ePortfolios to empower students in providing evidence of learning and professional development

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***Abstract**: University teachers are always asking: 1) how do we know that our students are achieving the expected learning outcomes in our courses, and 2) what evidence do we have to support the claim that they do? Program leaders and deans/associate deans face the same questions at the program level. These are questions that are invariably on the agenda of every visiting accreditation panel. However, the answers to these questions are not always straightforward. In the context of increasing emphasis on quality assurance, as evidenced in Australia by the establishment of the Tertiary Education Quality and Standards Agency (TEQSA) and the creation of discipline-based Threshold Learning Outcomes (TLOs), the higher education sector needs to take a more evidence-based approach to answer these questions. This paper presents a case study in a computer hardware design course taken by students of computer engineering and related programs. It uses an ePortfolio-based approach to support student self-assessment and reflection, leading to the creation of a Career Episode Report (CER) using Engineers Australia's CER templates. The CER contains the students' narration of how they developed certain professional competencies and is supported by evidence. The paper presents the experience gained along with student survey results, comments and peer feedback.*

Introduction

The approach taken to date by the higher education sector in providing evidence of student learning and development has been limited predominantly to mapping of courses (individual subjects or units) and programs to graduate attributes and professional competency standards. Some institutions have mapped the learning activities and assessment tasks in every course to graduate attributes and/or professional standards. However, mapping alone cannot guarantee that the desired attributes are developed by students (Blackmur, 2010). It is necessary to seek answers on how to conceptualise, assess and evaluate the development of graduate capabilities (Green, Hammer & Star, 2009). Here 'graduate capabilities' means disciplinary knowledge and skills as well as generic attributes such as critical thinking, self organisation, and communication and team work skills.

In tune with international developments (European Higher Education Area, 2010; UNESCO, 2011) new national standards are emerging in Australia for quality assurance. Recently the Tertiary Education Quality and Standards Agency (TEQSA) has been established to audit higher education institutions in regards to academic standards. In contrast with its predecessor, the Australian Universities Quality Agency (AUQA), TEQSA will have the regulatory powers to deregister programs and institutions failing to meet the academic standards. Minimum levels of generic capabilities graduates must acquire have been developed as part of a Learning and Teaching Academic Standards (LTAS) project and are known as threshold learning outcomes (TLOs). These developments along with the move from 2012 to a completely demand driven system of higher education, where students are able to freely choose what they want to study and where, make it all the more important for Australian higher education providers to reinvigorate their efforts into assurance of learning, and consequently on good graduate employment outcomes and satisfaction.

This paper presents the approach taken in a third year course on computer hardware design to enable students to progressively capture their learning and development using ePortfolio. The PebblePad ePortfolio tool (www.pebblepad.co.uk) was used. ePortfolios capture the processes and outcomes of learning (Reese & levy, 2009), providing a long-term view of learner's development with value that extends beyond graduation and well into professional practice (Joint Information Systems Committee, 2008).

ePortfolios and the Institutional Context

ePortfolios were introduced in first year engineering in 2009 as part of a university-wide pilot study using the PebblePad tool. Students were introduced to the concepts of ePortfolios during an active orientation program (Duff et al, 2009). Students were then required to use ePortfolios in three first year courses for a variety of purpose, for example, presentation of engineering drawings and models, reflections on course and on their learning, and self assessment of graduate qualities. A number of interesting observations were made from the pilot study, such as the reasons for some students' lack of enthusiasm in using ePortfolios, which included relative instability of the ePortfolio tool leading to accessibility issues and delays, lack of desirable formatting features, and above all, the absence of a clear view of where the ePortfolio activity fitted in their essential learning spectrum in their bid to develop as professional engineers (Faulkner & Aziz, 2011). Lessons learned from the pilot study were taken into consideration in conducting a university funded priority project in 2010 on the articulation of progressive development of graduate qualities, involving the disciplines of Engineering, Law and Nursing (Aziz et el, 2011). As part of the priority project, ePortfolio was introduced in a third year engineering design course to support student reflection, and self-assessment of graduate qualities (GQ) and Engineers Australia's (EA) Stage 1 professional competencies (Engineers Australia, 2004).

Course Context and Approach

In the computer hardware design course, the students are expected to develop skills in the design and optimisation of computer systems using industry standard tools. A project-based learning (PBL) approach is taken. The first two design projects are simple and students undertake them in a self learning manner using step-by-step guides. Through these projects students learn how to use the design and simulation tools, and also learn some design optimisation techniques. The projects enable students to revisit some of the fundamental concepts assumed in the course. This is important considering the diversity of the student cohort (international, mature age, advanced standing etc). The last two projects are more complex, and require students to apply their knowledge and skills in digital logic to design, implement and test computer processors. These are capstone projects to challenge students to explore design alternatives to achieve higher computer performance.

