Full Paper

Abstract

This study examined students' perceptions of the portfolio assessment supports offered in a first year project-based learning (PBL) course. The course was chosen as it follows recommendations for implementing PBL and provides students with their first encounter of both PBL and portfolio assessment. 42 students (27% response rate) answered 18 questions (i.e., 9 multiple choice, 5 free response, and 7 matrix questions with rating scales) measuring their opinions about the difficulty and value of varying portfolio components, their effort and attribution of success, their perceptions of resources, and their suggestions for improvement. Students identified the individual workbook used to document their contributions to the team projects as the most valuable part of the portfolio task. The individual grade nomination attracted the highest values for both task difficulty and student effort, suggesting students were challenged by this task. For five out of eight portfolio tasks, static resources on the Moodle website were rated as most helpful, with this choice being selected by 37% of participants on average across all tasks. This was followed by spoken tips from lecturers during lectures, tutorials or labs (18%) and collaboration with peers (18%). These data suggest it is highly worthwhile for lecturers to invest time in developing quality static resources as students do use and value these over more time-consuming personal communication. It is also important to realise that forums will not replace opportunities for face to face or one on one interaction, meaning that especially in distance contexts, further thought is needed on how to best facilitate peer and lecturer interaction in practical ways which students will value.

Introduction

Problem- and project-based learning are pedagogical approaches where learner-centred environments (Bishop, Caston & King 2014) and inquiry-based learning (Savery 2015) can encourage students to adopt a self-regulated approach to learning (English & Kitsantas 2013), which is highly valued in the workplace. This paper focuses on project-based learning (PBL) which is applied throughout Australian Higher Education in engineering faculties to achieve a variety of key graduate attributes concerning professional practice (Howard & Jorgensen 2006), teamwork and communications skills (Schaller & Hadgraft 2013), engineering design skills (Hall, Palmer & Bennett 2012), problem solving and ethical awareness (Elgezawy & Martin 2008), and acquisition of discipline-based technical knowledge (Rasul & Hassan 2011), to mention but a few.

However, PBL is not without drawbacks compared to traditional didactic curriculum; one major challenge is how to assess such learning. Given the nature of PBL, traditional instruments like one off exams and assignments are generally unsuitable for assessing the creative and critical thinking, reflective practice, and teamwork skills embedded within PBL courses. Decisions about how students will be assessed are critical as assessment "…does not objectively measure what is already there, but rather creates and shapes what is measured" (Stobart, 2008, p. 1). Portfolios are often used to assess learning in PBL (Howard & Eliot 2012; Jorgensen & Senini 2005), and work well in this environment as they allow learners to a) provide multiple sources of evidence of learning, b) reflect on and modify learning processes and products as the course progresses, and c) self-assess their own competence based on the evidence that they have provided. However, for most students, this assessment format will also be new, meaning they need support not only to understand the PBL approach, but also to comprehend and fulfil portfolio assessment expectations.

While the introduction of portfolios as an assessment task may seem logical given the goals of PBL, this approach can potentially create issues for lecturers and students, especially in initial implementation. Students may need to investment more time to understand and complete such processes given it will be a novel form of assessment for many (Struyven & Devesa, in press). Given their size, portfolios may be quite time consuming for students to produce and for lecturers to mark. Studies from diverse disciplines (e.g., physiotherapy, teacher education, and English foreign language) suggest students may be very concerned about the amount of time needed to create portfolios (Aydin, 2010; Bevitt, 2015, Kuisma, 2007; Struyven, Blieck, Roeck, 2014). If formative feedback is expected, this, coupled with the workload associated with setting up and managing team projects that deliver the intended course learning outcomes, can lead to sustained high instructor workload throughout the course, which can be a significant barrier to implementation (Howard & Eliot 2012; Ribeiro 2011). Instructors may need to continually guide student on how they undertake their teamwork to ensure they obtain suitable evidence of individual attainment of the course learning outcomes for their portfolios; there are many tensions noted about the challenges present when trying to determine how to fairly assess collaborative learning (Strijbos, in press). Explaining the work required to demonstrate the standards of achievement for each learning outcome can be a time-consuming task.
Demands on instructors are likely to be highest during students' first encounters with PBL as these students need additional support to understand requirements and transition into self-regulated learning habits. When implemented well, reports of first experiences with project- or problem-based learning are usually encouraging (Duda & Ross 2012) and research suggests that such approaches can potentially reduce student attrition, increase student satisfaction, and improve students' success rate (Nedic, Nafalski & Machotka 2010). Given student responses to new modes of learning and assessment are not always positive, especially if they are confused or feel unsupported (Struyven & Devesa, in press), first PBL encounters must be managed with due diligence to avoid negative perspectives towards PBL, underperformance, and/or attrition.

