ABSTRACT
Problem-Based Learning (PBL) requires that the educational experience be student-centred and situated in a real-world context. Further, the motivation to learn is largely driven by the student’s expectation and experience of assessment procedures. It is a challenge to design assessment processes that satisfy the simultaneous requirements of educational certification, quality assurance and problem realism, realistic outcomes whilst still encouraging creativity and deep learning. This paper reports on a trial assessment strategy that seeks to address the challenge in a PBL context.

Keywords: problem-based learning, assessment, motivation

INTRODUCTION
For twelve years, the University of Newcastle’s Bachelor of Construction Management (Building) Degree has been delivered using an Integrated Problem Based Learning (IPBL) approach. A primary aim of this initiative was to facilitate student growth as life long learners and problem solvers who are capable of meaningful independent activity upon graduation. The developed IPBL process integrates the dual practices of Self-Assessment and Critical Reflection into the assessment process, to achieve (Chen et al. 1999):

- The evaluation of the quality of students’ learning by the university.
- The development of the students’ ability to function at the highest professional level upon graduation.
- To foster the students’ development as life-long learners.

Staff, at staff forums, raised issue with the approach’s labour-intensiveness, specifically with the facilitation/assessment role. Furthermore, the students do not always appreciate the process of their development as reflective practitioners. Some students are confused about the boundaries between the components of self-assessment (SA) and reflection.

An initiative to address these issues was implemented by the authors, during 2002. This involved the production of a prescriptive marking scheme to encourage and support students in attaining the attributes of SA and reflection. The initiative also involved engagement with such issues as on-line collaboration, the active use of draft submission as a tool to better performance, and peer assessment.

The following account describes this process, addressing these multiple issues whilst maintaining the underlying educational principles of the programme. The changes to the assessment process were piloted in a course (phase) of 50 students in the second semester of their first year programme.

PROBLEM CONTEXT
Traditionally, the programme has utilised a two-stage assessment process. At the beginning of each phase (which is defined as a period of learning, ending with a formal submission) the students are advised of the competencies to be demonstrated and the evidence required, usually demonstrated through a structured report. Each phase is driven by a learning challenge (LC), a scenario of sufficient ‘wooliness’ as to avoid spelling out a set solution (Illinois Mathematics and Science Academy 1996) but act as the trigger to deep learning inspired by meeting the challenge (McGeorge 1996).

The student’s individual solution to the problem represents the culmination of an involved process of trial solutions allied to tests for appropriateness of the student outcome. This process is designed to maximise the opportunities for students to engage the predefined competencies. An informal process of formative assessment takes place throughout the phase incorporating feedback via tutorials, trial submissions and self-or guided assessments (Prideaux and Farmer 1994) The formative feedback students of their progress in the phase competencies without directly impacting or contributing to their final grade. The formative assessment process supports the students’ in the development of their formal submission submitted at the end of the phase.

As part of their formal submission, the students complete a self-assessment checklist. This documents the methodology they have applied to the LC whilst concurrently satisfying the learning objectives and assessment criteria. The checklist is returned to the student with the assessor’s summative feedback. This feedback identifies attained criteria, provides an indication of the quality of the submitted work and, if appropriate, provides guidance for improving the work. This process enhances student self-esteem through provision of a framework.
for self-direction and decision-making (Alverno College Faculty 1985). By the end of this component of the assessment procedure the student has an appreciation of their performance in a defined professional competency. This process supports the student appreciation of their status in relation to the competency levels defined as a "pass grade". There is also provision for providing direction for remedial work required to attain a pass level.

The second stage of the assessment process takes place at the end of the semester. Students present evidence of performance against the defined higher order competences, to a panel of academics and practising professionals. These competencies include:

- Critical reasoning and reflection.
- Conceptualisation.
- Innovative thinking.
- Creative problem-solving.
- Transfer of skills and knowledge.
- Extended learning.
- Synergistic performance.
- Appropriate professional values, attitudes and ethics.

This may be evinced in a portfolio of work accompanied by a reflective journal, verbal presentation or any other relevant form of evidence decided and designed by the student. Students can only submit this assessment on attainment of the requirements of the first stage assessment. This process rewards the excellence of each individual student and results in the award of grades.

This second stage assessment supports student motivation, for reasons including:

- Assessment does not end with the phase, students are encouraged to respond to feedback and improve their performance prior to the end-of-semester panel.
- Student grades are determined holistically, frequently over a number of phases contained within a course (for which they receive the grade).

Assessors actively look for evidence of improvement/growth in learning competence over the entire semester.

**PROBLEM ISSUES AND PROPOSED SOLUTIONS**

Through the process of program and course evaluation a number of issues have become apparent. Underlying many of the problems is the disparity between the student’s secondary school learning processes and the learning regime of this program. A shift from teacher-centred learning to student-centred learning is often a difficult transition (Brewer et al. 2000).

