“Thinking about thinking”: challenging first year undergraduates to reflect

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Abstract: This paper describes the triggers for the (re)design of a delivery and assessment mechanism for student reflection in a first year construction technology course at the University of Newcastle, Australia. The paper relates the implemented design to the underpinning theoretical concepts, explaining the subsequent multi-perspective evaluation of its effectiveness. It further discusses the results obtained from the evaluation metrics and concludes with reflections on possible refinements for future implementation.

Keywords: Problem-Based Learning, Reflection, Metacognition

Background to the study
There is a desire in Professional Programs offered by Universities to provide their graduates with an appropriate knowledge as well as a range of professional qualities that will prepare them for effective participation in the Profession. The ranges of skills considered by professional bodies are broad and appropriately include a range of, what could be considered, “personal” qualities. The ability to reflect on one's own decision making and practice is a quality that is recognised as desirable by many professional bodies: “Skills in recognising unsuccessful outcomes, diagnosis, fault finding and re-engineering”, and “Skills in documenting results, analysing credibility of outcomes, critical reflection, developing robust conclusions, reporting outcomes” (Engineers Australia Accreditation Board, 2005); “Learning through reflection on practice and experience” (Chartered Institute of Building Accreditation Panel, 2005).

To develop these graduate attributes courses must be designed to provide learning experiences that facilitate deep learning, discouraging strategic, shallow approaches, and which recognise that the practice of critical reflection is crucial because it facilitates:
  - 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
  - The encouragement of the students’ development as life-long learners (Chen et al, 1999).
Various mechanisms have been developed to nurture and assess the quality of students’ reflection (Brewer et al, 2001; Brewer et al, 2003; Brewer et al, 2004) that embody these attributes. This paper documents the implementation of an initiative which was designed to enhance student capacities in reflective practice.

**Underpinning Concepts**

It is a daily occurrence for professionals to be engaged in metacognitive activities, and thus become effective, intelligent learners (e.g., Borkowski, et al, 1987; Sternberg, 1986). Metacognition describes the higher order thinking that actively controls the cognitive processes required in order to learn: problem-solving activities such as conceptualisation, analysis, evaluation and synthesis are examples (Schon, 1987). Since it plays a critical role in successful learning it is important to study metacognitive activity and development in order to determine how students can be taught to better apply their cognitive resources.

It is convenient to think of metacognition as *thinking about thinking*, but it is not that simple. Although the concept has existed for as long as people have been reflecting on their thoughts, there is much debate as to precisely what metacognition is. All research emphasises the role of executive mental processes in the overseeing and regulation of cognitive processes (Flavell 1979, 1987), requiring both metacognitive knowledge and metacognitive experiences or regulation. The metacognitive knowledge component refers to a person’s acquired knowledge about cognitive processes, knowledge that can be used to dictate future cognitive activities. Flavell (1987) further categorises metacognitive knowledge as:

- knowledge of person variables,
- knowledge of task variables
- knowledge of strategy variables.

There are two practical consequences of metacognition in an educational setting. Firstly, having knowledge and awareness of “self-as-learner”, and secondly, conscious self-control and self-regulation when engaging in cognitive processes (Anderson & Krathwohl, 2001; Angelo & Cross, 1993). These manifest themselves as self-appraisal and self-management during learning.

Self-appraisal is effected by the students’ personal reflections about their own knowledge state and abilities: it requires them to discover the extent of their own knowledge and the processes by which they think in given contexts, using specific knowledge and thinking skills (Fonteyn, 1998).

Self-management requires students to develop the ability to "think-in-action", to develop an awareness of "knowing how they think", which progressively translates into managing their own thinking, increasing their problem-solving skills, ultimately developing as a life-long learner (Fonteyn, 1998).

"Metacognitive knowledge is more strategic than the other types of knowledge [factual, conceptual, procedural]. At the heart of metacognitive knowledge lie analytic strategies, evaluative strategies, and creative strategies. Initially, these strategies may need to be imposed externally, that is, directly taught by teachers" (Anderson & Krathwohl, 2001).
Incorporating the concept and practice of metacognition into course design and delivery promotes an "emphasis on making students more aware of and responsible for their own knowledge and thought" (Anderson & Krathwohl, 2001). As students become more aware of their own strategies for learning and thinking, as well as when and why they use them, their generic skills base grows, empowering them to be more effective learners as well as the ability to direct their future learning.