The study described in this paper was a first step towards examining student experiences of PBL within one university context, with a particular focus on understanding what supports within the course helped students complete their final portfolio task. It was hypothesised that students would have engaged with a diverse range of supports including written scaffolding and resources on the Moodle website, team projects, lectures, activities during residential schools, and peer- and self-assessment, along with conversations with and forum posts and emails from lecturers and/or peers. Understanding what students find most helpful has clear implications for course design as such data will help prioritise the further development of the supports which students value and determine which current mechanisms could be eliminated to lower instructor workload.

Study Context: CQUniversity Engineering PBL

CQUniversity first implemented PBL formally into undergraduate engineering programs in 1997 (Howard, Mark & Jorgensen 2008). Currently, 50% of courses in the CQUniversity Bachelor of Engineering programs are PBL and are designed to provide acontinuous rich and sustained inquiry-based learning experience from first term, first year through to the final year. The PBL courses all follow typical distinctions from problem-based learning (Mills & Treagust 2003), in that there is emphasis on replicating professional projects and applying taught materials in current and prerequisite courses, together with developing skills in self, team, and project management.

A first-term, first-year 12 credit unit course was studied to obtain student perceptions of their first encounter with PBL. Students complete one piece of summative assessment, an Individual Portfolio. This is a widely adopted practice in engineering courses across the

sector (Howard & Eliot 2012; Jorgensen & Senini 2005). The course studied provides a first experience to portfolio assessment for most students; other studies suggest that introducing this mode may increase student stress during its first implementation (Davis, Ponnamperuma & Jer 2009; Vaughan, Florentine & Carter 2011).

The course selected provided many learning supports for the students including:

- Portfolio preparation instructions provided examples of acceptable approaches for reflective writing and grade nominations from portfolio contents. Additionally, frequent formative feedback was provided by lecturers at key milestones during preparation of the portfolio;
- A Performance Standards Matrix described the PBL expectations for each learning outcome;
- A Reflective Writing Guide described alternate reflective writing models (Atkins & Murphy 1994; Bain et al. 1999; Driscoll 1994; Gibbs 1988; Johns 1995) to scaffold reflective assessments;
- A Technical Report Template provided an outline of the expected reporting structure and explanations of how to complete all sections of the report;
- Assessment tips on Moodle included video demonstrations of modelling tasks for latter projects;
- Specific Moodle discussion forums were created to encourage communication within teams, with the wider cohort and with instructors;
- Wikispaces pages were provided for each team and for each project;
- Anonymous Self- and Peer-Assessments (SPAs) were conducted at the conclusion of each project. Results rate student performance on a three-point scale for metrics of communication, collaboration, commitment and reliability (Beer 2011). Students were encouraged to reflect on their SPA results and engage in mentoring to improve team results;
- A compulsory 20-30 minute Viva Voce for all internal students occurred right after Portfolio preliminary marking was completed. This gave students an opportunity to address any anomalies found within their grade nominations. Students were asked questions to assess their understanding of the learning outcomes which were not demonstrated to an acceptable level.

