A new method of integrating project-based and work-integrated learning in postgraduate engineering study

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Abstract

This paper reflects on the introduction of project-based learning (PBL) into a postgraduate engineering management unit, as a form of work-integrated learning (WIL) extending the practice of students and their engagement with industry. The real life and authentic PBL was designed and implemented in extensive consultation with industry practitioners. WIL has often been conceptualised as a process of induction and introduction to workplaces and work practices. However, such models do not easily translate to postgraduate students with existing workplace experiences. The experience of this unit suggests that there is an intersection between PBL and WIL which may provide a pathway for broader student-industry engagement, scaffolding the development of professional networks and practices for students already within an engineering workplace, and allowing students to transform their practice and improve workplace capabilities. This paper presents a case study of the experience of students who have participated in an industry-led and assessed project based learning experience as part of a unit in the Masters of Engineering Management course. Student satisfaction and engagement with the unit was extremely high, with students self-reporting increased levels of confidence and ability to apply theoretical knowledge. It is concluded that through the integration of project-based and work-integrated learning it is possible to create authentic learning experiences for postgraduate students which enable transformative practice and capability development.

Keywords: project-based learning; work integrated learning; postgraduate; curriculum; engineering management

1. Introduction

Work-integrated learning (WIL) has often been conceptualized as a process of preparing students for the world of work. WIL has been demonstrated to provide benefits for students to enhance employability, work-readiness, professional identity, and 'soft skills' making the transition from university to the workplace more successful (Ferns, Smith, Russell, & Cretchley, 2014; Jackson, 2015). Such models of WIL, and most research in this area, has tended to focus on the experience of undergraduate students with little professional experience, or what may be considered an emerging professional (Stewart, 2017). WIL in these contexts is powerful in providing graduates with experiences and understandings of the workplace which allow them to translate and transfer the knowledge of the university to the practice of the workplace. However, in the postgraduate setting such is not necessarily the case. With universities, such as the Queensland University of Technology (QUT), moving towards strategic goals of all students having a WIL experience as part of their study, greater attention needs to be provided to what these experiences may be like, and what benefits may be evident for postgraduate students, who often have existing workplace experience.

This study focuses on the effectiveness of redesigning a postgraduate engineering unit with real life project-based learning and the experience of a cohort of students undertaking a unit of study within a Master of Engineering Management program. This program is intended for students who already have an undergraduate engineering degree and are seeking to extend their management and leadership skills

within this discipline area, and further develop their engineering skills. Therefore, 'traditional' undergraduate models of WIL which focus on work-readiness do not provide for this cohort of students the experiences and learning that are necessary for their further development. WIL experiences within this cohort of students do not need to provide simple access into workplaces, which most of these students already have, but instead need to give access to higher levels of workplace engagement, leadership and contexts in which their skills can be extended and further developed (Cain & Cocco, 2013; Stewart, Campbell, & Wheeler, 2016). WIL in postgraduate settings needs to provide for transformative learning experiences for students allowing them to leverage university learning to access opportunities which extend their professional competencies. This study proposes that a model which draws on project-based learning (PBL), with connections and engagement with industry, may provide a model of postgraduate WIL which delivers the expected transformative learning.

2. Background

The Master of Engineering Management is a postgraduate coursework program intended for engineering graduates seeking to advance skills in management, advanced quality control, decision support systems, optimization of resources and continuous improvement in organisations. The unit Enterprise Resource Planning (ENN570), which provides the context for this study, is a core unit within the program and aims to support students develop an understanding of connecting different functional units of an organization and integrating the business process through the use of a single common database. The unit is generally taken by students in their first semester of enrolment in the program and provides a foundation for future study. Students enrolling in this unit draw from a diverse background with majority of them are coming from overseas. The unit aims for the students to develop and execute a research plan cooperatively and productively as part of a project team and learn to appreciate group dynamics in project work. The unit therefore also aims to develop communication and group work skills important for students to be successful in subsequent units.

