Reflection: Can It Be Learned?

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CONTEXT

The Faculty of Engineering & IT at UTS is currently implementing a Graduate Attribute Project. This project aims to ensure that students graduate attributes are developed, evaluated and recognised as they progress throughout their degree. In this paper we discuss a particular focus of the project, which is the development and assessment of attributes such as self-review and lifelong learning (as exemplified by deep reflection). In today's dynamic work environment technical competency is necessary but not sufficient to be a successful professional. In order to prepare students to work in this environment, emphasis needs to be placed on the development of transferable professional skills to augment the traditional transmission of technical content. This requires a reorientation of responsibilities from teacher-centred (teaching) to student-centred (learning). Existing studies are inconclusive as to whether a Graduate Attribute (metacognitive skill) such as reflection is a skill that can be taught (enhanced with formal education), is an innate talent, and/or only develops with time and life experience.

PURPOSE OR GOAL

The aim of this research was to determine the impact of using a reflective learning tool on students learning and development. This reflective learning tool provides a structure to facilitate activities designed to enhance students' reflective ability, as defined by the proportion of 'deeper' reflective statements in their post-internship reports.

APPROACH

Our study was undertaken within the UTS: FEIT Professional Practice Program, which consists of two sets of subjects: pre-internship, internship and review, which includes reflective reports. Post-internship reports were examined to establish a baseline for the depth of reflection typical of our students. By analysing these reports it was clear the students had misconceptions about both the meaning of reflection and how to demonstrate it. A set of resources were developed to illustrate to students key concepts regarding the various stages of the reflective process. An incremental and iterative remedial approach was then implemented throughout the six semesters of the Professional Practice Program. This involved introducing step-by-step development of reflection in the first subject, which was reinforced with practice by writing journals with critical friends during the internship.

OUTCOMES

The study showed a significant improvement in the reflective reports compared to those used for the baseline data (pre-introduction of the tool and resources). Students had increased their ability to analyse situations from their internship experience, demonstrated through their insightful reflection writing.

CONCLUSIONS

The application of a reflective learning tool has to date been successful in improving the quality of documented reflective learning across the engineering practice program at UTS.

KEYWORDS

Reflection, learning tool, graduate attribute, assessment rubric, internships

INTRODUCTION

In today's dynamic work environment, technical competency is necessary but not sufficient to be a successful professional (Dowling, Carew & Hadgraft, 2012; UTS, 2011). In order to prepare university students to work in this environment, emphasis needs to be placed on the development of transferable professional skills to augment the traditional transmission of technical content. This is greatly assisted by a re-orientation of responsibilities from teacher-centred (teaching) to student-centred (learning) within a graduate attribute framework that includes opportunities for learners to practice skills and receive formative feedback. Existing studies are inconclusive as to whether a metacognitive skill such as reflection can be taught (enhanced with formal education), is an innate talent, and/or only develops with time and life experience, however, we believe that, by providing a framework, the students are to able to increase their awareness of their own learning process.

Gray discuss Kolb's experiential learning cycle, and adapt the work of Jarvis to explain three possible outcomes from potential learning situations (Gray et al., 2004). The first is 'non-learning' – where an individual doesn't learn anything from a particular experience and may end up making the same mistake again. The second is 'non-reflective learning' – where someone may learn something, but without understanding why. In this case the person may not make exactly the same mistake again, but may make a similar mistake in the future. The third possible outcome is 'reflective learning' – in which the learner makes a significant and conscious change in their thinking and behaviour, and is hence unlikely to make the same or even similar mistakes again. There is no doubt that employers would prefer their employees to exhibit reflective learning in the workplace, and this is a skill that we believe should be developed during university studies.

Local students admitted into professional engineering courses at the University of Technology, Sydney (UTS) are required to undertake a Diploma in Engineering Practice involving two twenty-four week industry-based internships. Each internship is bookended by an "Engineering Practice Preview" and an "Engineering Practice Review" subject. In the review subject, students are required to write a reflective report about their experiential learning. Around five years ago, it was observed by staff involved in the Engineering Practice Program (EPP) that students' ability to write reflectively was limited. Their "reflections" were mostly descriptive of their experiences. The authors have been involved in the development of a tool and resources to assist students (and staff) to develop their reflective writing skills. The aim of the research described in this paper is to evaluate the effectiveness of this reflective learning tool (RLT) and its associated resources.