Methods

The study reported here was part of the larger Higher Education Participation Partnerships (HEPP) funded Supporting Student Assessment Success (SSAS) Project (Dargusch & Harris, 2015-2017), investigating students' perceptions of the assessment supports provided in first-year university courses. To gather data around student experiences of assessment supports within the course, first ethical clearance was obtained (H15/02-024). All data were collected by the second and third authors who belonged to a different university faculty and had no involvement in the course. Data for this paper were primarily collected via surveys; students were provided details of the study and ethical safeguards, giving consent by choosing to complete the instrument. Additional demographic data about the students and their activities within the course (e.g., access of particular resources, grades) were also collected. Early in the term students were informed via email and forum of this passive data collection and given the choice to opt out. Ultimately, none did.,

Participants

Out of the 197 students originally signed up for the course, 153 students were still enrolled when final portfolios were due. Of these, 42 returned valid surveys, leading to a 27% response rate. All but two respondents provided a name and student identification number, allowing further demographic data to be determined about this portion of the sample (n=40). 29 male and 11 female students participated, with 6 studying at regional campus 1, 4 at regional campus 2, 8 at regional campus 3, 14 at regional campus 4, and 8 via Distance mode. Using Australian Bureau of Statistics based geocoding of home addresses (Pink, 2013), 3 participants were classified as high socioeconomic status (SES), 24 as medium SES, and 13 as low SES. There was a range of achievement levels represented in the sample (High Distinction= 9, Distinction=10, Credit=9, Pass=11, Fail=1). Mean participant age was 21.37 years old (SD=7.07), with ages ranging from 17 to 45. When comparing the sample to the course population they were drawn from, while grades, age, campus location, and SES were generally representative, female students were over-represented (27% of the sample versus 17% of the course).

Instruments

The survey instrument was designed to gather data about the students' experiences of portfolio assessment in the course. It contained 21 questions (i.e., 9 multiple choice, 5 free response, and 7 matrix questions with rating scales) to measure student opinions about the difficulty and value of varying portfolio components, their effort and attribution of success, their perceptions of resources, and their suggestions for improvement. Of these questions, 13 are analysed within this paper. For the matrix questions, a positively packed rating scale was used; as participants are generally more likely to agree than disagree, such a scale allows for finer discrimination of positive responses and also disallows neutral responses (Brown, 2004). For free response questions, students were provided with a box in which they could type answers, however, these data are not examined in this paper due to word length considerations. For the multiple choice questions, six answer choices, plus 'other' were provided; the first six were randomised to decrease chances that response patterns were affected by students selecting the first answer provided.

Invitations to participate in the survey were distributed via email and forum posts during the final week of term as students were submitting their portfolio. The survey remained open until the start of the next term – a period of approximately 4 weeks. A small number of gift vouchers distributed via random draw were offered as an incentive to encourage participation. Data were collected via the online survey system Survey Monkey and responses were not anonymous, allowing the research team to track responses to demographic information, Moodle activity, and student academic results.

Analysis

The survey included three question types which required different methods of analysis. For matrix questions, basic descriptive statistics were calculated (i.e. mean, standard deviation). Multiple choice responses were reported in percentages for each question; average agreement with each response across categories was also calculated along with some standardised mean difference effect sizes (d) and correlation coefficients (r) (Wilson, 2001), with d=.2 to be considered small, d=.4 considered medium, and d=.8 considered large (Hattie, 2009).

Results

Students identified the individual workbook used to document their contributions to the team projects as the most valuable part of the portfolio task, closely followed by their individual reflective paper (Table 1 and Figure 1). All of the 7 portfolio components attracted high ratings for value. The individual workbook used to complete activities and readings, peer

assessment, and the Viva Voce attracted the lowest of those ratings. The lower ratings for the Viva Voce may be partially explained by the fact distance students did not participate in this (note high standard deviation), and is likely also reflected in the lower scores and high standard deviation for effort and difficulty ratings for this portfolio component. Also of interest are the relatively high standard deviations for the Individual grade nomination (self-assessment) and peer-assessment, demonstrating that while these were still ranked as valuable and moderately valuable respectively, students were not homogenous in their beliefs about the value of these practices.