In the author's opinion, the development of graduate capabilities need to be conceptualised and facilitated through the curriculum in manners that place clear emphasis on the students being able to progressively collect, document and present evidence in support of their developmental progression and the processes associated with it. The process should incorporate ongoing self assessment and critical reflection. In an era when professions are experiencing unprecedented and rapid changes in practice, it is more important than ever before to prepare and empower the twenty first century graduates in this manner. The computer hardware design course aimed to achieve this through the approach illustrated in Figure 1 and described in the remainder of this section. The teacher's role here is that of mentoring, providing feedback, and examining and validating the claims of professional development made by the students. Thus, the teacher plays the role an employer or a professional body would play to assess, critique and/or recognise claims of professional development.

At the beginning of the semester the students were provided with mapping sheets showing how the seven course objectives were mapped to UniSA GQs and EA Stage 1 professional competencies. To provide a disciplinary context and to assist students in linking the learning activities and assessment tasks to the actual technical competencies being developed, a detailed skill profile was created in PebblePad for each of the course objectives. A snapshot is given in Figure 2, where statements of two skills are grouped under a course objective related to 'Design'. The figure also shows that the course objective and the detailed design skills are linked to UniSA graduate qualities 2 (lifelong learning) and

3 (problem solving and critical thinking). They are also related to a number of EA Stage 1 competencies, referred to as PEs in Figure 2. Details of these competencies can be found in the Engineers Australia website (Engineers Australia, 2004). Using the detailed skill profile students self assessed their skill levels on a 1-5 Likert scale at the beginning and near end of the semester, where 1 represents very low skill level and 5 represents very high level.

Figure 1: Schematic representation of learning activities leading to a portfolio capturing students' developmental processes and outcomes

Figure 2: Snapshot of a profile used by students to self assess their skills on a scale of 1–5

Students also wrote two reflective blogs on their learning during the semester. They were encouraged to capture the processes involved in their development. Towards the end of the semester, students self assessed their skill levels against specific EA competencies (developed through the course) using another PebblePad profile. The EA competencies are described at a much higher level and are not specific to any engineering discipline. Here the students had the chance to consolidate their thoughts on their own development by referring to the detailed skills profiles and reflections they had completed earlier. Finally, in the last week of the semester, students submitted an ePortfolio (called Webfolio in PebblePad), consisting of their reflective blogs, progressive (detailed) skills profiles, EA competency profile, and a career episode report (CER) using a template prescribed by Engineers Australia for professional engineers aspiring to achieve the chartered status. The CER provided the professional context and therefore the motivation for students to engage in further reflections. Students' reflective blogs were assessed and feedback was provided. The CER was also assessed. Overall, 10% of the course marks was allocated for the ePortfolio activities. The designs students completed were also examined using face to face demonstration, where students were required to justify their design decisions and answer conceptual questions.

Evaluation

A systematic approach was taken, following ethics approval, to evaluate the strategies used in the course. First, students' self assessment profiles and reflections were critically analysed. Formal evaluation included student survey and interviews, staff forum, and comments and feedback from a reference group, which included external members from key stakeholders such as Engineers Australia's accreditation directorate, the Australian Council of Engineering Deans (ACED) and an ALTC Discipline Scholar. Due to space limitation only selected results are presented in this section. Full details on the evaluation strategies and results can be found in Aziz et al (2011).

Student reflection

The majority of the students appeared to be initially daunted by the reflective blog writing tasks. For some this was a new and an apparently irrelevant task. Ongoing discussion in class on the relevance of reflective writing to professional development convinced most students about its usefulness. Students were given some questions prompting them to organise their thoughts around what to write about. These included 'what, why, how, what if' type of questions. They were asked to write particularly about the graduate qualities and Engineers Australia (EA) competencies they thought they had developed and how they had developed them. Examination of the reflective blogs revealed that some students successfully linked their project experiences with the graduate qualities and professional competencies they had developed. In some cases they provided narratives (evidence) on how these were developed, for example:

- *By performing project 3 I believe I have developed graduate qualities 1, 2 and professional competences PE1.1, PE1.2, PE2.1, PE3.3 and PE3.6. I have gained knowledge of RISC processors and the various other types of processors by virtue of extra reading done as preparation for project 3. I understand how processors work and how their performance is measured by understanding how instructions are executed. I also believe I can handle a challenge that is not only based on what is taught but also with the help of a bit of innovative thinking.*

Student self assessment

Students began by self assessing their proficiency levels against detailed design skills (includes modelling, simulation, analysis and optimization) grouped under 7 course objectives (see snapshot in Figure 2). The student profiles were examined and it was clear that the majority of the students rated their skills to be at a higher level at the end of the course compared to the commencement of the course. For example, Figure 3 displays the students' average self ratings of proficiency levels in four specific skills grouped under course objective #3. Clearly, the students rated their abilities in these four skills fairly highly (close to 3 or above) at the commencement of the course. This was because they were introduced to these skills in an earlier course. The higher ratings depicted by the blue bars indicate that the students considered their skills to have been enhanced by this course.