Furthermore it is contended (Prosser, et.al. 1994) that learning involves an interactive process of knowledge construction through the incorporation of new knowledge and experience into prior knowledge, resulting in assimilation and accommodation, similarly referred to as conceptual development and conceptual change. Metacognitive strategies aid in linking the new information, or skills, with prior knowledge. Also of considerable importance to the learning process is reflection or metacognition which is best facilitated by social interactions and communication with others in a diversity of settings or contexts.

Birenbaum & Amdur (1999) establish that students who have the ability to reflect have their learning significantly enhanced by the learning experience associated with the development of journaling or the documentation of their decision making.

This paper builds upon these principles, describing the design and implementation of a form of student reflection for inclusion in a first-year undergraduate course that is common to both the architecture and construction management programs. Its design was intended to complement the use of problem based learning in both of the programs, and stimulate the students’ interest in "thinking about thinking", with the intention of raising their awareness of the learning strategies they utilised.

**Application of Concepts**

It was intended that the application of the theoretical concepts described in the previous section to the design of a new teaching/assessment strategy would result in

- Progressive improvements in student learning strategies
- Increased awareness of the role of reflective practice in the life of a professional
- Increased awareness of the link between the development of vocational and generic skills, and their progress towards achieving the graduate skills profile
- A commitment to incorporating metacognitive development into their learning strategies.

Furthermore it was anticipated that the new teaching/assessment strategy would positively impact on student learning by

- Producing a visible and measurable improvement in student performance between learning event one and two, as a result of
  - Increased awareness of
    - The role of reflection as an integral part of professional practice
    - The links between the course content, programme objectives and professional practice (as articulated in the Graduate Skills Profile).

**Course/Assessment Design and Implementation**

The students were given a deceptively simple set of assessments consisting of two reports. These related to a building, purportedly being considered as a purchase by a tight-fisted uncle,
who was seeking expert advice as to its suitability, without having to pay a professional. The student was thus faced with a unique problem, set in a multilayered context where technical, educational, professional, and ethical issues constrained their freedom to act freely. The first of the reports was to describe the building as is, whilst the second was to describe a set of alterations/repairs/extensions to it that would improve its amenity whilst concurrently complying with current statutory controls. The students were asked to relate their learning and skills acquisition with reference to the graduate skills profile, acknowledging the extent to which their professional development was advancing as a result of the learning experience, and to relate in parallel their thinking about the problems that they were solving to their previous experience. This was to be articulated in the form of appropriately conceived and positioned footnotes within their reports, which were to be considered to lie outside of the actual report, instead being thought of as accompanying metacognitive commentary. These “reflective footnotes” were defined as “text that provides a metacognitive commentary which:

• Relates to, and augments the adjacent the written/graphical evidence of vocational competence contained in the body of the assessment submissions
• Illuminates the student’s decision-making processes
• Links their existing knowledge and skills to new experiences, establishing its suitability
• Describes their strategies for the identification and elimination of knowledge shortfalls”

Specific issues were used to trigger reflective activity although it was stressed that this should not be seen as delineating the scope for reflection, with topics including:

• Issues concerning the validity and reliability of advice given by a first year undergraduate
• Legal consequences of accepting money for professional services (liability/indemnity, conflicts with governing bodies of professional organisations, etc)
• Ethical responsibility to uncle
• Extent to which advice was based upon observation or speculation
• Extent to which ‘assumed knowledge’ could indeed be assumed to be correct (e.g. how appropriate would a high school report format be when applied to this problem?)
• Problem conceptualisation skills: how to identify ‘what you don’t know’.
• Link between course activities and professional skills development.
• Surrounding context.

This deployment of reflective assessment differed from previous implementations in that no specific marks were allocated to the act of reflection, rather, reflection was to be regarded as one of the attributes contained within the marking rubric described as "professional context". In this way the student would be empowered to reflect in any way that seemed appropriate, on whatever topic seemed appropriate, thus reflecting the individual nature of prior experience and problem conception. It would thus only reward meaningful reflection, reducing the likelihood of expedient reflection in order to gain marks purely as a result of writing something/anything.