Table 1: Student perceptions of task value, effort, and difficulty.

	Task Value	**Task Effort**	**Task Difficulty**
Individual grade nomination	5.02 (SD=1.297)	**5.29 (SD=0.805)**	**4.31 (SD=1.259)**
Personal reflective journal	5.10 (SD=0.906)	4.67 (SD=1.052)	4.05 (SD=1.081)
Individual workbook (activities and readings)	4.29 (SD=1.154)	3.86 (SD=1.138)	3.71 (SD=0.891)
Individual workbook (contributions to team projects)	**5.38 (SD=0.697)**	5.21 (SD=0.898)	4.17 (SD=1.167)
Individual reflective paper	5.21 (SD=0.842)	5.10 (SD=0.906)	4.29 (SD=1.132)
Individual Drawing folder	4.93 (SD=1.191)	5.02 (SD=1.158)	4.10 (SD=1.185)
Peer-Assessment	4.60 (SD=1.308)	4.73 (SD=1.205)	2.36 (SD=1.032)
Viva Voce	4.64 (SD=1.478)	4.55 (SD=1.735)	3.08 (SD=1.583)

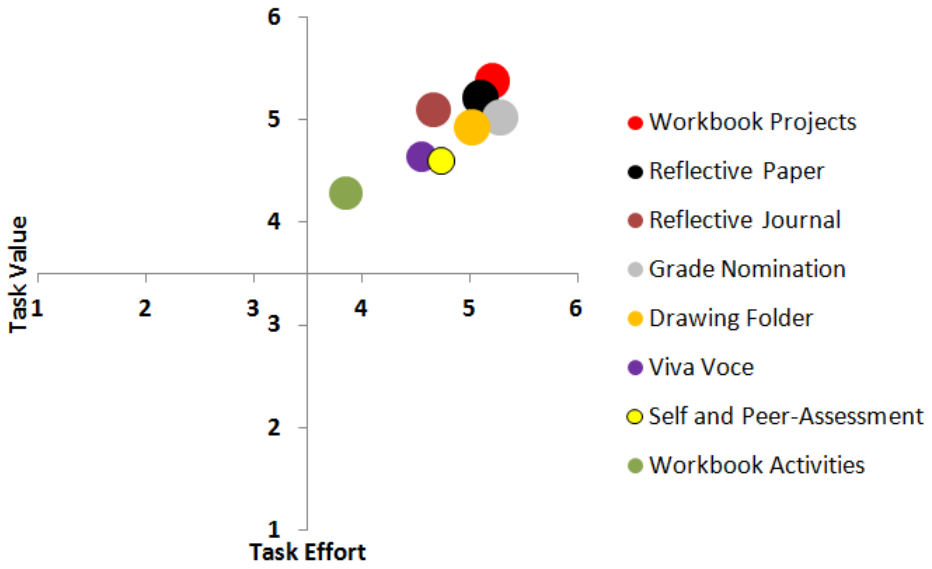

Figure 1 Quadrant analysis of Portfolio task effort and value with difficulty as marker size

The individual grade nomination attracted the highest values for both task difficulty and student effort, suggesting students were challenged by this task. Interestingly, while they found this self-assessment task difficult, they reported peer assessment as being comparatively easy, perhaps because the procedures within peer assessment only required students to complete a tick-box evaluation. Also interesting are the lower effort and difficulty scores attached to the individual workbook section connected to activities and readings; the low standard deviation for difficultly suggests that students generally agreed that this was one of the easiest component. As this portfolio component is most aligned with 'traditional learning' within the course, these scores suggest that students not only found these less novel tasks easier, but also of less valuable.

Students were also asked to explain what resources or activities (Question 6) and interactions or feedback (Question 7) they found most useful when completing the portfolio. Table 2 orders these rankings from highest (most useful) to lowest (least useful).

