

Supporting self-assessment using e-portfolios

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***Abstract:** The engineering profession requires graduates who can deal with open and complex problems and respond and adapt to changing circumstances in their workplaces. Engineering programs often incorporate experiential learning to provide opportunities for students to be confronted with open problems. To support students with experiential learning, the University of South Australia has implemented e-portfolios that include tools to support the development of students' self-assessment, reflection and action planning skills. This paper outlines the implementation of e-portfolios across a first year engineering program and more closely examines the support for the development of self-assessment skills within a 6 week Computer Aided Drawing (CAD) activity. Our experience emphasises the importance of integrating tools to support student learning from experience more broadly through the engineering program, particularly in those courses that have a professional practice dimension.*

Introduction

In the *Educating Engineers for the 21st Century* report, engineers were defined as technical experts who can operate and manage across boundaries in complex environments providing creativity, innovation, and leadership (Henley, 2006). Higher education was challenged in this report to adjust their programs to include more real-life and practical experiences for students to meet these needs. In parallel to this context, the University of South Australia has adopted experiential learning as the cornerstone of all programs (Lee, 2007). However, one cannot assume that just by having an experience that students learn what they need to be successful professionals.

Most models of experiential learning are cyclical and have phases: an experience or problem situation, a reflective phase, a self-assessment phase and planning stage (Kolb, 1984). Thus, to be successful at learning from experience, you need a range of skills including self-assessment, reflection and action planning. This ability to evaluate one's own work was identified by graduates to be the one professional skill that university least prepared them to do (Boud, 1986). Higher education needs to provide these experiences to adequately prepare students for the professional decisions they will be asked to make in their future careers (Boud, 2008).

The skill of accurate self-assessment needs to be learnt. A meta-analysis of self-assessment research showed that accurate self-assessment varies with a student's level of competence, their year level and the type of activity being assessed (Falchikov & Boud, 1989). In particular, first year students, in practical (rather than theoretical) courses were the most inaccurate at self-assessing their performance. This has been referred to as '*Dunning-Kruger effect*', where incompetent people fail to recognise their own incompetence, yet highly competent people underestimate their level of performance in comparison to others (Dunning *et al.*, 2003). Self-assessment can be considered as a skill that can be

developed and supported (Falchikov & Boud, 1989), a process that starts with developing learners' self-awareness (Weimer, 2002).

The use of e-portfolios in higher education is increasing (IMS, 2005; AEP, 2008) with the concept being promoted to students for personal development planning, lifelong and experiential learning. Portfolios actively involve students in their assessment,

... by managing and monitoring their learning in both the cognitive and affective domains, documenting their progress and achievement over time, articulating their achievement levels, and more importantly, experiencing success. Portfolios also encourage students to embark on the cycle of lifelong learning (Hertels, 2004; p.108).

This paper examines the implementation of e-portfolios within a common first year engineering program to support courses using experiential learning approaches and focuses on the use of e-portfolio-based tools to support the development of self-awareness and self-assessment skills. The hypothesis was that the use of e-portfolio tools designed to raise the awareness of required performance levels and provide transparent self-assessment activities has a positive impact on student learning and their ability to accurately self-assess their final grade.

Method

Implementing e-portfolios in first year engineering

The University of South Australia (UniSA) introduced a common engineering first year in 2008 that incorporated experiential learning approaches in three of the eight core courses. In 2009, activities requiring the use of e-portfolios were integrated into an orientation experience, a first semester service learning experience in *Sustainable Engineering Practice* and a computer aided drawing and modelling (CAD) component of the course *Computer Techniques* and as an optional tool for a work diary activity in a second semester course, *Engineering Design and Innovation*.

The assessment of the CAD component occurred within the first 6 weeks of university study. Students were required to model 3D parts using SolidWorks software and create assemblies of the individual parts. Using these models, students created engineering drawings (AS1100 standard), animations of the model's motion and photo rendered images. Student work was collated and presented within an e-portfolio (PebblePad) that contributed 50% to the final grade of the course.