BACKGROUND

The UTS Engineering Practice Program has been operating in its current form since 1998, documented in (Johnston, Taylor & Chappel, 2001). It comprises six subjects, undertaken by students in the following order:

1. Engineering Practice Preview 1
2. Engineering Experience 1
3. Engineering Practice Review 1
4. Engineering Practice Preview 2
5. Engineering Experience 2
6. Engineering Practice Review 2

In the “preview” subjects, students are prepared for their internship in the semester prior to undertaking their internship. The two main learning outcomes from these subjects are learning the tools to find an internship (resumes, cover letters, job search, interviews) and reflective writing.

In the “experience” subjects, students are employed full-time in industry for a period of twenty-four weeks doing engineering work, and maintain a reflective journal supported by two ‘critical friends’.

In the “review” subjects, students write a reflective report and give an oral presentation within a small group of eight fellow students. “Preview” students are also required to attend a “review” presentation session to help them prepare for their experience in industry.

The first internship is critical for students to begin to develop their professional identity and is required to be undertaken around one third of the way through their degree program. Students leave the university to undertake their internship as “recent school leavers” and return as “young developing professionals” (Lindsay et al., 2008), mostly with a changed attitude and approach to learning.

The second internship focuses more on the application of deeper engineering knowledge within their chosen field of practice and usually offers students more responsibility in the workplace.

As described in the introduction, around five years ago the authors recognised that the quality of reflective writing from students in the program was highly variable, and the average was relatively poor. We began by changing the assessment criteria in the subject Engineering Practice Review 2 to clarify the minimum expectations around reflective writing. We also gave students some readings on documenting experiential learning. We soon realised that a more integrated approach was required across the program to obtain more consistent and improved student learning outcomes.

Kolb states “Learners, if they are to be effective, need four different kinds of abilities – concrete experience abilities (CE), reflective observation abilities (RO), abstract conceptualisation abilities (AC), and active experimentation abilities (AE). That is, they must be able to involve themselves fully, openly, and without bias in new experiences (CE). They must be able to reflect on and observe their experiences from many perspectives (RO). They must be able to create concepts that integrate their observations into logically sound theories (AC), and they must be able to use these theories to make decisions and solve problems (AE).” (Kolb, 1984, p. 30). Thus, the process of reflection is an important element to the process of learning, especially in workplace setting, but also more generally.

It has been well established that reflection is an important element of deep learning:

> *Biggs describes the process of reflection as indicative of the highest extended abstract level of learning. He maps the SOLO levels against the concepts of deep and surface learning (Marton and Säljö, 1976; Entwistle, 1996) and concludes that reflection is indicative of deep learning and where teaching and learning activities such as reflection are missing that only surface learning can result. (Biggs 1999 in King, 2002)*

Boud (2001) discusses the complex issue of assessing reflective writing and concludes “reflective activities should be distinguished from those graded.” (p.7). We agree with this if the purpose of the reflection is about critical self-reflection of one’s inner self, resulting in ‘perplexity’, ‘inner discomforts’ or ‘disorienting dilemmas’. Reflective writing associated with professional practice is somewhat different and deals primarily with a person’s *professional* identity, not their *personal* one. We also believe that it is reasonable to try and assess the *process* of reflection more so than the *subject* of the reflection.

But what do we mean when we refer to 'quality of reflective writing'? As Sadler(2009) says "Quality is something I do not know how to define but I recognise it when I see it." Assessable tasks, with multiple, complex assessment criteria, are difficult to assess by multiple assessors across a cohort with reasonable levels of consistency and accuracy. Language, meaning and application of assessment criteria need a shared understanding within a particular context.

Using Bloom's Taxonomy or the SOLO taxonomy or the 5 R's of reflection(Bain et al., 2002), our aim is to move students 'up the scale' – from 'recall', through 'analysis' and towards 'evaluation' (Blooms); from 'pre-structural' to 'extended abstract' (SOLO); from 'reporting and responding' to 'reconstructing' (5 R's). In its simplest form, this is what we mean by "improving the quality of the reflective writing."

We developed a reflective learning tool based on Kolb's experiential learning cycle to provide the students with a framework to assist with the process of documenting experiential learning.

METHODOLOGY

Framing reflective learning

We believe that 'documented reflective learning' has two main components – the 'content' and the 'process'. The *content* is the topic or subject of the reflective learning, such as "yesterday I was involved in an incident at work that led to an argument between me and my co-worker about the design of a retaining wall" – in this case the 'topic' could be the application of theory to design of a retaining wall, or perhaps conflict resolution in a professional practice context. The *process* is the steps taken to document the learning in a logical, clear and concise way that demonstrates (has evidence of) meaningful analysis, abstraction and implications for future practice.