While all components did attract positive ratings, there was variation in student response. Agreement that the team projects and course performance standards were most valuable remained relatively consistent, both with standard deviations of less than one. It is also interesting to note students found personal conversations with the lecturer and peers to be more useful than similar interactions via the forum (d=.5425, r=.2618 for lecture discussion vs forum posts, d=.7117, r=.3353 for peer discussion vs forum posts). While it is tempting to consider forums as a suitable substitute for more personal and/or face to face communication, clearly a distinction remains between these modes in the minds of students. It is also of interest that students do consider personal discussions with peers to be a useful resource and one almost as valuable as the instructor (d=.1294, r=.0646), an attitude which should be further fostered.

Table 2: Student perceptions of the usefulness of assessment supports

Assessment support	Mean	SD
Team projects	5.43	0.887
Course performance standards	5.40	0.912
Personal conversation with lecturer	5.29	0.864
Formative feedback on team projects	5.24	0.983
Task and portfolio instructions	5.17	1.057
Discussions with classmates on-line or in person	5.17	0.986
Formative feedback on individual activities	5.17	0.730
Reflective paper	5.07	0.921
Spoken tips in lectures	5.02	0.975
Reflective writing guide	4.88	0.993
Emails from lecturer	4.83	1.305
Tips from lecturer on forums	4.76	1.078
Assessment help during tutorials, labs, or residential school	4.74	1.381
Self assessment	4.57	1.328
Questions or tips on forums from classmates	4.40	1.170
Peer assessment	4.31	1.405
Course schedule	4.13	1.473

When examining those rated as least useful, peer- and self-assessment and peer forum posts scored near the bottom, alongside the course schedule, which was designed to help students plan their workload across the term. This placement suggests that students in this course have yet to see themselves as legitimate assessors of their own work or the work of others and some may not yet want to engage in discussions with or trust the opinions of unknown classmates via a relatively generic and public medium like the forum.

When examining what resources students valued most in relation to each aspect of the portfolio, interesting patterns emerged. For each portfolio section, students were asked to nominate which aspect “was most valuable for helping you understand and complete the task” from seven options via multiple choice format (see Table 3). For five out of eight portfolio tasks, static resources on the Moodle website were rated as most helpful, with this choice being selected 37% on average across all tasks. These were followed by spoken tips from lecturers during lectures, tutorials or labs (18%) and collaboration with peers (18%).

Table 3: Student perspectives about which resources were most helpful

	Feedback from lecturer on tasks	Responses from lecturer via email, forum, phone, etc.	Spoken tips or instructions during lectures, tutorials or labs	Resources on Moodle	Self & peer assessment activities	Collaboration with peers via group work, email, forums, wikis, etc.	Other (please specify)
Individual grade nomination (n=42)	14.3% (n=6)	4.8% (n=2)	16.7% (n=7)	**47.6% (n=20)**	4.8% (n=2)	11.9% (n=5)	0.0% (n=0)
Personal reflective journal (n=42)	19.0% (n=8)	4.8% (n=2)	21.4% (n=9)	**40.5% (n=17)**	0.0% (n=0)	11.9% (n=5)	2.4% (n=1)
Individual workbook (activities and readings) (n=42)	4.8% (n=2)	0.0% (n=0)	19.0% (n=8)	**52.4% (n=22)**	2.4% (n=1)	16.7% (n=7)	4.8% (n=2)
Individual workbook (contributions to team projects) (n=42)	11.9% (n=5)	11.9% (n=5)	23.8% (n=10)	16.7% (n=7)	2.4% (n=1)	**33.3% (n=14)**	0.0% (n=0)
Individual reflective paper (n=42)	11.9% (n=5)	4.8% (n=2)	14.3% (n=6)	**61.9% (n=26)**	0.0% (n=0)	7.1% (n=3)	0.0% (n=0)
Individual Drawing folder (n=42)	14.3% (n=6)	2.4% (n=1)	14.3% (n=6)	**40.5% (n=17)**	2.4% (n=1)	21.4% (n=9)	4.8% (n=2)
Peer-Assessment (n=41)	2.4% (n=1)	2.4% (n=1)	7.3% (n=3)	22.0% (n=9)	29.3% (n=12)	**31.7% (n=13)**	4.9% (n=2)
Viva Voce (n=41)	19.5% (n=8)	7.3% (n=3)	**31.7% (n=13)**	12.2% (n=5)	4.9% (n=2)	9.8% (n=4)	14.6% (n=6)
Average across tasks	**12%**	**5%**	**18%**	**37%**	**6%**	**18%**	**4%**

