of accounting students that includes the contextualised development of generic skills, this work aims to enhance the links between teaching and research and build into accounting programs a greater awareness of concern for the broader public interest. This reflects the long-held, but often forgotten, mission of universities (see Schwartz, 2006).

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Integrating Academic Literacy Skills in an Elective Intermediate Accounting Subject

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Abstract

This paper describes a project that sought to integrate academic literacy skills into an elective intermediate accounting subject. It offers a strategy whereby students are set academic reading and writing tasks through a series of graded published articles, written by faculty members, which were accompanied by questions and other activities to help them understand the text and analyse the accounting issues. Whilst this particular strategy for the integration of academic literacy is resource intensive for faculty members who lecture and lead tutorials, there were a number of observable student learning outcomes. These include improvement in students' academic writing style; equipping students with new approaches to reading academic articles; and the development of a positive attitude towards the acquisition of literacy skills.

Keywords: Financial accounting, Academic literacy skills, Accounting curriculum

1. Introduction

The Division of Economic and Financial Studies, with over 11 000 students coming from 69 countries, is the largest and most culturally diverse at Macquarie University. In the Department of Accounting and Finance, international students in 200 level subjects (that is, in their second year of undergraduate study) represent approximately 70% of enrolments. Whilst the Department welcomes this diversity, we recognise that students may require assistance to develop their academic literacy skills in the context of a particular subject area such as financial accounting.

In Semester 2, 2006, an elective intermediate financial accounting subject was offered for the first time to students studying in the Bachelor of Commerce–Accounting and the Bachelor of Commerce degrees. The learning objectives were:

(1) To provide an intermediate-level coverage of the principles and concepts relating to financial reporting;

(2) To build upon introductory accounting by exploring financial reporting issues in greater depth; and

(3) To provide an evaluation of various theoretical issues where students would be challenged to question the foundations of financial accounting and to think critically about current issues in financial reporting.

It was anticipated that by the end of the semester students would have improved their knowledge of financial reporting with respect to both the preparation and interpretation of complex financial reports; enhanced their ability to analyse accounting issues and communicate the results; and be better prepared for undertaking advanced study in the subjects ACCG310 Corporate Accounting and Reporting, and ACCG323 Financial Accounting Theory and Practice. These objectives were not achieved mainly because students were ill-equipped to read and understand many of the articles and case studies prescribed for the course. The 'language' problem was associated with: many students coming from a non-English speaking background (NESB); little or no experience in reading academic articles, case studies and academic research; and a perception that accounting concentrates on technical accounting content, while reading and writing have little place within the curriculum.

In Semester 2, 2007, a project was undertaken to equip students with the requisite skills to read and understand

accounting theory and research within the context of an intermediate accounting subject and as preparation for advanced accounting subjects. The project presented students with a series of graded articles that were accompanied by questions and other activities to help them both understand the text and analyse the accounting issues. The preparation of such a book of readings is one of many possible approaches to the development of reading skills in financial accounting.

This paper describes that project and is organised as follows. The next section briefly reviews the literature on the development of particular generic skills. This is followed by a description of the reading material prepared for the students and the approaches they had to take in reading the academic accounting research; then by a discussion of the student learning outcomes and the implications for curriculum development. The final section offers some concluding comments.

2. Literature review

2.1 Generic skills

In the past two decades, there has been a developing literature on the development of particular generic skills in the accounting curricula. In 1990, the Accounting Education Change Commission (1990) emphasised the importance of critical thinking in its *Objectives of Education of Accountants*, which states that students must be active in both the cognitive and affective aspects of learning. It intimates that accounting education curricula should be designed to address not only accounting knowledge, but also expand and reinforce generic communication, intellectual, problem-solving and interpersonal skills. The subsequent academic literature has highlighted and promoted the investigation of the development of critical thinking and communication skills under the guise of generic skills development (Gabriel & Hirsch, 1992; Zaid & Abraham, 1994; Webb, English & Bonanno, 1995, Morgan, 1997; Boyce, Williams, Kelly & Yee, 2001; Crebert et al., 2004; Boyce, 2004). Generic skills include communication and interpersonal skills, academic literacy (reading and writing skills), problem-solving skills, critical thinking and analytical skills, and judgment and synthesis skills (Boyce et al., 2001). There is now a general consensus among academics and accounting practitioners that accounting courses must transcend subject matter and content, and integrate 'generic skills' that graduates are perceived as lacking into accounting courses (Zaid & Abraham, 1994, Morgan, 1997; Boyce, 2004; Crebert et al., 2004; Bloxham & West, 2007). However, it is evident from the extant literature that despite the consensus for the development of critical literacy skills within accounting courses, there are few studies which investigate explicitly linking teaching and learning approaches with literacy outcomes.

2.2 Approaches to integration

Gabriel and Hirsch (1992) outline a number of issues associated with implementing an integrated approach to critical thinking and communication skills within accounting courses, which builds on the previous research of Hirsch and Collins (1988). The authors argue that the most appropriate and effective way to teach critical thinking and communication skills (there is no perceived dichotomy between the two skills) is to embed them within accounting courses. Vygotsky's (1978) domain of context-embedded teaching and learning has permeated into all discipline areas and levels of education. Contemporary accounting education is located within this domain of context-embedded teaching and learning as the most effective way to develop the necessary skills and literacy for negotiating learning and participating within the discipline (Boyce, 2004; Crebert et al., 2004; Bloxham & West, 2007). Zaid and Abraham (1994) examine the communication skills that employers, academics and graduate accountants consider necessary to participate in the profession. The authors identify particular generic skills as essential for accounting graduates to possess, and the findings suggest that both academic and graduate groups agree that the accounting curriculum positively contributed to the development of written, but not oral, communication skills.

Friedlan (1995) examines the effect of two different teaching approaches, used in introductory financial accounting courses, on students' perceptions of the skills and abilities important for success. The findings suggest that the 'non-traditional' approach, which makes extensive use of prescriptive mini-case and other contextual materials, classroom discussion and critical thinking and that places less emphasis on technical material, encourages students to have a more realistic perception of the profession and the skills needed to enter that profession successfully. Morgan (1997), in a survey of academics and accounting practitioners in the UK, also highlights the recognition of the critical importance of communicative competence in accounting graduates. Similarly, Crebert et al. (2004), in a survey of three schools within Griffith University, recognise that a strong disciplinary base and technical knowledge does not guarantee employment for a new graduate. The authors' report indicates that it is graduate attributes that are perceived as the variable in determining a graduate's success in the workplace. Their data underline the importance of integrating the development and assessment of generic skills when designing the learning objectives of undergraduate programs. Boyce et al. (2001) moves away from the focus of particular generic skills needed by the accounting graduate, and argues for the transferability of broader generic skills. It can be argued that it is better for students to acquire life-long learning skills rather than detailed technical knowledge of the accounting profession because many accounting graduates will never work in professional accounting practices. This is consistent with anecdotal evidence that some international students appear less interested in studying for a profession and more interested in gaining permanent residence (Hope &

Chamberlain, 2003).

2.3 Implementation strategies

Despite the general consensus for an integration of generic skills into the accounting curriculum, there is a distinct lack (with some notable exceptions such as Webb et al., 1995; English, Bonanni & Jones, 1997) of recent literature investigating the practical implementation of strategies that address developing generic skills; and, more specifically, addressing academic literacy (reading and writing skills). The previous research literature stresses the need to develop learning outcomes that target generic skills such as academic literacy and critical thinking, but do not explicitly link those outcomes to students' learning. Biggs (1993) conceptualises relationships involving the student, the teaching context, learning process and learning outcomes, as an integrated 'open' system. Therefore, in order to develop and enhance students' academic literacy and generic skills, a holistic approach/intervention may be required, rather than a focus on one component of learning (for example, instructional strategy).

Zaid and Abraham (1994) call for further research into teaching and learning processes, "which were of most help in developing communication skills … and how undergraduate curriculum at tertiary institutions could be broadened to integrate communication skills effectively throughout an accounting course" (pp.211 & 218). Webb et al. (1995) attempted to address this gap in the literature by conducting a pilot project at the University of Sydney to integrate literacy skills, specifically academic writing skills, into a first year accounting course. Their project was followed up by a program to introduce into tutorial sessions the explicit teaching of skills identified by the AECC and reported in English et al. (1997). In a demographic survey of accounting students, 50% (n = 422) identified themselves as coming from a NESB (specifically 32% from a Chinese language background), and a diagnostic assessment identified 59% of students as needing an intervention in at least one of the four literacy areas assessed (English et al., 1997, p.345). Of the four basic skills developed in the tutorial program, "knowledge acquisition and conservation skills" addressed the critical reading skills of the students. The complex academic reading required for the tutorial sessions were accompanied by matrices and interactive reading guides. Reading strategies were explicitly modelled for the students, with the underlying purpose being student replication when negotiating new material. The overall results of students' feedback indicated that the redesigned course appeared to have achieved its educational objectives, and students perceived themselves as having learned to think critically and avoid surface approaches to learning.

2.4 Reading strategies

A second intervention initiative to integrate literacy learning objectives into the curriculum was undertaken in a second year commerce course at the University of Newcastle (Hazell & Woodward, 1996). The literacy objective for this course was, "to develop students' ability to receive and communicate information and concepts by teaching these skills (critical reading and writing) within the discipline" (p.2). A specific teaching and learning strategy used to achieve this objective was to provide students with, "task-based reading guides to supplement tutorial readings". A number of strategies were identified by the authors as being the most appropriate to assist the students in developing effective reading skills (p.3). However, the authors emphasised the need to integrate reading strategies more closely with subject content, and to explicitly address and highlight the intended reading strategy covered by each reading guide. The study was not followed up by the authors, and therefore a qualitative analysis of students' feedback and achievement of literacy outcomes has not been published. The initial results of this project suggest a discrepancy between students' perceptions of their ability to read critically and effectively, and their reported difficulties with the readings.

The extant literature identifies the need for accounting students to be equipped with literacy skills in order to take their place in a profession that increasingly is looking for graduates with generic skills that include communication and interpersonal skills, critical thinking and analytical skills and problem-solving skills. This paper adds to a growing literature on how to integrate such skills into the accounting curriculum.