Assessment in this unit is comprised of three tasks; tutorial based in-class problem solving, applied group project and final examination. It is the applied project assessment which provides the focus for this study; however, this project draws on learning from across the entire unit. Through the project it is intended that students work in small groups to select a real industry problem, collect data from industry, apply research skills to find root causes of problems and develop an appropriate ERP system to overcome the problem. Through this process students draw upon the theories and skills learned in the unit, with the aim to improve operational performance and productivity within the chosen industry. The project carries 50% of the marks for the unit with students working towards their solution across the entire semester. At the end of the semester, students submit a 10,000 word report on their project and present their work in a group presentation. They need to run and demonstrate the ERP programme they developed during the presentation.

This study has focused on the experience of one cohort of students who have undertaken this unit in Semester 2, 2017. In this semester, there were 75 students enrolled in this unit with 90% of students identified as international[1] enrolments (Karim, 2010). Of the enrolled students, 55 (73%) reported that they were either currently working or had recently worked in an engineering role. The remaining students had progressed into the program direct from undergraduate study.

WIL is broadly defined as a collective term for experiences in which students interact directly with industry and workplaces as part of their university studies (Cooper, Orrell, & Bowden, 2010; Edwards,

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[1] An international student is defined as a non-Australian citizen undertaking study within Australia. Some international students may be longer term residents of Australia, however, the majority are on temporary study visas.

Perkins, Pearce, & Hong, 2015; Patrick, Peach, & Pocknee, 2009). Within this umbrella concept are experienced labelled as internships, work placements, sandwich courses, and cooperative education. However, at its essence WIL is an integration of both practice (work) and theory (learning), with the context of learning and experience being located in activities of work. How 'work' in understood varies considerably across disciplines and fields of study, in much the same way a 'workplace' is no longer a defined bounded location with activities of the workplace being found in many different settings and locations. Therefore, a more useful understanding of WIL can be drawn from the policy of the university in which this study is located which provides that WIL has three characteristics: (1) learners engage with an industry and/or community partner, (2) learners undertake authentic activities for industry and community, and (3) learners are assessed on these authentic activities (Queensland Univeristy of Technology, 2017). This definition differentiates the experience of WIL from a broader understanding of authentic learning, but also highlights that these exist along a continuum where WIL captures the learning that occurs in close situation to the experience of work. The central point of differentiation being engagement with and for an industry or community partner.

Project-based learning (PBL) has its origin in the work of Dewey, who proposed the benefits of learning by doing, or what has become to be known as experiential education (de Graff & Kolmos, 2007; Dewey, 1938). Dewey's work argued for the value of experiential learning models which enabled students to translate abstract theory into concrete practical experiences. Project-based learning is an active exploration of real-world problems and complex challenges, with students self-directing the approach and control of the project development and product delivery (Bell, 2010). The origins and lineage of PBL has a similar path to that of WIL, with both approaches aiming for exploration of learning within experiential practice settings. Gamble, Patrick, Stewart, and Lemckert (2008), suggest that on a PBL continuum, work-integrated learning (WIL) would be positioned at one end, with fundamental engineering theory at the opposite end. However, others (Cooper et al., 2010) would contest that WIL and PBL are different approaches to learning, that although sharing some similar characteristics are fundamentally different. It is not the intent of this paper to explore in great depth the pedagogical and philosophical arguments around PBL and WIL, but instead we propose that due to its grounding in experiential learning in response to real-world challenges, PBL reflects many of the characteristics evident in WIL, and may provide a scaffolded precursor experience to enhance the capacity of students to engage with industry and develop their professional identities and understandings. For postgraduate students where they already have work based experience it is suggested that PBL may provide a model of WIL which allows students to advance their competence and demonstrate higher level skills in a work-related, but controlled, learning environment. Thereby, providing a foundation for more adventurous learning later in their study.

3.   Research Method

The purpose of this study was to better understand the experiences of students engaged in the new PBL designed for one of the units of Master of Engineering Management. The study draws upon data collected from students via a questionnaire survey and a series of interviews.