Another aspect of student behaviour ‘learned’ during schooling is the belief that by submitting incomplete drafts of their work to their assessor during the course of a phase they are somehow locking-in the deficit and penalising themselves. When questioned on their failure to make draft submissions for feedback most students indicate a lack of belief that it will benefit the final outcome. Students feel that exposing weaknesses in their thinking will inevitably reflect poorly in their final grade. It should be noted that many students also cite pressure of work for their failure to engage in the draft development activity. Attaching a tranche of marks to the submission of draft work was promulgated as a solution, together with a numerical indication of progress towards a satisfactory submission.

The use of on-line collaboration/communication tools as an integral method of programme delivery is now in its fifth year. This was implemented to provide ongoing feedback to students concerning their competency acquisition (Gameson and Chen 2000).

The adoption of this means of feedback by students has shown it to be "patchy". Students who have experienced this system of feedback are enthusiastic about it and tend to form collaborative groups to enhance their learning opportunities. The authors conjectured that by making its use a mandatory component of the phase students would experience its benefits and use the approach in subsequent years of their program. Situating this, compulsory element, in the context of a team-based activity was the most logical.

Fundamental to the concept of IPBL, as practiced by the Discipline of Building at Newcastle, is the equal importance attached to the development and assessment of the student’s learning processes (Gibbs 1995). This has been enshrined in the two-stage assessment process used. This required students to explain the learning strategies they adopted to produce their submission (SA). The process also required students to reflect on feedback to identifying better strategies and lessons learned for the future, documented in their reflective journal (RJ).
Although most students eventually attain the skills of SA, assessors agree that the quality of their reflection remains inconsistent. This in part explains student inability to see the alignment of teacher-imposed practice of reflection and the process intuitively used by reflective industry practitioners.

The twin imperatives of addressing this situation, and producing a clear link between SA/reflection and the student's final grade suggested that modifying the assessment process could be beneficial. Accordingly, a process involving the support of student summative assessments with developed "reflective self-assessment" (RSA) sheets, that;

- Indicated their assessment of the grade that their report would likely attract (as assessed against a set of supplied assessment criteria).
- Support their claim to professional competence with a supporting statement that linked their response:
  - To the phase objectives and subject areas.
  - To prior experience.
  - To formal and informal sources of expertise and information.
  - To feedback from previous phases.

The process of combining SA and reflection would have the added benefit of reducing the assessment workload for the teaching staff/assessors.

Finally, the authors believed that by producing a prescriptive marking scheme that nevertheless allowed scope for the individual student to demonstrate innovation and creativity in their response to the phase would align programme assessment procedures without losing integrity of underlying philosophy of the IPBL curriculum model employed in the program.

RESULTS

The effect of these assessment changes upon student learning was evaluated using a multiple perspective evaluation process, which utilised:

- Student Evaluation of Course (SEC) survey: a compulsory instrument issued by the University as part of its quality assurance (QA) mechanism. This contains a number of standard questions to investigate specific issues of interest to the University. A number of the questions relate to assessment issues.
- Student Evaluation of Teaching (SET) survey: a voluntary instrument provided by the University as part of its QA and promotions mechanisms. This consists of a number of questions picked from a standard question bank (of 400 questions) but can be added to/modified by the teacher to investigate specific issues of interest.
- Assessor reflection and presentation of initiatives.
- Student results and demonstration of reflective practice evidenced in the RJ. These were analysed against prior student norms of reflective documentation, recorded in previous RJs.

The process of evaluation was monitored by a number of staff of the discipline for the purpose of validation of the findings against staff perceptions.

This paper utilises data from the last three sources as they relate directly to the changes implemented on this occasion.

Table 1 is a summary of the SET questions specifically targeted at investigating the effects of the changes introduced in this phase, together with the results obtained. Questions 1 – 4 were taken from the standard bank of questions, whilst questions 5 – 8 were specifically designed for this application. Responses to Questions 1 – 7 were graded on a five point Likert scale where 1 = strongly disagree (with the statement) and 5 = strongly agree (with the statement). Question 8 required a simple Yes/No response. The survey achieved a 56% response rate in a class of 50 students.

DISCUSSION

There were two issues identified in the survey results:

- Students did not perceive group work and peer-assessment in the phase as beneficial to their learning.
- The overall assignment/activity structure to the phase was appreciated in terms of triggering and contextualising student learning. A significant majority of students valued the new assessment procedure.
Table 1: Summary of SET questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (M)</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. The feedback on assessment in this course helps me learn</td>
<td>3.3</td>
<td>0.853</td>
</tr>
<tr>
<td>Q2. Assignments have been interesting.</td>
<td>3.9</td>
<td>0.742</td>
</tr>
<tr>
<td>Q3. Assignments helped me learn in this course.</td>
<td>4.0</td>
<td>0.680</td>
</tr>
<tr>
<td>Q4. The assessment requirements of this course are clear.</td>
<td>3.8</td>
<td>0.804</td>
</tr>
<tr>
<td>Q5. The grading of work is fair.</td>
<td>3.4</td>
<td>0.859</td>
</tr>
<tr>
<td>Q6. Group work activities were a valued learning experience.</td>
<td>3.0</td>
<td>1.035</td>
</tr>
<tr>
<td>Q7. The online component greatly assisted my learning.</td>
<td>3.3</td>
<td>0.710</td>
</tr>
<tr>
<td>Q8. Did you see value in the new assessment structure?</td>
<td>Yes = 85.7%. No = 14.3%</td>
<td></td>
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</tbody>
</table>

These points were further illuminated by the responses to questions 9 and 10, sometimes in ways that could not be inferred from the structured question responses, raising further issues for course designers to consider.