3. Method

In the extant literature, there is general agreement that the most effective way to teach literacy skills is to use a context-embedded approach, where the need for literacy permeates the learning and assessment tasks. This project embeds literacy skills into regular assessment tasks and the final examination while at the same time equipping the students with the necessary skills to successfully undertake the literacy tasks.

Hazell and Woodward-Kron (1996) undertook a pre-course student learning survey to determine students' reading skills in relation to their tutorial preparation. In the project reported here, the authors deemed it unnecessary to survey students as the need to enhance students' reading skills was evident through the feedback of academic staff members in advanced financial subjects, who reported that the majority of students had difficulty undertaking the required reading of both academic research articles and case studies. The need is acknowledged but no reading guides have been distributed to students in these advanced subjects in the past.

3.1 About the subject

ACCG223 Contemporary Dimensions in Financial Accounting is an elective intermediate financial accounting subject.

Each week there is a two-hour lecture and a two-hour tutorial for students to attend. Whilst there was a convenor for the subject who took the majority of the lectures, there were four other faculty members who lectured in their area of expertise. One of the objectives of the subject was to help students to develop reading and writing (literacy) skills for further study and for the workplace. One strategy for developing literacy skills is to set reading tasks that are supported by relevant questions that lead the reader through the article, focusing attention on the salient points. In particular, when reading academic articles there is a general format that can be discovered through posing a series of questions to be answered. This strategy of critical reading supported by a series of questions was used in Semester 2, 2007, when 43 students were enrolled in ACCG223 Contemporary Dimensions in Financial Accounting. Thirty-three students (77%) of students were enrolled in the Bachelor of Commerce-Accounting or a double degree that included a Bachelor of Commerce-Accounting. In other words, these students were enrolled in a degree that could lead eventually to membership of a professional accounting body and/or employment as a professional accountant.

In the first lecture students received a booklet of six published articles written by faculty members in the Department of Accounting and Finance whom they would meet as lecturers either in this subject or in further advanced financial accounting subjects. Students were required to follow the instructions in the booklet as they related to each of the six articles and were expected to complete the answers to all the articles in the booklet itself. In designated tutorials, students submitted photocopies of their answers to be marked by the lecturer. A marking guide was available for each article.

Answers were discussed (but could not be changed) in tutorials before being submitted to the lecturer. The submission date of the article coincided with the topic being discussed in the tutorial. “Reading financial accounting” was an assessable task with a weighting of 15% of the overall raw score for the subject. Students were awarded up to three marks each for their best five submissions about the six articles. The lecturer awarded a mark of 0 to 10 for each of the following assessment criteria:

(1) I can understand what you have written and the style is appropriate

(2) Your use of words, grammar and spelling is correct

(3) The content of your answers is correct, relevant, and well supported by evidence from the article.

The mark out of 30 was scaled to a mark out of three. The lecturer retained a photocopy of each of the submissions, in order to trace the development of literacy skills for each student.

3.2 Specific requirements to develop literacy skills

Article #1 had been published in a professional journal and was written for practitioners rather than academics. This introduced students to research that was written for practitioners to read and therefore was a good introduction to learning about research in financial accounting. The first question in all the articles involved skim reading. This technique was employed to help students gain an appreciation of the aims of the articles and the conclusions drawn by the author/s. The second question challenged the students to think about how the ability to read complex material was important for a graduate to be successful. Then students were required to design other questions of their own to assist them in reading and understanding the article. The purpose of this exercise was for students to appreciate that reading guided by a set of questions is an effective strategy to enhance critical reading skills. In addition, the students were instructed to write out answers in full, with proper sentence structure and complying with the instruction words in the question.

Questions were prepared for Articles #2 through to #5. The development of the questions was undertaken by two students who had recently completed their honours degrees and were tutoring in advanced financial accounting subjects. One of them was the tutor for this subject. Neither were native English speakers. Each of the questions signalled the main points in the articles and required students to: describe the meaning of the content; understand and discuss different research methods; critically examine if the results were valid and the conclusions derived were defensible; and describe the limitations of published research. There were various instruction words such as “list”, “describe”, “discuss” and “evaluate”.

For Article #6, students were expected to design their own questions and reflect on how different it was to develop questions at the end of the semester, when they were experienced in critical reading through designing appropriate questions, than it was at the beginning of the semester when they were inexperienced. The final article was more complex than the first article but not as complex as the articles that had questions prepared already. Article #6 had been published in an academic journal whereas Article #1 was published in a professional journal. The final question was, “If you have a friend considering this subject next year, what will you tell them about the skills that you learnt?”

In addition to 15 marks awarded to students as part of their continuous assessment, there was a question in the final examination which related to the readings. Students were informed of this at the beginning of the semester. The final examination was out of 90 marks and the question relating to the readings was worth 20 marks. There were two parts to

the question in the final examination. First, students were asked to choose one article from *Readings in Financial Accounting* that changed their idea of accounting and describe why. Second, they were asked to choose a different article from *Readings in Financial Accounting* and discuss the following: What was the research/problem question (or the research objective)? How did the authors go about answering the question? And, What conclusions were drawn by the authors? The objective of including this question was to reinforce the importance of the critical reading skills by awarding marks to students for successful engagement with the task. Marks are important currency for students and their allocation signals important learning. Therefore, overall the critical reading component of the subject was worth 25% (35/140 marks) of the total final raw score.

4. Outcomes

There are a number of observable outcomes from this project, firstly the improvement in students' writing style. Because of the small number of students (43 enrolments) the lecturer was able to provide detailed comments on every submission made by all the students. When answering questions in relation to the first two articles, the majority of students used dot points and made cryptic comments that did not fully answer the question even though they were instructed to answer the questions using full sentences. This style of writing changed as students were given feedback; in particular, they were told to repeat parts of the question back to the marker to ensure focus on the instructions of the question (for example "describe", "discuss", "evaluate" and so on) and focus on the specific content necessary to answer the question. Although it is not easy to judge improved writing style, when answers to questions from Article #1 and #6 were compared, it was clear that students had understood the importance of analysing questions by using topic, focussing and instruction words. They were answering the questions in a structured way, and this was not evident in relation to Article #1. Many students were able to transfer this technique to the final examination. Apart from the question that was directly related to the readings, the examination comprised a further three questions that required fully constructed, written answers. Overall, 55% of the marks in the final examination were awarded for answers written in an essay style. Students had practiced this style throughout the semester and those students who regularly submitted the readings assignment achieved higher marks for the written component of the final examination.

The second outcome was that students recognised the value of designing questions as a strategy in determining how to identify the important issues in academic reading. This was evident in answers to the question in Article #6, "Did you find it easier to develop questions for this article for Article #1? If yes, why; and if not, why not?" Many students commented on how exposure to academic reading and writing had enabled them to know where to start in the reading and writing tasks assigned to them and how to identify the key points and key words. Comments were also made about the value of skimming articles before attempting in-depth reading and evaluation of the research. In addition, the types of questions that students designed for their reading task in relation to Article #6 demonstrated that they were able to identify the important aspects of the research and the questions clearly guided them through the readings.

A further outcome was the development of a positive and confident attitude towards the development of literacy skills in financial accounting. Traditionally, accounting is viewed as being weighted towards technical content and the development of literacy skills is neglected because of a "full" curriculum. In answer to the question in Article #6, "If you have friends considering this subject next year, what will you tell them about the skills that you learnt?", the majority of students wrote in positive terms about their experience and the good preparation for advanced financial accounting subjects. They acknowledged that accounting was as much about words as it was about numbers. This is particularly true in relation to the compulsory subject ACCG323 Financial Accounting Theory and Practice that requires an understanding of accounting theory and involves students in reading complex academic articles, where sometimes there are three articles per week to be read. Some students said they would tell their friends not to be afraid of reading and writing tasks because appropriate literacy skills can be developed in this intermediate financial accounting subject. Of interest was the number of students who referred to the importance of literacy skills in the workforce and that they would recommend this subject to their friends in preparation for getting a job.

Finally, responses to the final examination question, "Choose one article from *Readings in Financial Accounting* that changed your idea of accounting and describe why", clearly demonstrates that students enrolled in this subject had moved beyond the view that accountants only require technical competency skills. Interestingly, the most cited articles were in relation to accounting and earnings management; accounting and cultural differences in relation to professional judgement; and accounting and the politics of international accounting standard setting. The general consensus from the students was that they had never considered accounting beyond its technical dimensions. Now, having been exposed to research that investigated accounting at a conceptual, analytical and critical level, they realised that their study of accounting had to extend beyond only techniques to developing literacy skills in order to be a successful accounting student and graduate.

5. Implications for curriculum development

The need to integrate generic skills in the accounting curriculum has been well established in the extant literature (for example Zaid & Abraham, 1994; Webb et al., 1995; Hazell & Woodward-Kron, 1996; English et al., 1997; Morgan,

1997; Boyce et al., 2001; Boyce, 2004). However, many accounting academics remain unconvinced and sceptical because of the "tight" curriculum in terms of technical skills and knowledge that need to be acquired. In the past few years the complexity of accounting has increased as has the perceived need to pack the curriculum with technical knowledge, despite the call from the accounting profession and employers for graduates to have highly developed generic skills. In addition, with the large classes in accounting subjects it is difficult to assess these skills without setting tasks that require detailed marking and feedback. Multiple choice questions that necessitate calculations are generally preferred over writing tasks when there are in excess of 500 students in a subject.

Another factor contributing to accounting academics opting for teaching technical accounting skills is that they do not consider that they themselves have the necessary qualifications or experience to teach and assess literacy skills. However, research has shown that these perceived obstacles can be overcome through inter-disciplinary collaborative projects with language specialists (Gabriel & Hirsch, 1992; Tindale, Evans, Cable & Mead, 2006a).

In this particular project, the confidence of the lecturer to integrate literacy skills into an intermediate accounting subject so comprehensively was as a result of participation in inter-disciplinary collaborative projects that embedded generic skills into the majority of subjects in a postgraduate accounting program (see Tindale et al., 2006b).