Supporting self assessment

To support students' development of self-awareness and self-assessment skills in CAD, students were initially alerted to the requirement for self assessment during a lecture in week 1. Students were surveyed during this lecture about their awareness of e-portfolios and their initial level of comfort with self-assessing their work using KeePads audience response system and TurningPoint® software.

Students were guided to structure their e-portfolio in a series of pages that contained both a presentation of their work and reflection on their learning. To further support students develop self-assessment skills, the PebblePad Profiler tool was used to describe the competencies required to successfully complete the assessment to a professional standard. The Profiler asked students to self-assess their learning experiences based on the seven UniSA graduate qualities (UniSA, 2009). The Profiler used 42 questions, each with a 5 point scale to self rate abilities, outcomes and efforts from nil/poor/below standard to excellent and attach evidence of achievement. The Profiler formed the first page of the student's e-portfolio. Student responses to the Profiler were automatically and progressively collated into reports by PebblePad.

Measuring the impact of e-portfolios on students' self-assessment skills

To determine if students had benefited from a heightened awareness of self-assessment provided through the PebblePad Profiler e-portfolio activity, students were asked to predict their final grade in the CAD assessment. This perceived grade was compared to their actual grade (Dunning *et al.*, 2003). The percentage of students who completed this self-assessment activity was determined and this was also compared to the student's actual grade.

Results

Confidence with self assessment

An anonymous student survey was conducted at the conclusion of an introductory lecture describing experiential learning and the basics of PebblePad e-portfolios. Less than half (46%) of the students had created a PebblePad account as part of their orientation experience. Self-confidence with understanding how e-portfolios work was 65% and only 52% of respondents expressed any level of comfort with the notion of assessing their own work (n=158).

PebblePad Profiler self-assessment reports

Self-assessment of CAD and engineering drawing knowledge

Students were asked to rate their knowledge of solid modelling and engineering drawing before and after the course. Students self assessed that they brought a low body of knowledge of solid modelling and engineering drawing into the course (Figure 1) but self-assessed an increase in knowledge over 6 weeks. This tool was able to provide a benchmark of commencing capabilities for the teaching staff and demonstrated to the students their individual growth in knowledge due to undertaking the course. Importantly, it highlighted to the students gaps in their knowledge that needed further development.

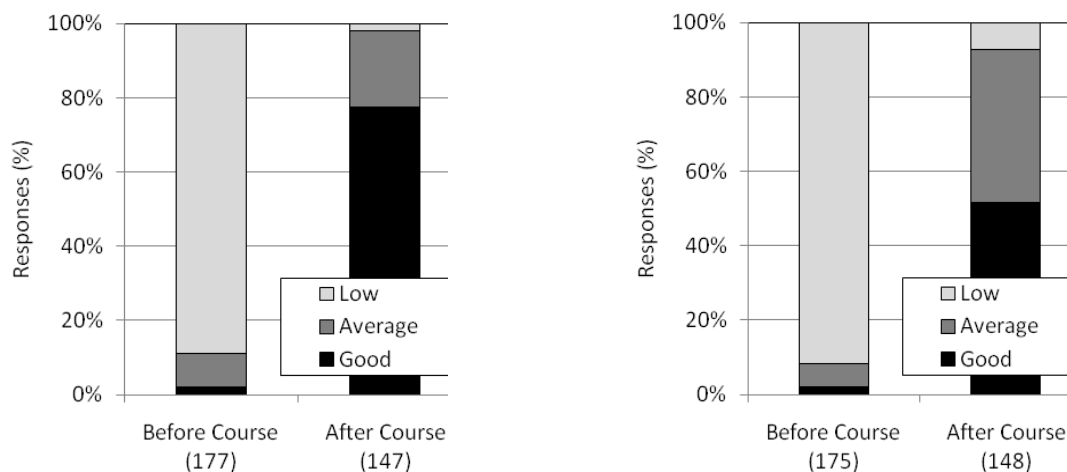


Figure 1: Consolidated Profiler results of student self assessment of knowledge of solid modelling (left) and ability to create engineering drawings (right). Numbers in the title refer to the number of replies to the question from 182 submissions.