Our assertion is that this division of components can be used to guide students to improve their documented reflective learning, and can also assist in its assessment. Although the 'content' has different meanings and significance for individual learners, we guide students to choose non-trivial content such that it has relevance to their development as a professional engineer (Table 1: B2). For example, the content could be related to one of the Australian Engineering Competency Standards published by Engineers Australia, and/or a University's published set of Graduate Attributes. Hence 'relevance to professional engineering practice' is one of the assessment criteria.

The 'process' can be developed and assessed, based on evidence and quality of each stage of Kolb's experiential learning cycle (see Table 1:A1-A4). It can be taught to students based on the above. That is, students can be guided about 'relevance', 'non-triviality', application of the structure of Kolb's experiential learning cycle, and the meaning of each stage. Students can learn this through a variety of means, such as guided instruction, learning by variation, and from peer and staff feedback when supported by robust assessment criteria.

Learning Resources

Based on the above, we have developed a set of learning resources on documented reflective learning which are given to students in the various subjects within the program, as well as a set of assessment criteria that are applied to student work. The learning resources in each subject are different; however they are designed around the same common framework described above. A sample from the first subject in the program and the assessment criteria are provided in Appendix A and B respectively.

Table 1: Framework for the reflective tool

Criterion	
A1. Concrete Experience (CE) stage is complete and concise	Concrete Experience stage is complete and concise. It must describe an event (or series of linked or similar events) and the outcome. It must have enough detail to describe the circumstances (when, where, who [including own role], what happened) but should be no more than around 200 words
A2. Reflective Observation (RO) stage is evaluative or concluding	Complete analysis of the event and roles that contributed to the outcome and the formation of a (specific) hypothesis. (i.e., reasons and a conclusion as to WHY the outcome occurred). Identification of all significant contributing factors (self and other), and causal relationships. Where possible, link to theory on that topic.
A3. Abstract Conceptualisation (AC) stage is appropriately broad	A generalised conclusion is stated which allows the lesson(s) learnt to be applied to a broad range of related situations, but not so broad as to be a "motherhood statement". Although generalised, the conclusion must still refer to other specific situations. What you have learned needs to be clearly stated.
A4. Active Experimentation (AE) stage is specific and appropriate	A plan for specific future action (i.e. set of specific steps to be taken) that will test the generalised conclusion in a broad range of related situations.
B1. All 4 stages are present, balanced and in the correct order	4 stages are clearly evident and in the order: 1. Concrete Experience 2. Reflective Observation 3. Abstract Conceptualisation 4. Active Experimentation There is a good balance of discussion across all of the 4 stages.
B2. Reflection provides deep insight into a non-trivial, relevant issue	The reflection is highly relevant to one of the competencies of the Engineers Australia Stage 2 standard and/or graduate attributes and/or subject/program objectives; AND The reflection provides a clear understanding of broader lessons learnt from a significant experience
B3. Demonstration of reflective learning through clear, concise and logical articulation. (How does this reflection "hang together?")	The experience described is specific with details about what, when, where and who. Conclusion is based on the specifics of the experience. Abstract conceptualisation is appropriate for the experience. Plan for future action is specific to the broader lessons extracted. Good linkages between sentences and paragraphs; good flow; clear, concise expression.

Implementation within the program

The Engineering Practice Program at UTS involves about seven hundred students being on a twenty-four week internship in each calendar year. The ‘preview’ and ‘review’ subjects that bookend each work placement involve relatively large student cohorts. We have gradually been making changes throughout the program in a more “evolutionary” than “revolutionary” way. This includes changes to curriculum, assessment tasks, resources, tutor support and staff development. Here is a brief summary of the major changes in each of the six subjects in the program:

- 48121 Engineering Practice Preview 1 – resources have been produced to help students with reflective writing, including a lecture and tutorial. A new assessment task has been added - an online reflective learning journal is created and involves the completion of three entries during the semester – one is peer assessed during a tutorial session to engage students in the assessment criteria; all three are staff assessed with detailed feedback provided to allow students to improve their next entry. Students are informed that this journal will be used in the next subject.
- 48110 Engineering Experience 1 – an online learning journal is maintained by each student during their work placement. Students are put into groups of three ‘critical friends’ who peer assess each other’s work once every two weeks during their twenty-four week placement. This is periodically checked by staff and comments made online. A minimum standard is required to enable students to “pass” their placement. This journal becomes the ‘raw material’ that students use in the preparation of their major report in the next subject.
- 48122 Engineering Practice Review 1 – students must write a comprehensive report about their first internship and give a presentation to a small group of eight students. Parts of these assessment tasks require reflective writing to a minimum standard. A significant proportion of students are required to resubmit their report and/or redo their presentation and/or fail the subject for not meeting the minimum standard.
- 48141 Engineering Practice Preview 2 – an interactive module is delivered that further explores the notion of professional reflective practice. Students maintain a weekly reflective learning journal that is an assessable task.
- 48130 Engineering Experience 2 – as per 48110
- 48142 Engineering Practice Review 2 – resources provided to further assist students with developing professional reflective practice and documentation. This is applied to a comprehensive internship report and the completion of three engineering competency claims in the format required by Engineers Australia for the process for CPEng (Chartered Professional Engineer). A tutorial session helps students to identify if they have met the required minimum standard and an opportunity to resubmit with a small marks penalty is available.