Integrating academic literacy skills into the accounting curriculum is no longer an option but must be viewed by accounting schools/departments as necessary for professional accounting education. Incorporating these skills into the curriculum requires time and resources, particularly for the collection of appropriate academic articles in a specific discipline area; discussing these articles in tutorials where tutors are time-poor because of the number of homework questions of a technical nature; recruiting faculty members who are convinced of the value of these skills and who are committed to developing assessable tasks; and the marking of written assignments to give students timely feedback on their performance and ways to improve their skills.

Because of the small enrolment (43 students) in 2007, it was possible for faculty members to devote the required time to marking. Also, the research assistance to prepare the questions for each article was paid for by a Divisional teaching grant. As numbers grow, it will be difficult to sustain the commitment to timely feedback and the possibility of outsourcing marking may need to be considered.

6. Conclusion

This particular strategy for the integration of academic literacy skills into an intermediate accounting subject is time intensive for faculty members who lecture and run tutorials. However, qualitative analysis of students' learning outcomes indicates that they have developed and enhanced their skills in reading academic articles as a result of the task-based strategies. Further, students have developed an ability to engage in academic writing through written and timely feedback that encourages and rewards continuous improvement. Future research can track the performance of these students in advanced financial accounting subjects to see if these skills are transferred. In addition, quantitative analysis can be done to investigate if the students who undertake this elective intermediate accounting subject perform better in the reading and writing tasks in the more advanced financial accounting units.

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Graduates' Use of Spreadsheet Tools in Learning and Applying Financial Mathematics

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Abstract

We investigate, using questionnaires, the use of spreadsheet software in the financial sector workplace by recent graduates and the benefits of spreadsheets in the teaching and learning of actuarial and financial mathematics at postgraduate level. This study investigates the nexus between learning and work in order to modify the university curriculum. We aim to equip graduates with skills applicable in the workplace and to improve the learning of actuarial and financial theory.

The results indicate that the use of spreadsheets in the workplace is ubiquitous and that graduates find them relatively easy to learn, easy to use and very useful for their work. Spreadsheet skills are considered very valuable. Little or no formal training had been provided during their university studies and graduates mostly learned on the job. The surveys of postgraduate students and of employers support the conclusions reached from the graduates' survey. There is considerable justification for university courses to include training in the use of spreadsheets.

Keywords: Actuarial, Financial, Assets, Liabilities, Calculation, Valuation, Spreadsheets, Software

1. Introduction

In industrial practice, many financial and statistical calculations are done using spreadsheets. At university the traditional approach used in teaching financial mathematics is for students to solve problems using pen and paper and then to do any calculations required using a calculator. The traditional approach may be a barrier to the learning of financial theory for many students.

This paper investigates the use of spreadsheets and other software in the workplace by recent graduates, the extent to which these skills were learnt at university or on the job, and the type of software skills required by financial sector employers of recent actuarial science and other graduates. It also investigates the opinions and attitudes of postgraduate coursework students regarding the use of spreadsheets and software in the teaching and learning of actuarial and financial mathematics.

Our purpose is to consider the nexus between learning and work in order to determine whether the university curriculum should be revised – both in order to improve the learning of financial theory and better to equip graduates with applicable skills for use in the workplace.

Financial mathematics is used for various purposes such as: financial decision making; the valuation of financial contracts, assets and liabilities; and the measurement of and reporting on the financial condition of financial institutions. Much of the mathematics and theory was developed before computers were in widespread use. Its teaching reflects this.

In current industrial practice, computers and spreadsheets are usually used to perform calculations to assist with financial decision making. These calculations vary from the straightforward to the complex. Consider the following 2 examples:

Example 1: Repayment Calculations for an Amortizing Loan

$$\text{Payment} = \frac{Pi}{1-(1+i)^{n}}$$

$$\text{Debt at time } t = \frac{P\left(1-(1+i)^{-(n-t)}\right)}{1-(1+i)^{-n}}$$

Where P = Principal, i = interest rate, n = term of loan, t = time elapsed since loan taken out.

This is a straightforward financial calculation which can feasibly be done on a calculator. Both formulae involve only 3 variables and basic mathematical operations.

Example 2: The valuation formula for a "chooser option". This is a financial contract where at time S you can choose whether at time T you get the payoff from a call option or a put option. The option is to buy (call) or sell (put) an asset worth V now for price X at time T in the future. At time T you get a payoff of either Max(V–X, 0) or Max(X–V, 0) depending on your choice at time S.

$$\text{Value} = (Ve^{-yS}N(d_1(S)) - Xe^{-rS}N(d_2(S))) - (Xe^{-rT}N(d_2(T)) - Xe^{-rT}N(d_1(T)))$$

$$d_1(S) = \frac{\ln\frac{V}{X} + (r - y + 0.5v^2)S}{v\sqrt{S}}$$

$$d_2(S) = \frac{\ln\frac{V}{X} - (r - y + 0.5v^2)S}{v\sqrt{S}}$$

Where: V = value of asset now, y = dividend yield, r = interest rate, T = maturity date, S = decision date, X = exercise price, v = volatility of asset. $N(x)$ = cumulative density function of standard normal distribution evaluated at x.

This is a more complicated example of a financial formula. It involves several variables, advanced functions, and functions of functions of functions. This is not suited to calculation on a calculator.

Spreadsheet programs are ideally suited to performing these and other financial and insurance calculations. They are also suited for creating tables, graphs and reports and presenting the results. They are used for these purposes in the financial services industry. Using spreadsheets for teaching financial theory may be a better way of preparing students for the workplace than the traditional approach to teaching the theory. It allows student to work on more realistic problems and case studies.

In this paper we review the literature on the use of software in teaching mathematical skills, and we report on the attitudes of three groups: postgraduate finance and actuarial students; graduates working in the financial services industry; and managers who supervise these graduates.

2. Background

There have been no previous studies on the use of spreadsheets (such as Excel) as teaching tools for courses specifically in actuarial studies. However, there has been a good deal of work done on issues that are directly relevant to our study. The following overview will show, for example, that the use of computer algebra systems (CAS) and other software programs has been extensively investigated at university level, both regarding the value of these as teaching tools, and the attitudes of students to their use. From a pedagogical viewpoint, investigators have found value in using computers to do complex calculations that have in the past been done by hand. They argue that this enables students to attend to the way in which different stages of complex problem-solving processes fit together, leaving the student free to concentrate on components or aspects of the process which they would be likely to overlook when preoccupied with time-consuming hand calculations.

A number of studies have focused on the use of software programs (such as computer algebra systems – CAS) for teaching university courses in mathematics, statistics, science and engineering. Some of these studies are concerned with students' and lecturers' attitudes to the introduction of unfamiliar software into university courses, while others are concerned with the pedagogical value – the pros and cons – of software programs as teaching tools. Both of these concerns are present in a study by Stewart, Thomas and Hanna (2005), who looked at the use of CAS in teaching a group of first and second year science and engineering majors. They found that students fell into four "types" or groups:

(1) One was "openly opposed" to computer work because they believed that working out problems by hand benefited their education more than relying on computers.

(2) A second had no such qualms, but lacked the ability to use the software to its full advantage and so made limited use of it.

(3) A third had poor mathematical skills and so welcomed the possibility of using computers to do calculations that they had difficulty doing themselves.

The fourth group found that using computers helped them to understand concepts because they were not distracted by the lengthy process of doing calculations by hand and so were better able to understand problem-solving processes as a whole.

Other studies have concentrated on student attitudes to the introduction of computer technology into university courses in mathematics. Cretchley and Galbraith (2002) and Cretchley and Harman (2001) are among those who have looked at students' confidence, attitudes, motivation and engagement with regard to (i) learning mathematics generally, (ii) using technology generally, and (iii) using technology in learning mathematics in particular. They found that confidence and motivation correlated strongly with achievement in mathematics, but those attitudes towards using technology in learning mathematics correlated much more strongly with a positive attitude towards computer technology than with a positive attitude towards mathematics itself. Coupland (2000) looks at students' opinions regarding the use of Mathematica in their first year of study and she found that just over 50% of them had positive or neutral attitudes while almost 50% had a negative attitude. Previous computing experience seemed to correlate with a positive attitude, a conclusion also supported by Galbraith, Pemberton and Cretchley (2001). These results all point to the importance of the level of computing skills in students' attitudes to the use of computers in studying mathematics, since negative attitudes may arise not because computers impede learning or are simply not useful, but because students have insufficient computer skills to feel comfortable with computers, or lack the skills to benefit from the educational advantages they might offer.

Forster (2006) is concerned not only with the educational value of computer use including spreadsheet programs, but also the technical understanding required. Reviewing a wide range of literature, he argues that passing mathematics processing to a technology allows students to focus on mathematics properties and relationships, provided that technical expertise is in place. Regarding spreadsheet software programs in particular, he says that their capabilities are better than with those on graphics calculators and CAS. The limited screen area on hand-held graphics and CAS technologies means that results are often accessed on different screens to the one on which information is entered, which prevents direct comparison of input and output. He argues that learning in statistics, too, is aided by the use of spreadsheets. Forster emphasises, however, that the use of technology in teaching requires careful attention to the students' computer-specific understanding. He warns that the status of students' technical understanding under three different headings – input of information, procedures in activating the technology, and the interpretation of outputs – should be assessed before exposing them to computer-based activities.

In terms of research specifically on spreadsheets, several studies point to their effectiveness for student learning. Johnson (2006) sets out to demonstrate the educational value for mathematics teaching of Excel in particular, but also other spreadsheet software, arguing that it facilitates hypothesis testing, the investigation of variants and algebraic reasoning. Wagner (2006) is also concerned with demonstrating the pedagogical uses of Excel and similar spreadsheet programs – in this case in the context of engineering – and observes that across a number of relevant numerical tasks and problems students show significant improvement in their skills. Kademan (2005) argues, similarly, that Excel and other spreadsheet software are highly useful in science teaching, because of their data manipulation capacities.

3. Method

Questionnaires were designed to obtain the opinions of three groups of people: students (postgraduate commerce students including actuarial science, accounting and finance and other business students); recent graduates working in the financial services industry; and the managers/supervisors of those recent graduates. The questionnaires were distributed in class for the postgraduate students and by email for the graduates and employers. Participation in the surveys was both voluntary and anonymous.