An evaluative questionnaire was developed and given to students at the conclusion of the semester and PBL experience. The use of student ratings and feedback through survey instruments has been demonstrated to generate reliable results which reflect student learning, given administration under appropriate circumstances (Benton & Cashin, 2014; Wachtel, 1998). This questionnaire captured student satisfaction with the assessment design and self-reports of knowledge gain through the experience using Likert scale questions. Students were also able to provide qualitative comments in response to a broad open-ended question. The questionnaire was administered electronically and anonymously thereby

negating instructor bias and influence. A total of 52 (69%) of students responded to the questionnaire. Descriptive statistical analysis of student responses to the questionnaire was undertaken.

The questionnaire was supported with a series of interviews of students (n=15) with questions focused on connecting the PBL/WIL experience with future practice and work. Interviews were conducted with students at two points of their experience (during and concluding) using a semi-structured approach (Creswell, 2014). The interviews were undertaken as part of a broader research study into student understanding and experiences of PBL, with a number of questions included to elicit student experience within this PBL project. The interview questions focused on this study were formed around the following thematic questions:

1. How did your activity in the project compare to your previous experience of engineering and/or work practice?
2. How do you think your experience of the project will support your future work practice?
3. What skills or new understandings will you take away from the project experience to support future study or work?

Interview participants were recruited via an open invitation to participate in the research with the sample selected to provide a combination of male and female, engagement with different projects, years of professional experience, and home country/ethnicity. All interviews were undertaken by the same researcher with analysis undertaken using an iterative thematic analysis with validation achieved through researcher conversations and reviews (Creswell, 2014). *A priori* themes used to analyse interviews were informed by student responses to the questionnaires and themes evident in literature, with these themes able to be organized under the constructs of experience, expansive practice, employment, and professional identity. Participants were de-identified with direct comments referenced in this paper using a numerical code to differentiate each interviewee.

Ethical approval for this research was provided by the Queensland University of Technology Human Research Ethics Committee.

4. Design of the New PBL

The Master of Engineering Management course at QUT aims to enhance the core discipline-specific knowledge, professional practice, and employability of graduates from across engineering fields and provide pathways for both domestic and international students for upskilling in an increasingly competitive job market. These aims are aligned with the QUT Real World Learning 2020 vision (Queensland Univeristy of Technology, 2016) as it aspires to embed authentic learning and assessments in all units, and work integrated learning (WIL) in all courses.

The current QUT Blueprint and strategic plan has highlighted an objective that all students of the university, both undergraduate and postgraduate, should have access to a WIL experience at some point of their degree program. It is intended to achieve this objective by 2020, with over 70% of current graduates already undertaking a WIL placement or project experience. To support attainment of this objective WIL opportunities have gradually been introduced across all programs at the university. Within science and engineering the usual WIL option, particularly for undergraduate students, has been a placement model in which students undertake a prescribed number of days within a workplace setting. However, such models are not easily scalable or sustainable, and do not reflect the diverse discipline experiences and demands of students, particularly with regards the experiences and networks of postgraduate students. Therefore, in the field of engineering management an approach which draws upon

PBL has been adopted. This study considers the effectiveness of such an approach on student learning, engagement and satisfaction, and employability as measures of quality.

Recent internal student surveys and focus group studies at QUT demonstrated that postgraduate students within engineering at the university were very keen to have WIL and internships included in their courses. However, as the duration of the Master of Engineering Management course is only 12 months, it is challenging to incorporate WIL in the form of internships and placements. Within a postgraduate cohort of students with existing work experience there is limited benefit of WIL with industry attachment to enhancing employability skills. Within this course about 90% students identified as international students with no connection with local industries, and therefore present further challenges where they are expected to seek their own industry placements. Literature suggests that international students are currently underrepresented in WIL in Australia (Felton & Harrison, 2017; Jackson, 2017), with the Bradley report into higher education highlighting the importance of preparing international students for working in Australia (Bradley, Noonan, Nugent, & Scales, 2008). The combination of these challenges meant that a different approach was required to incorporate authentic learning and WIL into the Master of Engineering Management course.