As stated previously, students self assessed their development against selected EA competencies at the end of the course. Examination of these self ratings indicated that students achieved varying levels of proficiency in the EA competencies addressed by this course. This is not surprising considering the variations in commitment, engagement and intellectual ability of the students in the cohort. The good thing is that students were able to judge their strengths and weaknesses. The CER was the place where the students consolidated their claims of EA competencies by providing a reflective narrative for each competency they claimed. A few students voluntarily contacted the author after graduation, seeking advice on further enhancing their Career Episode Report, for submission as a Competency Demonstration Report (CDR) for assessment of their qualifications by Engineers Australia. This is evidence that students not only found the experience useful, but also considered the processes used as helpful for professional development and recognition beyond graduation.

Student survey

15 out of the 17 students enrolled in the course responded to a survey at the end of the course. Results confirmed that the majority of the students developed awareness of both UniSA Graduate Qualities and EA professional competencies. Most were also able to discern which particular competencies

were developed through the course. Surprisingly, few students selected competencies that were not the focus of this course. As illustrated in Figure 4, all respondents agreed that the activities they had completed had facilitated the development of knowledge relevant to the discipline (73% strongly agreed and 27% agreed).

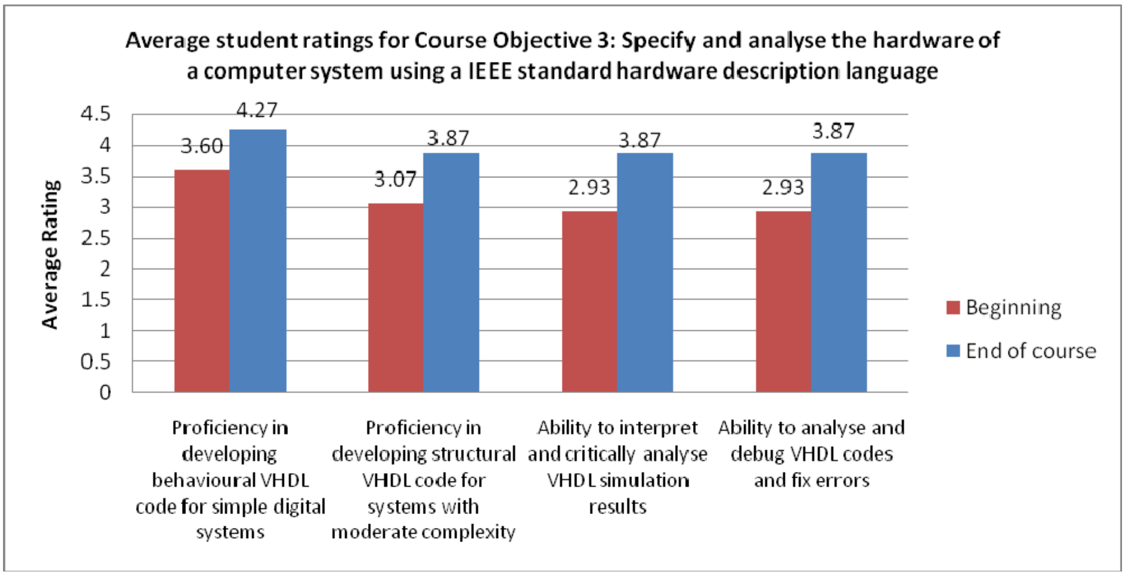

Figure 3: Student ratings in self-assessment of their skills at the beginning and end of the course

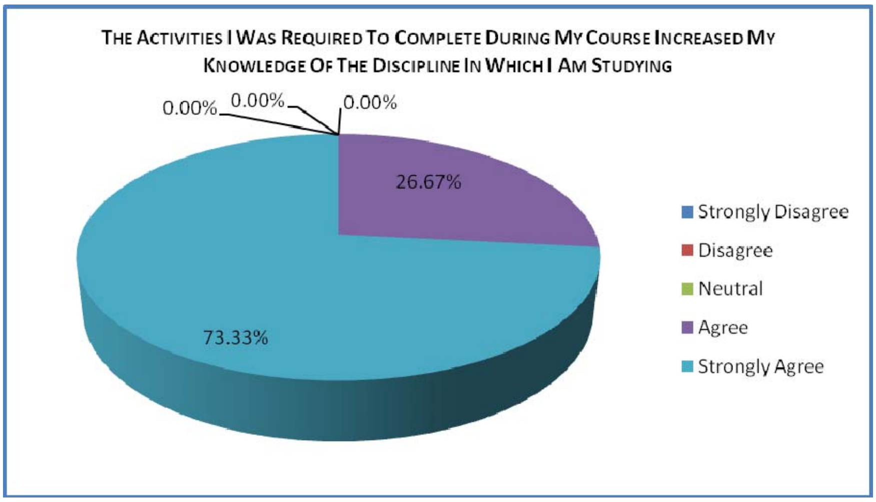

Figure 4: Student survey responses indicating 100% agreement that the course activities increased knowledge of engineering