3.1 The student survey

The student questionnaire uses a 5-point Likert scale (Appendix C). All but two of the questions fall into one of the three following groups:

(a) those inquiring into attitudes to the use of software programs in the classroom, without comparing this approach with traditional teaching methods (questions 1 and 9),

(b) those asking the student to compare the merits of traditional and computer-based learning methods as ways of learning and mastering university work (questions 2, 3 & 4);

(c) those inquiring into student perceptions of the value of using computers in the classroom as preparation for the workplace (questions 5, 6 and 7).

Ninety-three (93) postgraduate students participated in the student survey. The cohort of students was comprised of about equal proportions of actuarial students and accounting/finance students. The survey was conducted at the end of semester. By this time, some but not all of the students in the cohort had been exposed to the use of spreadsheets for performing financial calculations during the semester, some had experience in using it from before then and some were complete novices. During their undergraduate studies, these students would have been taught financial mathematics in the traditional way.

3.2 The survey of recently hired graduates

Seventy (70) graduates who were working in the financial services industry participated in the graduate's survey. The survey (Appendix B) asked questions about:

(1) The demographic characteristics of the respondents, such as age, gender and length of time in the current job.

(2) The software they use at work, how much time they spend at work using spreadsheets, and for what purposes they use spreadsheet software.

(3) The training they have had in using spreadsheets, the importance of spreadsheet skills in the workforce, and the advantages and disadvantages of spreadsheets.

3.3 The survey of employers / managers / supervisors of recently hired graduates

Ten managers responded. The survey (Appendix A) asked questions about:

(a) The type of graduates they employ, what software these graduates use at work

(b) The importance of spreadsheet and macro/visual basic skills in graduates

(c) The spreadsheet skills training they provide to graduates and their views on their training needs

4. Results

The results of the three surveys are set out in Appendix A, along with a statistical analysis and relevant graphs.

4.1 Survey of Postgraduate Students

Figure 1 shows the average score by question. A score of 3 indicates neutral on the proposition expressed in the question, a score of 4 indicates agreement and a score of 5 indicates strong agreement. It is apparent from the graph that the students are in agreement with the propositions in the questions, except for question 1.

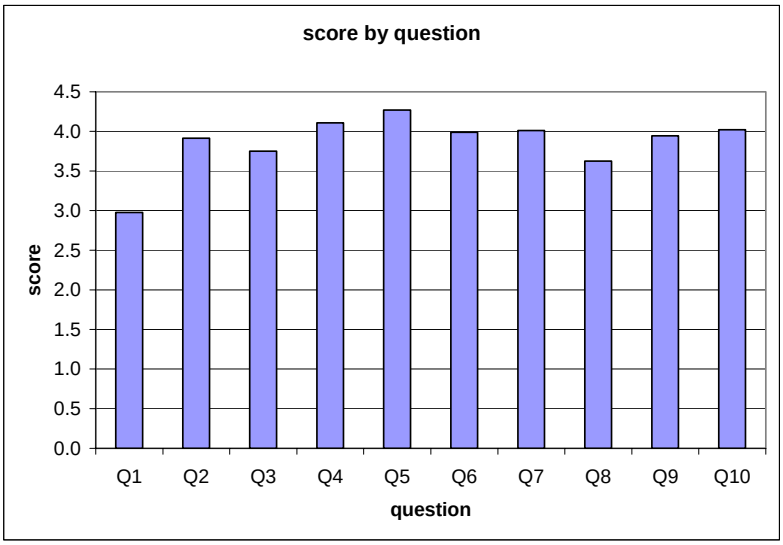

Figure 1.

In Figure 2 we collapse the "agree/strongly" agree categories into a single category and we do the same for "disagree/strongly" disagree categories. This results in three categories of "agree or strongly agree", neutral, and "disagree or strongly disagree". This graph shows the relative proportions of responses in these three categories for each question. It demonstrates visually that for question 1 opinion was polarised whereas for all the other questions the "agree" category dominated the other two categories of response.

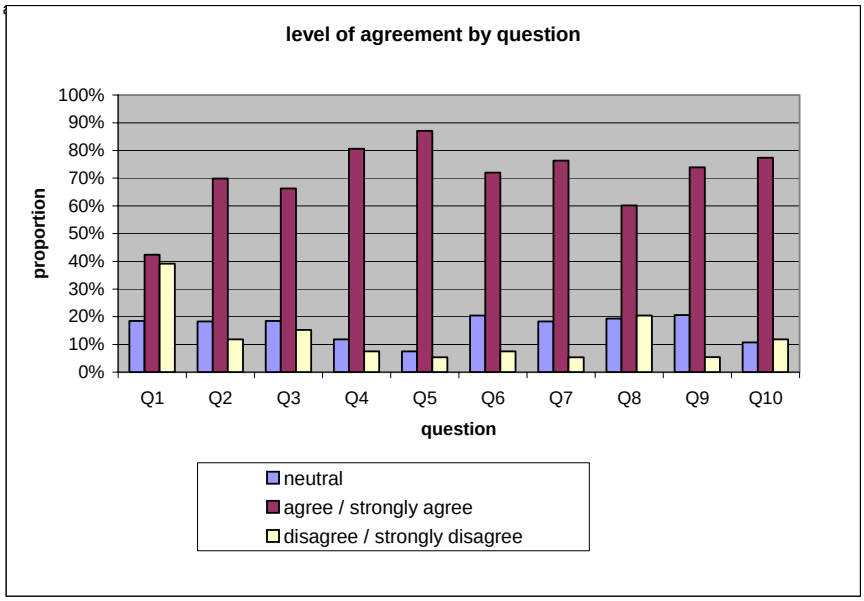

Figure 2.

Thus the response to question 1 stands out as the only one of our questions where there was not a positive answer. This question – from group (a) of the groupings listed under 3.1 above – asks whether "complex formulae and tedious calculations are a barrier to learning". From the literature review it is apparent that in general students tend to be divided in their attitude to hand calculation and complex formulae, with some actually liking them, some finding they present no barrier, and some finding them difficult (Stewart, Thomas & Hanna, 2005; Coupland, 2000). In this context it is interesting that the student responses for question 1 were polarised – much more so than with any other question – with roughly equal numbers of students accepting and rejecting the proposition. This could reflect the divide between actuarial studies students in the cohort (comprising about half the group) and those studying other subjects. High achievement in mathematics is an entrance requirement for actuarial students, they have regular exposure to very complex formulae throughout their university studies, and would therefore be unlikely to be daunted by difficult mathematical calculations.

Students' largely affirmative answers to Question 10, which asked them to respond to the proposition that "it can be an intellectual challenge to solve financial/mathematical/actuarial problems using computers and spreadsheets", show that our cohort of students did not view the classroom use of computers simply as a means of "letting the computer do the work" but found using spreadsheets to solve complex problems to be an intellectually interesting process. This supports the proposition that computers can enhance a student's understanding of complex problem-solving techniques – a benefit of the classroom use of computers remarked upon by a number of the researchers surveyed in our literature review (Johnson, 2006; Wagner, 2006; Kademan, 2005; Thomas, Monaghan & Pierce, 2004; and Forster, 2006).

The answers to questions 2, 3 and 4 – the questions making up group (b) – were all positive and clearly show that our students preferred computers to calculators for their studies. Their answers to question 3 in particular support what we have inferred from their answers to question 10 – that computers are a valuable learning tool.

The students answers to questions 5, 6 and 7 – our group (c) questions – were also all positive, showing that the cohort saw the classroom use of computers as an important part of their professional training for the workplace.

The general view of the classroom use of computers expressed by our students was more positive than the views commonly reported in the literature. A number of researchers (Coupland, 2000; Cretchley & Harman, 2001; Galbraith, Pemberton & Cretchley, 2001; Cretchley & Galbraith, 2002) suggest that a lack of experience in the use of sophisticated software is a common source of resistance to the use of computers as a teaching tool. Since the majority of students in our cohort had had a good deal of prior experience in the use of such software, this may partly explain their generally positive attitude to the classroom use of computers.

4.2 Survey of recent graduate entrants to the workforce

Seventy graduates who have recently joined the workforce participated in the survey. Details of the survey results are set out in Appendix B.

The cohort was 27% female and 73% male. The age distribution was: 71% aged 18-25, 24% aged 25-30, and 4% aged over 30. Regarding their degree majors, 90% of them had an actuarial science major, 41% had accounting/finance

majors, and 16% had a mathematics/statistics/computer science major (note students are able to complete more than one major). Regarding their duration in their current job, 43% of them have been in their current job for up to one year, 44% of them for one to three years, and 13% for more than three years. These people work in a wide range of jobs in the financial services industry.

Almost all of the respondents (99%) use spreadsheets in their work. About 90% of them use word processing software and 47% use specialised statistical software. About 30% of them use high-level programming languages. Almost all of them spend a significant proportion of their time at work using spreadsheets. More than 60% of them spend more than half of their time at work using spreadsheets, and 85% of them spend more than 20% of their time at work using spreadsheets. Spreadsheets are used for a wide range of purposes from ad hoc straightforward calculations to highly complex calculations and statistical modelling and simulation.

In our sample none of them had received any training in spreadsheets at university and only 19% had been given a training course by their employer. The rest had learned it from colleagues on the job or by themselves. The majority (81%) of them are of the view that some level of training in spreadsheet skills should be provided at university. Almost all of them (99%) rate themselves as being experienced spreadsheet users.

We asked them about their perceptions of the advantages and disadvantages of spreadsheets. Overall their attitude to spreadsheets is very positive. A clear majority agree on the major pros and cons, as follows:

Pros: It is possible to develop a spreadsheet quickly for all sorts of calculations, both simple and complex (95% of the sample agreed on this point). Spreadsheets are widely used in industry (86% agreed). Spreadsheets are easy to learn and easy to use (71% agreed). They have a wide range of tools and functions that make them useful for work (71% agreed).

Cons: Spreadsheets are often inadequately documented (76% agreed). It is difficult to audit spreadsheets and verify that they work as intended (71% agreed).