Group work and peer assessment

In the context of this phase the students were assigned to groups that were tasked to research discrete areas of information related to domestic construction. Everyone in the class would need complete access to each other’s researched information. At the conclusion of the exercise, students would then give a presentation based on their findings and disseminate it to the other groups. In that way, a mutual dependence and vested interest in the quality of the contributions from other groups was created. This was intended to mimic the mutual interdependence found in real projects in the construction industry. This in turn would drive honest peer-assessment, based upon assessment criteria that stressed the assessment of perceived value to the assessor.

The evaluation of the initiative identified student opinion was polarised as to the value of the exercise. The following responses to the survey’s free response questions provided further clarity to the situation:

- “Good to know where my work compares to everyone else and what they think of my work ...”
- “Feedback from peers was useful.”
- “Peer assessment allowed me to receive feedback from my peers, based upon what they expected of each group/individual. This helped my learning by giving me a clear indication on what the rest of the class expected.”
- “Helped reflect on what was learned.”
- “... but I feel that peer assessment is not extremely reliable as they are your peers that are marking my work and therefore there are various biases.”
- “It did help ...”
- “… although it seemed that others were more interested on what their group was doing and not listening to the other groups information.”
- “marking of peers was not fair.”

The free response questions also identified the effectiveness of the gathering and disseminating processes of the system were more importance than the peer assessment itself. This was evidenced in the responses:

- “It gave me some background which I could build from.”
- “The peer assessment didn’t really support my learning except for the fact that I didn’t need to search through hundreds of websites. Instead I was able to find the website that the groups had found useful and use them.”

Upon reflection, the writers believe that the students would have derived a disproportionately small benefit from the information delivered by the other groups when set in the overall context of the phase. They believe that peer-assessment of an entire phase would be more beneficial to the student and that peer-assessment within the group setting would more accurately mimic industry experience.

Overall assignment/activity structure

Feedback from the students, both in the structured and open-ended questions indicated that the range of activities, both formative and summative, assisted their learning, enabling them to deliver the required assessment products. In particular, the marking scheme and RSA were targeted for praise:

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It was also suggested that allocating marks to draft submission, whilst ensuring a 100% engagement, ran counter to the spirit in which they were originally conceived. In the original assessment model, draft submissions could not have a direct effect on the students' final grade, something that clearly was the case now.

- "Marks allocated for draft submission made no sense to me and I thought were a little unfair."
- "Maybe a little more feedback, otherwise neutral feelings on the assessment procedure."

CONCLUSIONS
The authors have drawn conclusions from the study that, in some respects appear specifically applicable to an IPBL environment, but upon further reflection are valid across all higher education environments. Specifically:

- Assessment mechanisms (and consequently, marking schemes) should concentrate on outcomes, deliverables and products. They should not be specifically used to trigger engagement with particular learning experiences, especially if the quality of the output is not to be the subject of summative assessment. For instance, using a mark allocation to trigger the use of an on-line collaboration tool is meaningless unless the quality of that engagement is assessed (e.g. the quality of the students' contributions to a discussion board).
- Peer-assessment requires the assessors to have a strong vested interest in honest marking. This is more likely to occur where the peer assessed product forms a major component of the final grade. Similar comments apply to the peer assessment of group work.
- SA and reflection are mutually interdependent activities. The authors believe that separating them causes confusion in the minds of students. Conversely, the amalgamation of these processes has resulted in a demonstrable benefit to the students' understanding of the assessment process. This can be summarised as an explanation and defence of the research methodologies employed by the student, making links both to prior experience and newly learned information. Put simply, the student links the product and process by stating, "My work is good and an appropriate, professional response to a problem situation. Furthermore I know why this is the case and can support this claim to professional competence by making critically appraised and meaningfully supported links to prior and newly acquired knowledge". The logical conclusion of such a process for the student should be a meaningful estimate of their likely performance when compared to carefully specified performance criteria.

REFERENCES


Gameson R and Chen SE 2000, 'Problem-based learning: experiences of delivering and undergraduate construction management degree course at the University of Newcastle, Australia' in proceedings of the CIB W89 International Conference on Building Education and Research, Atlanta, Georgia, 16–18 May, pp.267–277.