The first lecture in the course included the concepts and importance of development of professional competence, and reflective practice as an essential component of the complete professional as described in the Graduate Skills Profile for the programme. Thereafter, reflective practice was discussed on a weekly basis, being linked to/triggered by the course content. Reflective practice formed the core content of three tutorials, one of which was triggered by a diagram known as the "course balloon" (Figure 1), which summarised the
contextual relationship between the technical professional and academic requirements of the course problems. The development of metacognitive awareness was underpinned by three core course readings, and augmented by periodic holistic summaries posted to the announcements area of Blackboard. Triggers to reflection were posted to Blackboard in the week preceding the first assignment submission, and generic feedback was again posted to Blackboard immediately after individual feedback was e-mailed to the students. The former was the basis for the students reflection in action (the sole content of the reflective footnotes for the first assignment), whilst the latter formed the basis for the students reflection on action (part of the content of the reflective footnotes for the second assignment, together with reflection in action concerning the second learning event).

Figure 1. The “Course Balloon”.

Evaluation strategy
It was recognised that detailed evaluation of the effectiveness of established delivery and assessment protocols (e.g. Brewer et al, 2000) was best achieved using quantitative mechanisms, applied to data collected pre and post intervention. It was recognised that the time constraints associated with Human Research Ethics Clearance (HREC) would render such a study impractical. Concurrently it was also recognised that the prototype nature of the initiative rendered it necessary to conduct a pilot study, prior to initiating a full study. It therefore proved both appropriate and expedient to use a modified version of the Student Evaluation of Teaching (SET) instrument (anonymous questionnaire consisting of statements, agreement with which was indicated on a 1-5 Likert scale, plus a single open-ended question) as the primary data collection and analysis method. Modifications to the SET consisted of a set of eight (8) specific questions targeting the issues under consideration. Thematic analysis would be conducted on the qualitative data. Elements of this would be compared with a quantitative analysis of the both the uptake rates and benefit arising from the use of reflective footnotes for the two assessments used in the course.
Results
Eight statements were presented to the students in a questionnaire (see Figure 2). Likert responses were analysed for mean values and standard deviations. One question was discarded as being flawed as a result of an ambiguous trigger statement. The mean values for the remaining questions are shown in Figure 2, with the full SET responses included in Appendix 1.

Uptake rates for reflective footnotes and their consequent impact upon students’ grades were recorded at the time of marking and are summarised in Figure 3.

Written responses to the question “Is there any other comment that you would like to make regarding Reflective Footnotes?” are reproduced verbatim below:

“JUST TELL US WHAT TO DO AND GIVE NO SPACE FOR THINKING. IT MAY NOT AID PROFESSIONAL DEVELOPMENT, BUT IT ASSURE[sic] EASY MARKS.”

"Reflection is an important part of our professional development but it is not part of any other subjects."

"Don't fully understand their relevance."

"It got better as time went by!"

“It is hard to see the linked between what we write and how we are assessed but the process is useful. I can see why Graham keeps on about it.”

“This course has been inspirational. School was so limiting.”

“Reflective footnotes are a good way to learn however they are not entirely inducive [sic] to honesty. People will not reflect that they were lazy or board. Sometimes people NEED to be told this.”

Discussion
In order to determine the minimum viable response rate for a known class size an online sample size calculator (EZsurvey, 2006) was used. A margin of error of 10% was selected, at a confidence level of 95%, giving an acceptable sample size of 28 responses. At the point of survey (the day of final lecture, in week 13 of semester) 32 respondents (out of a cohort of 95 who remained enrolled on that day) returned questionnaires, making the study statistically valid. An analysis was then conducted of the mean response values for each question.

When analysing the data summarised in the previous section it could be seen that the students indicated a significant level of understanding and acceptance of the benefits of reflection as part of professional practice, and reflective footnotes as a suitable means of metacognitive review. More specifically:
I understand the use of reflective footnotes as a means to organise my learning experiences.

I found the reflective footnotes an effective way to "think about thinking".

I believe that reflection has enabled me to improve my performance during this course.

I would not reflect if it was not an assessable item.

I found the reflective footnotes an effective way to understand the relevance of the tasks in this course to my professional development.

I understand the link between the vocation-specific course objectives and the graduate skills profile.

This course has increased my awareness of the role of reflection as part of professional practice.

Figure 2. SET questions and mean value responses.