Other disadvantages that were identified were the risk that a user can modify the way the spreadsheet works; that spreadsheets have a slow execution speed; that it can be difficult to explain them to new users; and that it is cumbersome to have both code and data in the same file. It is noteworthy that none agreed with the proposition that spreadsheets can be difficult to understand and difficult to modify.

We asked them about the importance of spreadsheet skills for entry-level staff and 80% of them rated spreadsheet skills as fairly important to essential. 77% also thought that employers rate them this way. Skills in Visual Basic (Macros) were seen as less important than basic spreadsheet skills.

4.3 Survey of managers / supervisors of recent graduate entrants to the workforce

We sent the survey to a sample of 50 employers / managers / supervisors, of whom ten responded. Though this is a small sample, the results are similar to those in the survey of recently hired graduates:

(1) Software used in the workplace: All (100%) of the graduates use spreadsheets at work, 80% of them use word processing software and 70% use statistical software.

(2) The importance of spreadsheet skills in graduates: All of them rated these skills as at least fairly important and 80% rated them as very important to essential. Visual basic skills were not seen as quite as important.

(3) The type of graduates employed: Actuarial science (100% employed actuarial science graduates), accounting / finance (30%), economics (30%), mathematics / statistics / econometrics (50%), computer science (20%).

(4) Training in spreadsheets: Only 30% provided a basic training course. The rest expect staff to learn on the job from colleagues or to already have these skills before joining the organisation.

(5) Spreadsheet training needs of entry-level staff: A big majority of the sample (80%) agreed that at least some of the training should be provided in university courses.

5. Implications for learning and teaching

Both recently hired graduates and employers overwhelmingly think that university courses should provide some training in spreadsheet skills. The extent to which training courses are provided for new graduates in the workforce is low. Spreadsheet skills are seen by both employees and managers as very important skills. Basic spreadsheet skills are more important than visual basic (VB) or “macro” skills.

Ninety-nine percent of the graduate employees and 100% of the employers reported that spreadsheets are used in the workplace by graduates. Spreadsheets are used for a significant proportion of the time by most graduate employees. They are used for a wide range of tasks from simple to complex. Over 60% of graduates reported using spreadsheets for more than 50% of their time at work. While spreadsheet, word processing and statistical software skills are evidently required in the workplace, not much training in these skills is provided by university courses.

Among the various studies done on the use of software in teaching at university level, both regarding the value of these

as teaching tools and the attitudes of staff and students to their use, a number of investigators have found pedagogical value in using computers to do complex calculations that have in the past been done by hand. Our inquiry offers general support for these conclusions.

The main disadvantages of spreadsheets brought to light by our inquiry were a perceived lack of documentation provided for most spreadsheets, and the difficulty in auditing them and verifying that they work as intended. It is likely that the reason why our inquiry was able to bring out this problem was the high proportion of postgraduates in our student sample – in other words, students sufficiently advanced to identify a problem of this kind. The generally positive attitude in our student cohort to the use of computers as a study tool contrasts with the mixed response often encountered by other researchers. A number of those researchers have suggested that negative responses may be explained by students' lack of experience with sophisticated software. If so, it is plausible that the relatively positive attitude of the students in our cohort can be explained by the fact that a high proportion of them had extensive experience in the use of advanced computer software.

Our student survey indicates that the use of spreadsheets in university training is likely to be welcomed by students. That such training will better prepare them for the workforce is evidenced by our survey of recently hired graduates, who generally find spreadsheets very useful in their work. In this context it is worth mentioning that in industry practice it is important to be able to do the numerical calculations efficiently and accurately, and this means using computers and software to do it. For example, in statistics most of the formulae used for model fitting and hypothesis testing are too complex and tedious to do by hand. No practicing statistician does this sort of calculation by hand. The focus is on using and interpreting the results and not on the calculation process. The same applies to actuarial science and financial mathematics. It is important to understand the mathematical theory, but it is just as important to be able to apply it and this requires computer skills. Both a theoretical understanding and the ability to apply it are required. Having one skill without the other is inadequate in today's workforce.

There is definitely a need for training in the use of spreadsheets to be included in university courses in actuarial science, financial mathematics and finance. This will enhance students' learning and also better equip them for the workforce. It is recommended that university training in financial mathematics and actuarial mathematics should be updated to provide students with training in spreadsheets and other software, and in how to apply these in practical problem solving. Such training would ideally include instruction in how to document and audit spreadsheet models, how to write them, and how to convert a mathematical solution into a spreadsheet model.

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APPENDIX A: Results of survey of managers / supervisors of recent graduates

What type of graduates do you hire?

Actuarial Studies	100%
Accounting / Finance	30%
Economics	30%
Maths / Statistics / Econometrics	50%
Computer Science	20%
Other	10%

What software do these recently hired graduates use in their jobs?

Spreadsheet software	100%
Word processing software	80%
Statistical software (S+, SAS, etc)	70%
High level languages (C, C++, Fortran)	30%
Other (e.g. in house valuation software)	40%

How do you rate the importance of spreadsheet skills for graduate staff:

(a) not important at all	0%
(b) somewhat important	0%
(c) fairly important	20%
(d) very important	20%
(e) essential	60%

How do you rate the importance of visual basic (spreadsheet macro) skills for graduate staff:

(a) not important at all	20%
(b) somewhat important	20%
(c) fairly important	20%
(d) very important	30%
(e) essential	10%

Does your organisation provide staff with any training in spreadsheets?

(a) We provide a basic training course	30%
(b) On the job training from their colleagues	30%
(c) We expect staff to have skills before they join us	40%
(d) Staff learn by self study in their spare time	0%

What is your view of the spreadsheet training needs of recent entrants into the workforce:

(a) should be included in university training	20%
(b) it should be “on the job training”	20%
(c) both (a) and (b) apply to some extent	60%
(d) expect staff to already have a basic level of competence	0%

APPENDIX B: Results of survey of recent graduate entrants to the workforce

Demographic profile of respondents

gender		Age		Time in current job		Degree major		Type of work they do	
Female	27%	18-25	71%	0-1 year	43%	Actuarial Science	90%	Life Insurance	26%
Male	73%	25-30	24%	1-3 years	44%	Accounting, Finance	41%	General Insurance	30%
		Over 30	4%	3-5 years	10%	Maths, Stats / Computing	16%	Superannuation / Pension Funds	3%
				Over 5 years	3%	Other	6%	Investment / Finance	37%
								Other	14%

Software used at work

Software used at work		Proportion of time using spreadsheets at work		Purposes spreadsheets are used for		Ability as a spreadsheet developer / writer	
Spreadsheets	99%	Nil	1%	Ad hoc straightforward calculations written by me	77%	Novice	1%
Word processing	90%	0%-20% of the time	13%	Routine calculations and other tasks using already developed spreadsheets	70%	Experienced at spreadsheets but not vb / macros	43%
Statistical software (SAS, S Plus, R etc)	47%	20%-50% of the time	24%	Ad hoc highly complex calculations written by me	70%	Experienced at spreadsheets and vb / macros	22%
High level languages (C, C++, Fortran etc)	30%	Over 50% of the time	61%	Statistical model fitting and simulation	23%	Expert in all aspects of spreadsheets	34%
Other	13%						

Advantages and disadvantages of spreadsheets

What are the advantages of spreadsheet software?		What are the disadvantages of spreadsheet software?	
Easy to use and easy to learn	71%	They can be difficult to understand and difficult to modify	0%
Can develop a spreadsheet quickly to perform all sorts of calculations, both simple and complex	95%	It can be difficult to audit & verify that they correctly do what they are designed to do	71%
Spreadsheets are widely used in industry practice and many staff use them	86%	They are often inadequately documented	76%
They have a wide range of capabilities and built in functions and tools that make them useful for calculations and the production of tables and graphs	71%	A user can modify the code and alter how they work. It is difficult to protect them from this risk	38%
Tedious and repetitive calculations or other tasks can be automated using "macros" or visual basic	24%	Other (e.g. slow speed, difficult to explain to others, cumbersome to have code and data in the same file)	19%

Importance of spreadsheet skills

Importance of spreadsheet skills for entry level staff		Importance to the employer of spreadsheet skills in entry level staff		Importance of VB / Macro skills for entry level staff	
Not important at all	1%	Not important at all	1%	Not important at all	10%
Somewhat important	29%	Somewhat important	22%	Somewhat important	44%
Fairly Important	15%	Fairly Important	37%	Fairly Important	32%
Very important	18%	Very important	21%	Very important	9%
Essential	37%	Essential	19%	Essential	4%

Training

What training did you receive in spreadsheet skills		What is your view of the spreadsheet and other software training needs of recent entrants into the workforce?	
None at all	29%	It should be included in university training	1%
I was sent on a training course by my current or a former employer	19%	It should be "on the job training" depending on the specific requirements of the job	43%
I learned from my colleagues / supervisor	14%	Both of the above apply to some extent	22%
I learned from university studies	0%	Expert in all aspects of spreadsheets	34%
I taught myself about it on the job / in my spare time	38%	Employers expect new staff to have a basic level of competence in the software we use in the workplace.	