The next highest level of agreement (60% strongly agreed, 40% agreed) was with the statement that there was 'encouragement to think about the professional knowledge, skills and abilities acquired in the course'. Likewise, all respondents agreed that the course activities facilitated the development of professional proficiencies relevant to engineering (53% strongly agreed, 47% agreed). For the statement related to understanding of their future role as a member of the profession, 40% strongly agreed and 60% agreed. Agreements by all the respondents with all of the above statements indicate the effectiveness of the approach taken in this course to support professional development. Nevertheless, one must be mindful of the limited development that any specific course can support in terms of becoming a professional compared to the development that occurs across a program.

Course evaluation

On the question whether the course had enabled students to develop or strengthen a number of UniSA graduate qualities, 100% respondents agreed (73% strongly agreed). There was also 100% agreement (73% strongly agreed) on the question whether the assessment tasks were related to the GQs. These two items received very high levels of student agreement in previous years due to ongoing in-class discussions on the links between the course activities and GQs. However 100% agreement was never achieved prior to 2010. This indicates that the activities the students had undertaken, which had engaged them in self assessment and reflection, and required them to provide evidence of development in the Career Episode Report, gave them a better appreciation of their learning attainment.

Peer and reference group feedback

As stated previously, the reference group included representatives from key stakeholders (Aziz et al, 2011). First, their feedback was sought to refine and validate the approach taken in the course to support professional development. They were given access to a web site where the approach used in this study and the evaluation strategies were uploaded. They participated in multiple meetings via teleconference. Their feedback was positive, supporting the approach, and the long term value of developing students' ability to document progressive development in the form of portfolios. One reference group member commended the use of ePortfolios as 'an essential ingredient for students to become conscious of the skills and attributes that they need to develop'. The reference group members also provided valuable suggestions, which can be found in Aziz et al (2011). A university wide staff forum was held where the approach and some of the observations were presented. Feedback received from the forum pointed to some of the potential benefits of the approach, for example:

- "It is good to see the focus on mapping and setting a learning and career path - I think it needs to be communicated to everyone in the Uni".

Teacher reflections

The students in the computer hardware design course did not have any prior experience of reflecting on and documenting their own development. From this perspective, although many of the narratives students provided in blogs and career episode reports (CER) were more descriptive than critically reflective, the experience they had gained not only increased their awareness but also provided them a foundation for further development. Linking the process of development of graduate capabilities to CERs used by Engineers Australia motivated students to engage with the process. A few international students completed the course as part of their Masters program. Some of them contacted the author after the course to discuss further development of the CERs into *narratives demonstrating Stage 1 competency* as part of their applications to gain membership of Engineers Australia. This is evidence that the approach taken in the course assisted students in making the connections between their development during the course and their profession. The course assessments included judging the quality of student designs, and their ability to demonstrate the designs and answer questions. These are vital evidence to ascertain student learning and development of graduate capabilities. The approach taken in this course to engage students in self assessment, reflection and preparation of CER assisted them in capturing the processes of their development. In the author's opinion this is useful for empowering learners to progressively collect and provide evidence in support of their development.

Conclusions

The computer hardware design course engaged students in self assessing their progressive development of skills, in reflecting on their learning and in developing an evidence-based career episode report. This has assisted students in identifying and self-managing the development of their capabilities. In particular, there has been an emphasis on developing students' capacity to demonstrate a supported case to professional bodies and prospective employers that they have attained the required proficiencies. Student surveys and interviews, feedback from staff forums and comments by reference group members have reinforced the benefits of the approach adopted in the course. The students used ePortfolios in this course, which is a very good way to document self development because the electronic form enables easy adaptation for multiple purposes. However, what is most important is the process, not a particular tool. In this course, the students were given a basic ePortfolio template that they could copy and build on. They were further assisted with the creation of their first ePortfolio in class as a group activity. This type of support is crucial to ensure that students feel comfortable in using the tools, otherwise frustrations may develop and focus may be inadvertently shifted from creating evidence of development of graduate capabilities to resolving issues with the tools.

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