<table>
<thead>
<tr>
<th>Learning Event 1 (assessed in week 8)</th>
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<tbody>
<tr>
<td>Extent of adoption of reflective footnotes by students in their work</td>
<td>7.8% of students (9/115)</td>
</tr>
<tr>
<td>Extent of positive impact of reflection upon their grade</td>
<td>5.2% of papers (6/115)</td>
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<tr>
<th>Learning Event 2 (assessed in week 13)</th>
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<tr>
<td>Extent of adoption of reflective footnotes by students in their work</td>
<td>12.6% of students (12/95)</td>
</tr>
<tr>
<td>Extent of positive impact of reflection upon their grade</td>
<td>11.6% of papers (11/95)</td>
</tr>
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Figure 3. Adoption and benefit rates for reflective footnotes in learning events 1 & 2.
• When considered in isolation the generic act of reflection was recognised as being worthy of inclusion in the array of learning strategies to be employed in future courses, albeit at a less emphatic level (58%).

• Nearly 80% of those surveyed recognised that reflective practice had benefited their performance in the course.

• The majority (61%) of those students surveyed indicated an understanding of the links between the course content and the Graduate Skills Profile and 67% of them suggested that the reflective footnotes had helped them in this regard.

Thus it appears that the teaching of reflective practice was widely appreciated, as was its link to professional practice. Tangible appreciation of the use of reflective footnotes was evident, albeit at a lower level.

Comparison of the survey responses with the explicit outcomes from the assessment process proved to be interesting. The student uptake rate for reflective footnotes in the first learning event was disappointingly low (7.8%) and the consequent benefit rate (i.e. positive impact of reflection upon grade) of 5.2% was only to be expected. Although the predicted increase in uptake and benefit did occur in the second learning event, the level of adoption remained far lower than hoped for (12.6% uptake), resulting in a positive benefit for less that 12% of the class.

Paradoxically a significant majority of those students surveyed reported satisfaction with the concept of reflection and the positive effect it had produced in their performance on the course. This seeming contradiction can be explained if a significant number of students, after exposure to the reflective component of the learning event, saw fit to reflect internally/informally on their learning approaches, and adjusted their strategies for the course as a result. Assessor feedback confirmed that several of the students receiving High Distinction grades had chosen not to use reflective footnotes. Yet their performance suggested that it was quite likely they would have had to reflect upon their pre-existing learning strategies (e.g. those that they had developed at high school) and adjust them significantly, in order to achieve such a level of performance.

It is therefore a matter of conjecture as to whether the teaching of reflective practice or the assessment of a specific form of reflection (i.e. reflective footnotes) was responsible for the level of performance achieved by the class, or whether reflection played no part in this. The use of pre- and post-implementation surveys would have helped in this regard.

Examination of the qualitative feedback provided as a response to the open-ended question revealed the whole gamut of possible responses, from the inspired and energised, through the strategic, to the hostile and frustrated.

This discussion should be tempered with the possibility that the sample tested were not in fact representative of the cohort as a whole. The decision to administer test during the last session of semester was calculated to give the respondents the fullest opportunity to have benefited from the delivery of the course, and to be able to reflect upon that in their responses. It could be argued that the sample did not represent a group of typical students (e.g. the enthusiastic and engaged, the desperate looking for last minute clues, etc), however this was not seen as fatal flaw for the purpose of evaluating a pilot study for a new teaching strategy.
Conclusions
This initiative is believed to align with the extensive body of previous research, which indicates that the teaching and assessment of reflective practice is beneficial to student performance and is valued by the students themselves, as it helps them to develop a skill set that will be beneficial to them in their professional life. Further, it appears to offer support to previous research indicating that the rate at which this development occurs varies from student to student, resulting in a wide range of emotions being present in a student cohort.

The assessment of reflective practice is probably beneficial in encouraging student engagement with reflective practice, especially at the beginning of their undergraduate career. However, this study has proved inconclusive in this regard. It is recognised this particular implementation of reflective footnotes has proved less beneficial than expected, possibly as a consequence of the less overtly prescriptive assessment criteria associated with it.

Finally, in terms of piloting an evaluation methodology, it was apparent that more detailed results would be gained from the use of repeat pre- and post-intervention surveys, combined with a focus group study, all triangulated with quantitative analysis of uptake and benefit rates.

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