Appendix C: Questionnaire for postgraduate students

		S D	D	N	A	S A
Q1	There are many complex formulae and tedious calculations involved in learning and studying finance/financial mathematics/actuarial mathematics. This can be a barrier to learning the material.	1	2	3	4	5
Q2	In **learning** finance theory/financial mathematics/actuarial mathematics, using a computer and spreadsheets is preferable to using a calculator for performing the calculations involved in problem solving and answering assignments questions.	1	2	3	4	5
Q3	Using a computer and spreadsheets for the calculations in finance/financial mathematics/actuarial mathematics makes it easier to learn the material.	1	2	3	4	5
Q4	In the **practical application** of finance theory/financial mathematics/actuarial mathematics, using a computer and spreadsheets is preferable to using a calculator for performing the calculations involved.	1	2	3	4	5
Q5	Using a computer and spreadsheets for problem solving in and learning of finance/financial mathematics/actuarial mathematics **makes me better prepared for the workforce**.	1	2	3	4	5
Q6	It is important to receive additional training by the university in the use of spreadsheets so that I am better prepared for the workforce.	1	2	3	4	5
Q7	The training in spreadsheet programming that I received in my university course will prove to be useful when I enter the workforce.	1	2	3	4	5
Q8	Using computers and spreadsheet software to solve financial/mathematical/actuarial problems is an important aspect of my university course.	1	2	3	4	5
Q9	Students should be allowed to use computers and spreadsheets in the final exam instead of a calculator if they wish to.	1	2	3	4	5
Q10	It can be an intellectual challenge to solve financial/mathematical/actuarial problems using computers and spreadsheets.	1	2	3	4	5

Appendix D: Statistical analysis of results of student survey

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Proportion who are neutral	18%	18%	18%	12%	8%	20%	18%	19%	21%	11%
Proportion who agree / strongly agree	42%	70%	66%	81%	87%	72%	76%	60%	74%	77%
Proportion who disagree / strongly disagree	39%	12%	15%	8%	5%	8%	5%	20%	5%	12%
Level of agreement (average score)	3.0	3.9	3.8	4.1	4.3	4.0	4.0	3.6	3.9	4.0
P-value for Hypothesis that score is 3 (neutral)l	85.90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
P-value for Hypothesis that score is 4 (agreement)	0.00%	21.91%	1.66%	13.42%	0.33%	45.72%	45.31%	0.23%	28.22%	42.40%

To compute the average score / level of agreement, we assign numerical scores as follows:

Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly agree = 5. The level of agreement with each question was computed by averaging these scores.

From the last 2 rows, showing the p-values we can reach the following conclusions:

(1) The scores are all statistically significantly bigger than 3 except for question 1. For question 1 the score was 3.0 indicating neutrality on the proposition in the question.

(2) For questions 2 to 10 the scores are all close to 4.0 (agreement). For question 5 the score is statistically significantly higher than 4.0. For questions 3 and 7 the scores are statistically significantly lower than 4 but for the other questions the scores are not statistically significantly different from 4.0.

Statistical analysis of the average scores is only one way of analysing the results. Alternatively we can look at the proportions who agree or strongly agree versus the proportions who disagree / strongly disagree or who are neutral. We see that for all questions except the first the proportion who agree or strongly agree clearly dominates the proportions who are either disagree or strongly disagree or are neutral.

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Student Perceptions and Preferences for Feedback

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Abstract

Provision of effective and high quality feedback has been identified as a key element of quality teaching. Despite its importance this area has been neglected in research to date; in particular research on student experiences of feedback. In a previous study Rowe and Wood (2008) invited economic and finance students (both undergraduate and postgraduate) to attend focus groups and individual interviews. In line with previous research the authors found that students valued feedback, and were aware of its importance to achieving learning outcomes. The aim of the present study is to extend the findings of the previous qualitative study with quantitative data. A survey was developed from themes identified in the focus groups and was distributed to a large cohort of students at Macquarie University and Canberra University. Some preliminary results are provided.

Keywords: Assessment, Feedback, Higher education, Student perceptions, Student preferences

1. Introduction

The provision of effective and high quality feedback has been identified as a key element of quality teaching and this view is well supported by meta-analytic studies (Astin, 1991; Black & William, 1998; Hattie, 1987; Hounsell, 1987; Ramsden, 2003). Nevertheless this element of teaching has been largely neglected in research; in particular, the experience of students has not been extensively investigated. In a previous study by Rowe and Wood (2008) undergraduate and postgraduate economic and finance students from Macquarie University were invited to attend focus groups and individual interviews. The purpose of the study was to explore student perceptions of feedback. Participants consisted of 29 students with a wide range of backgrounds in terms of age, ethnic and language background and experience, so it was considered that the opinions expressed reflected the range of opinions of the student population. Due to problems of scheduling to fit into students' timetables, groups ranged in size from one to five depending on who was available in the timeslots. The interviewer asked a series of open-ended questions and probes were used if initial questions did not lead to developed responses. Focus groups were audio recorded and transcribed.

As shown in previous research (Higgins, Hartley & Skelton, 2002; Hyland, 2000; Weaver, 2006), the authors found that students valued feedback and were aware of its importance to improved learning outcomes. Results indicated a diversity of preferences (that is, written/verbal, specific/general, group/individual), suggesting that a balanced approach in providing feedback would be most effective to meet individual needs. There were clear preferences for verbal feedback when generic and provided to the group as a whole. Written feedback was preferred, on the other hand, when offered as specific comments addressed to the individual on an assignment or exam. The overall message received from students was their need for teaching staff to provide more feedback. At the same time they expressed empathy for teachers, recognising the time and resource constraints of providing such a personalised service. The students interviewed in the previous study indicated that they wanted more engagement from their tutors, and while it is evident from the comments made that some tutors try to provide helpful feedback, this practice was found to be inconsistent. One possible explanation for this is time constraints due to large class sizes. The wide variety of responses received, when students were asked what they thought feedback was, suggests that many are confused about what to expect from tutors. While this could be attributed to differing perceptions about the role of feedback between students and teachers, another possibility is poor communication by teaching staff. It is suggested that the introduction of "assessment dialogues", as

proposed by Carless (2006), may be beneficial here.

Feedback was considered particularly unhelpful when vague or untimely, or when not enough information was provided to make it useful. Many students wanted more face-to-face individual contact, but were aware that this can make unreasonable demands on lecturers' time. An interesting finding was that some students described feedback in emotional terms, for example by pointing to its role as a motivator and in providing reassurance, thus reducing their anxiety about a subject. Many commented that it was disrespectful of teaching staff to provide late feedback. Students expressed the value they placed on it and how they wanted their needs to be considered, for instance by saying that they wanted tutors to consider their feelings and point of view, and show care for their work. These findings were important enough for us to include a section on emotions in the survey developed for the current paper, to further explore this area.

1.1 What is the role of feedback?

Previous research has identified several constructs involved in the feedback process: the sources of feedback (teachers and students); the mode of feedback (how it is presented); the content (information conveyed); and the occasion (when it is presented) (Rucker & Thomson, 2003). While there has been an attempt by some researchers to explain relationships between some variables, little has been done to integrate these constructs into a coherent theoretical model. Few studies have focused on teacher feedback about student performances, and fewer on student perceptions or preferences. Drew (2001) found that for students, feedback relating to all aspects of progress was important, not just performance in essays or exams (see also Deeprose & Armitage, 2004).

Available research suggests that feedback is most effective when provided soon after task performance; is presented in a manner sensitive to the students' learning styles; clearly identifies strengths and weaknesses; has suggestions for improvements; and is constructive and motivating (Hattie & Timperley, 2007; Parikh, McReelis & Hodges, 2001; Rucker & Thompson, 2003). Earlier research also established feedback as a necessary condition for student goal setting (Erez, 1977). Although the purpose of the present study was to explore student perceptions, a comparison of students' conceptualisations and research definitions is useful for refining teaching methods. For the purpose of this paper Hattie and Timperley's (2007) definition of feedback will be adopted, which they conceptualise as:

information provided by an agent (e.g. teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding … feedback is thus a "consequence of performance (Hattie & Timperly, 2007, p.81).

In this study feedback is defined as information provided to students about their performance, and includes written comments on assignments, verbal responses provided in class or individually, postings on WebCT (the online student learning system), and peer- and self-evaluation forms of feedback.

1.2 Why study student preferences?

In recent years, increasing attention has been given to assessment and instruction. This is due largely to a growing trend for higher education institutions to adopt service orientation models in the provision of educational services (Hill, 2005; Higgins et al., 2002). As Birenbaum (2007) notes, such information not only assists higher education institutes to better serve their customers, but investigation of students' preferences for instruction and assessment is valuable for understanding a variety of other factors that drive the learning process and its outcomes. Some studies, for example, link student learning and testing preferences to performance differences (Phillips, 1999). Teacher evaluations have been found to be influenced by student preferences (Birenbaum, 2007). Unlike teaching preferences, which have received much attention, few studies regarding student assessment preferences are available, especially on feedback.

Some studies have looked at the interaction between preferences and student characteristics, that is, personality, attitudes, cognitive styles, learning orientations and strategies (Birenbaum, 2007). Positive feedback has been found to improve mood and satisfaction ratings in undergraduate students (Stake, 1982). Such studies suggest that preferences for feedback are related to students' self–esteem, self-concept and self-efficacy. The relationship between feedback and self-efficacy has been supported both by theory (Bandura, 1986; Zimmerman, 1995) and experimental studies (such as Lackey, 1997). Some gender differences in perceptions have been found (Rucker & Thompson, 2003). In a study of medical students Parikh et al. (2001) found that individual feedback was the most strongly preferred type, with peer and group feedback also favoured. Assessment preferences have been linked to learning orientations and styles (Birenbaum, 1997; Entwistle & Tait, 1990; Gijbels & Dochy, 2006). For example, 'surface learners' have been found to prefer teaching and assessment procedures which allow them to memorise and reproduce factual contents of study materials, and 'deep learners' have been found to prefer courses which are intellectually challenging and where assessment procedures allow them to demonstrate their understanding (Biggs, 2003; Entwistle & Tait, 1990; Gijbels & Dochy, 2006). Birenbaum (2007) found that students preferred instruction and assessment that was on the teacher-dependency side of the dimension of learning.

Other studies point to differences in student and teacher perceptions. Deeprose and Armitage (2004) found that tutors failed to recognise the positive impact that their assessment feedback was having upon students. Reid and Johnston

(2001) found that perceptions of what constitutes good teaching differ between students and academics. Such studies demonstrate the importance of considering the viewpoints of both students and academics, in that staff need to be more sensitive to student perceptions and students would benefit from a greater awareness of why particular teaching techniques are preferred by their teachers (Reid & Johnson, 2001). Finally, Birenbaum (2007) notes the importance of studying preferences lies in the fact that, "students are aware of the factors that debilitate/facilitate their learning and this awareness influences their instruction and assessment preferences" (p.753).