Over a period of several semesters, the staff in the program began to observe significant improvements in the quality of the students’ reflective writing. The logical next step was to try to quantify and define this quality improvement.

Sampling method

A number of sample reports were chosen from the subject 48122 EPR1 in semesters prior to changes being made and also from post-change semesters. Reports were chosen on the basis of being close to the average mark from all combined semesters of each sampling group. Passages from each report were chosen where students had labelled that they were addressing the report assessment criteria of “documented reflective learning”.

RESULTS

Here is an example of a section from an EPR1 report that was written prior to the introduction of the reflective learning tool

> *I had learnt AutoCAD, a most commonly used engineering computer drafting program, from TAFE and used it for a short period of time before joining the company as a civil/structural drafter. However I was required to acquire Microstation, similar to AutoCAD, for civil and structural drafting tasks such as 3d modelling and structural detailing. At the beginning I found it very difficult to get used to the new terminologies and user operation, even though the company provided some short training courses. I was required to learn it through other means, such as reading the program manuals, searching for online tutorials and resorting assistance from other senior level drafters and designers. By now I have been using Microstation for nearly five years and found that it is very efficient and powerful tool for creating drawings with well presentation.*
>
> *From some practice, I had developed reflective learning methods on how to learn Microstation as a new program, in the same way of learning any other computer program. First of all, I got myself familiar with the terminologies and interface of Microstation. In this way I could easily adopt some existing knowledge in facilitating the learning process. Furthermore, I started to use it for some simple tasks including text editing from mark-ups, simple shape drafting and navigation. After I got more familiar and confident with the simple functions, I progressed myself to more complex tasks such as 3d objects, preference setting and some advanced program configurations. During the time, it would be inevitable to be confusing. One of the senior CAD designers had been very helpful to mentor me through some difficult stages. In the later stage I was able to practise the program on real world project. From then, I was able to understand industrial CAD standards and job requirements so as to fully utilise the program for better work.*

In this sample, although the ‘content’ is relevant and a valid learning experience, most of the writing is descriptive, and qualifies predominantly as the ‘concrete experience (CE)’ stage. There is one sentence in paragraph 1, starting “At the beginning, I found …” which could be considered as ‘reflective observation (RO)’. There is a glimmer of ‘abstract conceptualisation (AC)’ at the beginning of the second paragraph, however, this is largely a ‘motherhood’ statement and too general. Because the reflective observation and abstract conceptualisation sections are far too short and incomplete, there is no foundation for any active experimentation (AE), which is absent in this example. There is, therefore, no real ‘documented reflective learning’ in this example.

In contrast to the above, here is an ‘average’ sample from a report written after the introduction of the reflective learning tool:

> *In one instance during my apprenticeship I was working in Southampton, UK on a 100ft racing yacht. I was becoming more confident of my abilities. Often when asking a question about procedure, I would agree with the answer and sometimes suggest an improvement which was accepted. I then began to see fit that I make assumptions and decisions of my own accord. During this time, I was installing a large piece of fit out onto the foredeck of the yacht, which was due to go racing the next morning. It was a warmer than a usual day as I mixed the appropriate glue and set myself up to glue in the component. Unbeknown to me this particular glue was very*

sensitive to heat and as I was gluing in the component, the glue cured and the component was not properly aligned. To rectify this, I was forced to spend all night removing the glued in component and re-install it in the cool hours of the morning, ready for racing the next day.

In reflection, I had become confident of my abilities and tried to solve a problem by myself, possibly seeking praise from my superiors. The net result for my actions was a mistake, albeit rectifiable, which was certainly more frowned upon than the first option which was to clarify my proposed actions with a more experienced member of the team.

I learnt that we cannot become complacent with our abilities.

In future workplace scenarios I will be more inclined to seek a second opinion if I am at all in doubt. This option is highly beneficial as the worst case scenario is agreement and a small amount of extra time. There is also a high chance the more experienced person will be able to suggest a change, however minute, that may increase efficiency or economy which is extremely important in engineering.