Preferred modes of learning

To raise learning self-awareness (Weimer, 2002), students were asked to self assess their most effective modes of learning (i.e. pre-reading text books; attending lectures and computer practicals; undertaking an assignment and on-line tutorials) to identify their most beneficial learning activities. Students had diverse learning preferences but rated the most beneficial learning (90% 'learnt a lot') being from the interactive computer practicals which provided a structured set of tasks to be undertaken under the guidance of a tutor. In contrast, only 12% of students identified that they had 'learnt a lot' from their text book (full data not shown).

Effective communication

The course's assessment required students to communicate their learning by creating an e-portfolio (webfolio) that contained 3D models, engineering drawings, several photo-rendered images, an animation and a poster. Figure 2 shows the student's self-assessment of their communication abilities in these areas. Students felt least equipped to create an A3 poster of their work. The self assessment reflected the standard of work submitted with the poster being the weakest presentation medium and this can be explained by the required format being open and minimal training was provided.

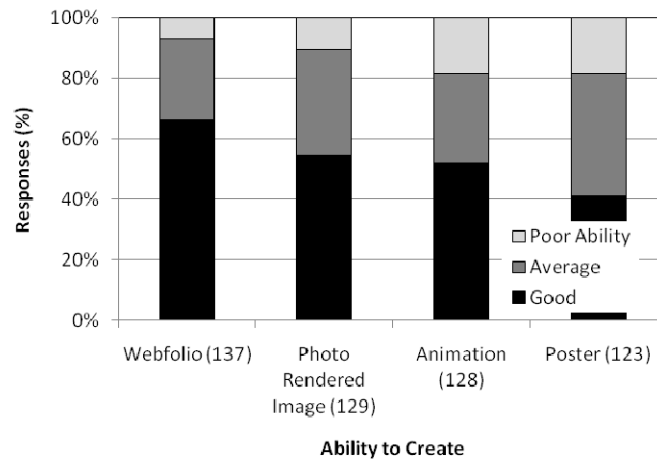


Figure 2: Consolidated Profiler results of student self assessment of their communication abilities. Numbers in the title refer to the number of replies out of 182 e-portfolios.

The impact of e-portfolios on student's self-assessment skills

Students were asked to reflect on their effort and learning in the course to predict (self-assess) their grades and provide a reason why they thought they should get that grade. This prediction was compared to their actual grade using methodology described by Dunning et al. (2003) (Figure 3). A total of 65% of students successfully predicted their actual grade within one grade of that achieved; 20% received a grade two or more grades higher than expected and 15% received a grade two or more grades less than self assessed.

Some students acknowledged their effort within the experiential learning activity had been low (5%) or average (12%) and offered reasons. Briefly, students gave replies such as:-

- I expect a high distinction because I have done and answered everything correctly
- I expect a credit because I understood most of the course but had a few difficulties here and there
- I expect a bare pass as I did not try too hard, but thought I have done just enough to just pass
- I expect to fail as I have not had the time to put the effort into the course.

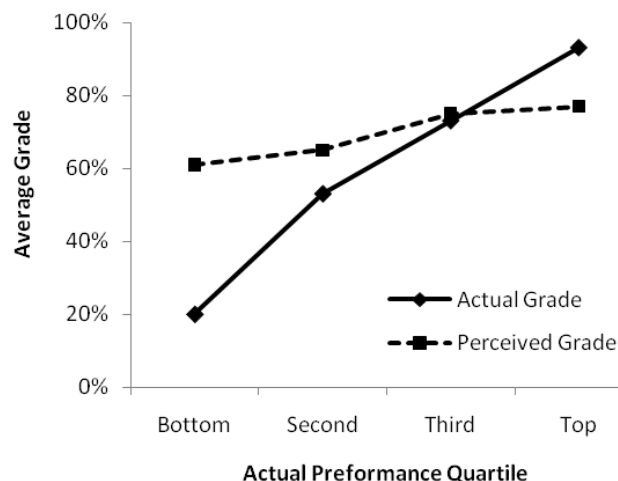


Figure 3: Comparison of students' actual grade with their perceived grade, as per Dunning et al. (2003).