1.3 Research questions

The current paper aims to extend the findings of Rowe and Wood's (2008) previous qualitative study with quantitative data. The focus of the present study is to investigate student perceptions and preferences for feedback. Preliminary explorations will also be made into the importance of emotions in the process. Building on themes that emerged from the focus groups, demographic variables such as gender, year of enrolment, enrolment type and first language were anticipated to affect student perceptions and preferences. For example, in the focus groups many international students said they preferred verbal feedback as this allowed them to clarify information. A final objective of the study is to explore the link between perceptions and preferences, that is, do students who value feedback perceive it differently, and how does this affect their preferences? It was anticipated that their preferences would fall into six identified categories (verbal/written, group/individual and specific/general feedback) and perceptions into two categories (practical/emotional).

2. Method

2.1 Participants

The participants were 883 undergraduate and 83 postgraduate students enrolled in a range of disciplines, the majority of which included commerce (23.7%), accounting (19.4%), actuarial studies (17.2%) and business (15.1%). There were 837 students from Macquarie University and 153 from the University of Canberra. Additional demographic data is presented in Table 1.

Table 1. Demographic variables

Demographic variable	Number (%)
Gender	
Males	500 (51.5%)
Females	468 (48.2%)
Undergraduate Year of Enrolment	
First year	341 (35.2%)
Second year	329 (33.9%)
Third year	142 (14.6%)
Fourth year or higher	71 (7.3%)
Student Type	
International	463 (47.9%)
Domestic	503 (52.1%)
First Language	
English	352 (36.3%)
Other	614 (63.3%)

The age of respondents ranged between 17 to 60 years (M=21.66 years, SD=4.62), with 48.6% aged between 21-30 years. For international students the average number of years lived in Australia was 9.61 years (SD=9.35). The majority of international students were from China (45%), Hong Kong (14.8%), Korea (4.0%), Malaysia (5.6%) and Vietnam (3.1%). This sample was representative of demographics within the faculty.

2.2 Survey instrument

Qualitative data from focus groups in the previous study were entered into NVIVO software. A questionnaire was developed using themes extracted from the data (refer to Appendix A) as well as themes identified in the literature. The questionnaire was divided into six sections: i) Demographic Data, ii) Type of Feedback, iii) Perceptions of Feedback, iv) Value of Feedback, v) Preferences for Feedback and vi) Suggestions for Feedback. Sections ii), iii) iv) and v) required students to indicate their level of agreement with a series of statements on a five-point Likert scale, ranging from "strongly disagree" to "strongly agree". For part of section ii) a five-point Likert scale with numerical points of

reference (0%, 25%, 50%, 75% and 100%) was used. This section was adopted from Parikh et al.'s (2001) feedback survey of American medical students. There were two open-ended questions on the importance of feedback (section iii) and suggestions to improve it (section vi). Once completed the questionnaire was administered to five colleagues and research assistants for validation purposes. Appropriate ethical approval was then sought and obtained.

2.3 Design

Using a randomised block design, the survey was administered by the researchers to students in classes at Macquarie University and at Canberra University from weeks two until weeks nine of Semester 2, 2007. Surveys were distributed, completed and collected during class time. At Macquarie, undergraduate and postgraduate students were surveyed from actuarial, accounting, business, economics and statistics classes. Copies of the survey were also left in the student centre. Undergraduate business/commerce and information technology students were recruited from Canberra University.

3. Results

A principle components analysis (PCA) was carried out on the core group of questions (Type of Feedback, Frequency of Feedback, Perceptions of Feedback and Value of Feedback) to determine whether they could be grouped by common dimensions. The results indicated that all groups of questions could be defined by one dimension with the exception of Preferences for Feedback which needed two.

Two new sub-groups were formed for this set (Pref A and Pref B). There appeared to be similarities between these two groups and two learning approaches (surface and deep) as conceptualised by Biggs (2003) and others. Pref A group preferred feedback that allowed them to think deeply about their subject matter and encouraged independent learning through reflection. Statements indicative of such responses include, "I like it when tutors guide us to work out the answers ourselves", "general feedback in class helps me to learn independently", and, "it is more important for me to see the reason why I received a particular grade, than to know how other students went." By contrast the Pref B group were less interested in understanding the material but wanted feedback which gave them the answers or information about the tutors' marking criteria. Responses indicative of this group included such statements as, "I prefer it when tutors just give us the answers", "the grade is more important to my learning than feedback", and, "I don't like it when teaching staff encourage questions in lectures because it waste time." Emotion items included in section ii) failed to appear as a separate dimension.

An independent-samples t-test was conducted to compare scores for Type of Feedback, Frequency of Feedback, Perceptions of Feedback, Value of Feedback and Preferences for Feedback (across both groups, Pref A and Pref B) for Macquarie and Canberra University students. No significant differences were found between these groups for any of the feedback measures.

Independent t-tests were then used to determine whether there were any differences between demographic groups across the subscales. Men and women were found to differ significantly across all measures, as can be seen in Table 2. Women's mean scores for all feedback measures were higher than those of men.

Table 2. Effect of gender on feedback subscales

Feedback Scale	*t*	*df*	*Sig. (2-tailed)*	Mean Difference (on a five point Likert Scale)
Type of Feedback	2.75	963	$p<.05$	.09
Perceptions of Feedback	5.12	951.12	$p<.001$	.14
Value of Feedback	4.09	951	$p<.001$	.13
Preference Group A	3.89	920.24	$p<.001$	.11
Preference Group B	2.55	951	$p<.05$	.08

Further t-tests on each of the perception questions revealed mean differences ranging from .007 to .290. The most significant difference between men (M=3.65, SD=.86) and women (M=3.9, SD=.76) was in their response to the statement, "when the tutor gives me feedback it shows me that they care about the work I have done." Women also agreed more than men with statements such as: "feedback tells me what I need to do to improve my performance in a subject", "feedback explains my grade for a subject", "feedback tells me what the expectations of the lecturer/tutor are", "feedback motivates me to study", and, "lecturers who provide feedback care about what students think." These differences were small, however. T-tests on gender and preferences revealed mean differences ranging between .01

and .21, which were considered too inconsequential to report.

Significant differences were found between international (M=3.01, SD=.509) and domestic students (M=3.16, SD=.494) on Type of Feedback, t (963)=5.34, p<.01 (mean difference .17), suggesting that domestic students are more satisfied with the amount and type of feedback that they are receiving. A significant difference was also found between international (M=3.01, SD=.51) and domestic students (M=3.12, SD=.49) for Pref B group, t(951)=-4.55, p<.001. This difference was small (-.15), and no further analyses were carried out. A one-way between-groups analysis of variance was conducted to explore the impact of year of enrolment (undergraduate students only) on the above measures. No significant differences were found with the exception of Type of Feedback, F(3,878)=2.84, p<.05. First year students (M=3.44, SD=.49) were found to be more satisfied with the Type of Feedback they were receiving than fourth year students (M=3.26, SD=.57). The mean differences, however, are small and such results may be caused by the large sample size. This finding is contrary to comments made by first and second year students in the focus groups, who were generally more dissatisfied with the amount and quality of feedback they were receiving (due to large class sizes) than those of third and fourth year students. No significant differences were found between undergraduate and postgraduate students across any of the measures.

Preference group data were analysed by multiple regression, using demographic variables (university, age, gender, enrolment type and language) as regressors. The regression was a poor fit for both Pref A (R^2_{adj} = 1%) and Pref B (R^2_{adj} = 3.7%), however, possibly due to the large sample size significant relationships were evident. The effect of gender was significant for both Pref A, F(1,852)=14.54, p<.001; M(males=3.71, females=3.82), and Pref B, F(1,852)=8.90, p<.05; M(males=3.05, females=3.15). Enrolment type, F(1,852)=1.51, p<.05; M(international students=3.05, domestic students=3.4), and First language, F(1,852)=6.23, p<.05; M(English=3.15, language other than English=3.04), were also found to be significant predictors of student preferences (Pref B group only). No other significant relationships were found.

4. Discussion

4.1 Findings

This paper provides preliminary results that extend an earlier qualitative study. A more comprehensive analysis of the data is currently being undertaken and will be published at a later date. While it was expected that preferences for feedback would fall into the six categories identified (such as verbal/written, group/individual and specific/general feedback), factor analysis identified two dimensions of preference. The most interesting finding of the study appears to be a link between student feedback preferences and learning approaches. Previous studies have identified a relationship between learning strategies and assessment preferences (Birenbaum, 1997; Entwistle & Tait, 1990; Gijbels & Dochy, 2006). The characteristics of the two preference dimensions identified appear to reflect two learning approaches (surface and deep) as conceptualised by Biggs (2003) and others (Entwistle & Tait, 1990; Gijbels and Dochy, 2006). Pref A students appear to reflect deep learners whose preferred approach is to engage meaningfully in learning that enhances their understanding of the material. These students prefer feedback that allows them to understand the material and welcome the opportunity to engage with the lecturer. Perhaps this reflects a more self-regulated approach to learning (Birenbaum, 2007). Pref B students appear to fit the category of surface learners whose preferred approach is to meet course requirements with minimum effort. They prefer positive feedback that gives them the answers and dislike class participation. Perhaps these students could be viewed as falling into the teacher-dependent category (Birenbaum, 2007).

Very few significant differences were found between any of the demographic variables. Neither institution nor year of study significantly affected how students valued or perceived feedback, or their preferences. Some minor differences were found between international and domestic students on their perceptions of the feedback being provided to them and their preferences, however, these were not highly significant. Similarly, year of enrolment was found to significantly effect student perceptions of the type of feedback they were receiving, with third and fourth year students reporting lower levels of satisfaction than first and second years. Gender emerged as the demographic variable most likely to affect perceptions and preferences, with men and women differing significantly across all measures pertaining to this: women were more satisfied with the amount and type of feedback they were receiving, valued feedback more and seemed to view feedback as important for emotional reasons more than men. While these differences were small they are noteworthy. It is difficult to compare the present gender findings to previous studies (such as Rucker & Thomson, 2003) because of the measurement of different constructs.

The results of the regression analyses suggest that demographic variables are a poor predictor of student feedback preferences. The small amount of variance in preferences explained by demographics suggests that there are other variables which need to be explored (such as the extent to which students value feedback, and their perceptions of it). It is recommended that further analyses of the data look closely at the relationships between such variables and student preferences. It is anticipated that students who value learning are more likely to hold a deep learning approach, while surface learners will hold a cynical view of education (Biggs, 2003). Based on the overall findings, it is suggested that

the provision of good practice for everyone is more important than accounting for individual differences, and that clearly-communicated feedback should work successfully across all demographic groups. As per the focus groups, many students reported that they were not receiving enough feedback. The importance of teachers providing effective and timely feedback is highlighted by the following comment made by an undergraduate international student: "'the sound of silence' is not a happy song."