Discussion

Although based on responses from a relatively small number of students, this study has shown that, when well supported, students do see the value of engaging in project- based learning via portfolio assessment, despite it being perceived simultaneously as being difficult and requiring substantial student effort. This is a positive finding given that using portfolios in conjunction with PBL provides opportunities for students to work in ways that will be characteristic of their future profession.

This finding is especially important given the diverse nature of the student cohort in the participating course and survey, which included many mature age students and those coming from low SES backgrounds and other equity groups. One important limitation other than sample size is that due to the timing of the survey, only students who were still enrolled at the end of the course had the opportunity to participate. While 22% of the initially enrolled students did not make it to this point, some of this attrition would have been a result of students going from full to part-time study and it does sit lower than the university's overall rate of attrition of 36% (Australian Government Department of Education, 2013). Notwithstanding, student who dropped the course may have differing perspectives on what is needed to support students within PBL and future studies should try to elicit the perspectives of these students to determine if there are systematic differences in need between those who do and do not complete the course.

Overall, it is also positive that static resources on the Moodle course website are viewed as the most important resource for students when seeking help. This endorsement suggests that by having clear instructions and examples, students are less reliant on one-on- one discussions with their instructors. These data indicate that it is highly worthwhile for lecturers to spend considerable time developing quality assessment support resources for their courses and thinking about ways to make tips and reminders explicit within their teaching as these steps are likely to decrease the number of student questions requiring response during course implementation. Also, students clearly want to see examples of what they will need to produce when working in new assessment modes. It is important that lecturers remember that many students may have no prior experience with portfolio assessment and may struggle to visualise what the final product may look like; whenever introducing assessment approaches which are likely to be novel to students, the process must be made intelligible to students, with timely feedback and support provided along the way (Struyven & Devesa, in press).

Additionally, nurturing student perceptions that peers can be important sources of clarification may also help to decrease lecturer workload. While the teaching team cannot completely divest responsibility to students in this respect, encouraging students to discuss questions amongst themselves first will mean that instructors can clarify key points to multiple students at one time rather than one on one.

However, despite the best practice approach adopted to PBL within this course's implementation, tensions remain around some aspects of the course. For example, self- and peer-assessment responses attracted relatively high standard deviations, suggesting some students were yet to be convinced about the appropriateness and/or validity of these approaches to assessment, consistent with other findings about student responses (e.g., Brown & Harris, 2013, Harris & Brown, 2013). It is unknown if students would have been more receptive to these practices had they been formative rather than summative in nature. Regardless, these findings underscore the importance of lecturers explicitly explaining to students how self- and peer-assessment can improve their learning and taking active steps to make sure they have clear understandings of assessment criteria and practice in applying

them before their own judgements count towards grades.

Conclusion

While difficult issues remain in relation to the assessment of PBL (e.g., use of self- and peer-assessments, how to differentiate between individual and group processes and products within grading), this study contributes to the conversation about how students might be best supported to complete portfolio assessment in PBL courses within Engineering higher education. It gives an insight into the tensions and challenges that still exist despite best practice efforts and provides an opportunity to consider further how students access assessment resources in different ways and for different purposes. In an era where students belonging to equity groups are increasingly entering university and more students are studying via distance and blended modes, it is important to think about if current support structures will cater equally for all or if new approaches are required. While considerable progress has been made, there is still work to be done to ensure that all students are supported in the ways they require to understand and meet assessment requirements.

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