Of note, only 59% of students participated in this self-assessment activity and a linear correlation was observed between this and the student's actual grade (Figure 4).

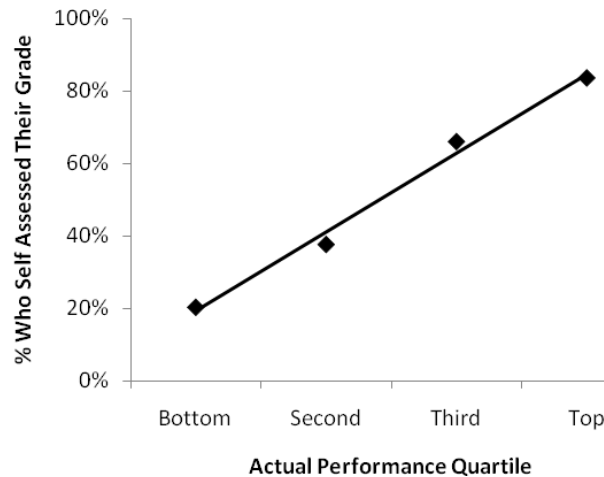


Figure 4: Comparison of students' actual grade with the percentage of students who participated in the self assessment activity.

Discussion

Self assessment is a meta-cognitive skill (Dunning *et al.*, 2003) which although demanding for first year students, is a worthwhile curriculum inclusion as long as it is a low-stakes assessment. The primary reason for inaccurate self assessment has been reasoned to be a lack of awareness of an individual's skill level in comparison to others (Dunning *et al.*, 2003). This suggests that incorporating opportunities for students to actively share (e.g. peer review and peer assessment) and compare their work to standards (e.g. through Profiler or rubrics) would also improve students' skills in self-assessment.

It was hypothesised that by incorporating self-assessment activities, by using a Profiler e-portfolio activity, that student's awareness of their level of competence would be raised, and this would improve their accuracy in self-assessment. Almost half of the students were perplexed at the idea of assessing themselves as a part of their learning when surveyed after an introductory lecture.

To measure improvement in self assessment skills, students were asked to predict their grade for their work and this prediction was compared to their actual grade. Although a total of 65% of students successfully predicted their actual grade within one grade of that achieved, the *Dunning-Kruger effect* was evident with the two plotted lines intersecting in the 3rd quartile. This meant that poor performers remained 'blissfully ignorant of their incompetence' at the end of this 6 week activity while top performers underestimated their grade (Figure 3).

This examination of self assessment skills represents our baseline data. As students' self assessment skills develop in later courses, we would expect that the plots of actual and perceived grades to overlay (at least in the top 3 quartiles) and the area formed between the two intersecting lines to decrease. Further monitoring of students' self-assessment skills is required in later courses in the engineering program to ascertain development.

The e-portfolio activity described above occurred in the first 6 weeks of semester 1 of the engineering common first year. In semester 2, another core course, *Engineering Design and Innovation*, was available to the same group of students. For one assessment in this course (work diary), students were allowed to select from several tools. Choices included wikis, blogs, word documents and PebblePad. When given this choice, the majority of students from this cohort (67%) opted to use PebblePad for a work diary activity in a semester 2 course. This suggests that the tools within the PebblePad e-portfolio were perceived as acceptable by students for supporting experiential learning activities. Provided that students are started on PebblePad, we argue that it would be appropriate to continue to integrate PebblePad as a support for subsequent experiential learning courses within the engineering program.

Another interesting observation from this research was the linear relationship between students' actual grade and their participation in the self-assessment activity itself (Figure 4) suggesting that we need to promote to our students the value of accurate self-assessment as a life-long learning skill in professional life.

Conclusion

Through the inclusion of a self assessment activities within a CAD and modelling activity and by asking students to predict their final grade we have established base line data on student's self-assessment skills for first year students in engineering. We argue that 'learning from experience' tools, such as those incorporated within PebblePad e-portfolios, provide a flexible mechanism for actively monitoring the skills required for effective experiential learning and that there is evidence to warrant their inclusion in practice-based courses throughout the engineering curriculum, as well as a support for the continuing professional development of engineering graduates.

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