4.2 Challenges

There were challenges to the present study. Some students did not fill in the last page, which implies that the survey may have been too lengthy. Other potential factors that may have introduced a bias were an imbalance in sampling; for example, mainly day classes were surveyed. A further observation is that instructions given to classes were not controlled. These factors may have affected the final results. Despite these limitations the current study provides an innovative step towards an understanding of the dimensions of student perceptions and preferences for feedback.

4.3 Future directions

Further analyses are currently being undertaken using this data to explore other possible relationships between variables yet to be determined. Future research is needed on the role of emotions in learning – specifically emotions and feedback. Although statements on emotions in section ii) (Type of Feedback) failed to emerge as a separate dimension in the factor analysis, this could be due to the small number of items allocated to this theme. Many written comments obtained from the survey point to emotional factors, including several requests for the provision of feedback to be made more personal. For example:

It [feedback] motivates and encourages students in the right direction. It should be personal and able to be applied easily. Not only is it justification, but it's advice. (Undergraduate domestic student - female)

It [feedback] shows the tutor/lecturer is in tune and cares about his/her students. (Undergraduate international student – female)

Interaction between tutor and students must be encouraged. (Undergraduate domestic student – female)

These were interesting comments made by female students. Given that women's responses were significantly different from men's on two statements linking the provision of feedback to the extent to which lecturers care, this suggests that for women receiving feedback holds as much emotional as academic significance. Written comments were also found to complement qualitative data from the focus groups, with similar themes emerging – for example, the role of feedback as a motivator, in reducing anxiety, providing encouragement and making students feel cared for (Rowe & Wood, 2008). Students' written comments from the survey have not been reported extensively in this paper, but they will be the focus of a later publication.

4.4 Conclusions

The present study illustrates students' perceptions about the role of feedback, and adds to the emerging literature focussed on improving student learning and the student experience. The survey presented students with an opportunity to reflect on the significance of feedback in their learning. The findings highlight the importance of developing a much deeper dialogue with students about issues related to the individual meaning of receiving feedback. A student-participative approach to teaching and learning is essential for two reasons: firstly, the way that students perceive the learning context and the way they approach learning affects their learning outcomes and, secondly, student-teacher concepts of what constitutes good teaching often differ (Gijbels & Dochy, 2006; Reid & Johnson, 1999). An important finding of the study was a possible link between student feedback preferences and learning approaches. Approaches to learning have been extensively studied so now that literature can be applied to student preferences. The preliminary findings in this study imply that the provision of appropriate and timely feedback promotes deep learning in students.

Universities are increasingly recognising that feedback is an important way of improving their teaching ratings. Indirectly this then assists them to secure critical learning and teaching performance funding. Future directions for research are to further explore the relationship between student preferences and approaches to learning (such as deep and surface), and to consider the impact of other demographic variables such as age and country of origin. The effect of feedback on student emotions is another promising area of investigation.

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Appendix A – Student Feedback Questionnaire

Macquarie University is interested in student learning experiences and wishes to investigate student perceptions of and preferences for feedback, with the aim of improving learning and teaching. There are no right or wrong answers in this questionnaire. Please complete the following questions on the basis of your experience studying at the University. Any information or personal details gathered in the course of this study will be kept confidential. No individual will be identified in any publication of the results. Only the researchers will have access to the data.

---

1. Demographic Data

a) What program are you enrolled in? _____

b) What gender are you? ❍ Female ❍ Male

c) What is your age? _____ years

d) Are you an undergraduate or postgraduate student?

❍ undergraduate ❍ postgraduate

e) If undergraduate, are you a first, second, third or fourth year student?

❍ (1) ❍ (2) ❍ (3) ❍ (4)

f) Are you an international student? ❍Yes ❍No

If yes, which country do you come from? _____

g) Is English your first language? ❍Yes ❍No

If no, what is your first language? _____

h) How many years have you lived in Australia? _____ years

---

2. Feedback Provided by the University

Please indicate your level of agreement with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I receive enough feedback from my lecturers and tutors	❍	❍	❍	❍	❍
The feedback I receive is relevant to my goals as a student	❍	❍	❍	❍	❍
The feedback I receive is related to the purpose of the assignment	❍	❍	❍	❍	❍
My lecturers and tutors provide enough information to make feedback useful	❍	❍	❍	❍	❍
Feedback on assignments is always provided within two weeks	❍	❍	❍	❍	❍
Teaching staff are always willing to provide feedback	❍	❍	❍	❍	❍
The feedback I receive can be applied to my studies and/or work	❍	❍	❍	❍	❍
Class feedback is presented in a way so that everyone can participate	❍	❍	❍	❍	❍
Teaching staff need to be more active in providing feedback	❍	❍	❍	❍	❍

Please indicate how often (as a percentage of time) you receive the following types of feedback:

	0%	25%	50%	75%	100%
No feedback	❍	❍	❍	❍	❍
Grades	❍	❍	❍	❍	❍
Individual written comments from the tutor	❍	❍	❍	❍	❍
Group verbal feedback from the tutor	❍	❍	❍	❍	❍
Group written comments from the tutor	❍	❍	❍	❍	❍
Individual verbal feedback from the tutor	❍	❍	❍	❍	❍
Peer feedback	❍	❍	❍	❍	❍
Self-assessment	❍	❍	❍	❍	❍

3. Perceptions of Feedback

Please indicate your level of agreement with the following statements. When responding think about what you consider to be the most important aspects of feedback:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Feedback is a justification of the grade I have received	❍	❍	❍	❍	❍
When the tutor gives me feedback it shows me that they care about the work I have done	❍	❍	❍	❍	❍
Feedback tells me what I need to do to improve my performance in a subject	❍	❍	❍	❍	❍
Feedback explains my grade for an assignment	❍	❍	❍	❍	❍
I deserve feedback when I put so much effort into tutorials and assignments	❍	❍	❍	❍	❍
When the tutor provides feedback I don't worry as much about the subject	❍	❍	❍	❍	❍
Feedback is a response from the tutor to something I have said in class	❍	❍	❍	❍	❍
When I receive a lot of feedback I feel encouraged	❍	❍	❍	❍	❍
Feedback is any individual contact with the lecturer	❍	❍	❍	❍	❍
Receiving feedback does not reduce my anxiety about a subject	❍	❍	❍	❍	❍
Feedback is an evaluation of my strengths and weaknesses	❍	❍	❍	❍	❍
Lecturers who provide feedback care about what students think	❍	❍	❍	❍	❍
Feedback tells me what the expectations of the lecturer/tutor are	❍	❍	❍	❍	❍
Feedback motivates me to study	❍	❍	❍	❍	❍
When I don't receive any feedback I feel that the lecturer does not respect me	❍	❍	❍	❍	❍

Feedback is important because …

_____
_____
_____
_____

4. Value of Feedback

Please indicate your level of agreement with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Feedback is important to me	❍	❍	❍	❍	❍
I always collect my assignments	❍	❍	❍	❍	❍
I always read the feedback on my assignments	❍	❍	❍	❍	❍
I use feedback to try and improve my results in future assignments	❍	❍	❍	❍	❍
Feedback is only useful when I receive a low grade	❍	❍	❍	❍	❍

5. Preferences for Feedback

Please indicate your level of agreement with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
General feedback provided in class helps me learn independently	❍	❍	❍	❍	❍
Tutors' written comments are often difficult to read and poorly explained	❍	❍	❍	❍	❍
Feedback is only useful when it is positive	❍	❍	❍	❍	❍
Individual feedback is better because I can clarify any issues with the tutor	❍	❍	❍	❍	❍
I like it when lecturers post sample answers on WebCT	❍	❍	❍	❍	❍
I feel encouraged when lecturers provide general feedback in class	❍	❍	❍	❍	❍
An important part of learning is being able to discuss the subject with my lecturer/tutor	❍	❍	❍	❍	❍
I learn better when the lecturer encourages me to think deeply about the subject matter	❍	❍	❍	❍	❍
Verbal feedback is easier to understand	❍	❍	❍	❍	❍
I don't like it when teaching staff encourage questions in lectures because it wastes time	❍	❍	❍	❍	❍
Specific feedback is better because it helps me to understand what I did right and wrong in an assignment	❍	❍	❍	❍	❍
I learn more when my tutor focuses on the questions I got wrong	❍	❍	❍	❍	❍
It is boring when lecturers provide general feedback to the class	❍	❍	❍	❍	❍

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Participating in classroom discussion is the most effective way to learn	❍	❍	❍	❍	❍
Marking grids are good because I don't feel like I am being personally singled out	❍	❍	❍	❍	❍
Written feedback is unreliable because tutors have different marking criteria	❍	❍	❍	❍	❍
The grade is more important to my learning than feedback	❍	❍	❍	❍	❍
I prefer general feedback in class because it's not personal	❍	❍	❍	❍	❍
I prefer verbal feedback because I can communicate with the tutor and clarify information	❍	❍	❍	❍	❍
It is more important for me to see the reason why I received a particular grade, than to know how other students went	❍	❍	❍	❍	❍
Group feedback is best because I can see where other students have experienced similar problems	❍	❍	❍	❍	❍
Marking grids are too vague	❍	❍	❍	❍	❍
I like it when tutors guide us to work out the answers ourselves	❍	❍	❍	❍	❍
I forget verbal feedback easily	❍	❍	❍	❍	❍
I prefer it when tutors just give us the answers	❍	❍	❍	❍	❍
Written feedback is better because I can refer to it later	❍	❍	❍	❍	❍

6. Suggestions for Feedback

What are your suggestions for improving feedback at Macquarie?

_____

_____

_____

_____

A journal archived in Library and Archives Canada
A journal indexed in CANADIANA (The National Bibliography)
A journal indexed in AMICUS
A leading journal in social science research

Asian Social Science

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