In this second example of documented reflected learning, we can clearly see the 4 stages of Kolb's experiential learning cycle – each of the stages has been allocated its own paragraph. The RO stage provides an analysis of the contributing factors (Table 1, criterion A2). Although the AC stage is rather brief, it provides a generalised conclusion. The AE stage could be a bit more detailed but overall, is reasonably good. All in all, this example of documented reflective learning is complete and much better than the previous one.

This second example is typical of an 'average' level submission that we are now consistently seeing in the program. Prior to the introduction of the reflective learning tool, there was the occasional example of excellent reflective writing – outstanding students usually produce excellent work. However, since the implementation and continuous reinforcement of the reflective learning framework, not only has the 'average' improved, but we are seeing a significantly larger proportion of excellent submissions.

Further Work

The above provides strong anecdotal evidence of improvements in quality of the reflective writing. Our next step is to develop a reliable and robust rubric that can be used by tutors and students across the program. We have begun to do this through the use of SPARK(Gardner & Willey, 2009) and various benchmarking exercises. At the time of writing, we have seen evidence of Sadler's anomalies (Sadler, 2009) in assessment and are working to improve the reliability of the rubric. One of the difficulties of this is that we have tried to implement an analytic rubric with some holistic judgment.

Conclusion

Evidence presented has demonstrated that the application of a reflective learning tool has, to date, been successful in improving the quality of documented reflective learning across the engineering practice program at UTS. Assessment of reflective learning has focused predominantly on the *process* of completing Kolb's experiential learning cycle and not so much the *content* of the reflection. We believe that the next step is to develop a shared understanding of the assessment criteria in order to improve the accuracy and robustness of the rubric.

Documented Reflective Learning – A "how-to" Guide

Tip 1: Reflect on something that is relevant to your development as a professional engineer

Stage 1: Concrete Experience

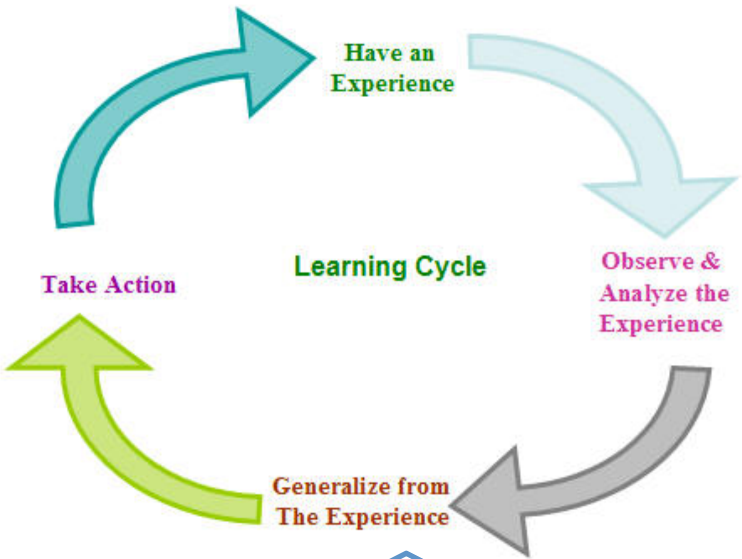
Describe a situation in which the result was unexpected (worse or better than you expected). What did you expect? What actually happened? What was your role in the situation? Be as concise as possible with this stage. Give just enough information to set the scene.

Tip 2: Ensure you write at least one sentence for each stage in the correct order (1, 2, 3, 4)

Stage 4: Active Experimentation

The final stage in the process is working out what you are going to do about it and then, if possible, actually doing it.

- What will you do differently next time you come across this type of situation?
- How can you prepare for this type of situation in the future?
- How do you know that your plan for future action will be more effective next time?



Stage 2: Reflective Observation

Imagine yourself stepping out of your body and observing the situation from a neutral position. Analyse the experience. Some possible questions:

- What caused the outcome to be worse or better than you expected?
- What decisions did you make?
- What were your feelings during and after the experience?
- Who else had an influence on the experience?
- Overall, how did you perform on that occasion?
- If possible, draw a conclusion

Tip 3: You can reflect about a negative or a positive experience

Stage 3: Abstract Conceptualisation

In this stage, you need to answer the question "what does this mean for me?" You need to generalise your conclusion from stage 2. What type of experience did you have? Can the conclusion you drew for this specific experience be applied in other situations? Which ones? It's important to generalise because if your learning is too narrow, you may never experience that situation again. But if you generalise, your learning may apply in many future situations.

Tip 4: Use a specific example of an experience from your work. Be

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