In order to achieve QUT's Real World Learning 2020 vision (with a key success target of all graduates across the university participating in a WIL experience), learning activities must be designed taking into consideration the importance, relevance, and integration of theory and knowledge with professional practice to develop solutions to real world issues. As a first step, the content, delivery and assessments of the unit ENN570, one of the units of the Masters of Engineering Management, was overhauled. Changes include modifications in the delivery mode, introduction of real world project-based learning (PBL), involvement of industry experts in teaching and assessments, and expectations of students to demonstrate implementation of theoretical knowledge acquired by solving real industry problems.

Designing effective learning and assessment which provide the integration of theory and practice demands the adoption of pedagogical practices that deliver learning outcomes more relevant to industry demands, including skills such as critical thinking, teamwork and communications, as well as technical or discipline-specific skills (Karim, 2010b; Karim, Fawzia and Islam, 2016). As part of the review of the unit ENN570, real world project based learning was introduced as the platform through which students engaged with evidence-based practice using authentic industry problems, cases and projects and utilising contemporary software/analytic tools and engineering management skills.

The learning outcomes of the unit ENN570 are:
1. Identify the factors that lead to the development and implementation of ERP systems.
2. Critically reflect upon theoretical approaches and analyse their application to achieve effective use of Enterprise Systems to support operations and management practices.
3. Justify and interpret theoretical propositions and related bodies of knowledge to critically evaluate the resolution of business problems and recommend actions in contemporary Enterprise Systems.
4. Describe how an integrated information system can support effective and efficient business processes.
5. Critically apply cross-disciplinary knowledge with creativity in decision making supporting the development, implementation and use of Enterprise Systems.
6. Plan and execute a substantial evidence-based project linked to Enterprise Resource Planning Systems to generate and evaluate complex ideas and concepts at abstract and practical levels.

The proposed real world project based learning is expected to achieve 2, 3, 4 and 6 of the unit learning outcomes.

As part of the design of the new real world authentic PBL, extensive consultations with different stakeholders were conducted. Building on an extensive review of literature on PBL and WIL, a group of four industry experts (which included two with PhDs in the field of engineering and resource management) were invited to the university to explore industry requirements and expectations of graduates from a postgraduate engineering management course. To complement the input of industry experts, and translate their expectations into pedagogical practice, teaching and learning consultants from the university, alongside past students, were also consulted. Emerging from these consultations was an aim to design learning experiences which enhanced the practical and transferrable skills of students, developed through an authentic real-world experience, thus the development of a PBL approach grounded in principles of WIL. The underlying design of the PBL, informed through consultation with a range of industry leaders and professionals, was designed to cater for a changing professional landscape, with new emerging professional areas and developing students more responsive to changing professional needs.

The new PBL approach designed in this unit required students to undertake the development of an enterprise resource planning (ERP) solution for a real industry for the better management of a complex business process. At the beginning of the semester a list of industries were supplied to the students. They were given the option either to select from the list or make their own arrangement to work in an organization of their choice. Students undertook this project as part of a team of five students, with the PBL approach placing greater emphasis on collaboratively analyzing and visualizing real data from multiple sources in the context of different industries, and negotiating solutions to the industry problem. Many students undertook projects based on their current workplace or in the organisations they worked before. Selecting a project based on known workplace helped them in identifying the problems, critical analysis and data collection. These workplaces include local as well overseas organisations. For the students who selected an industry from the supplied list, an initial relevant database was provided to them. They were also connected to the industries for the further communications.

The process of learning and practice broadly followed a pattern of: (1) student teams identifying key problems in their chosen industry; (2) collection, analysis and engagement with real data sets from the industry partner; (3) application of the tools, techniques, and methods they learn in the unit to generate possible solutions; and (4) presentation of key findings and outcomes. Student teams, and the PBL approach, was well supported by academic and industry experts throughout the semester with ongoing input and feedback on student progress towards solutions. For example, two workshops, run by an external industry expert, on Microsoft Access were organized at the start of the semester as most students intended to use this software in developing their ERP system. Students were also able to access regular guidance and advice from academic and teaching staff in navigating the complexities of working as part of a team. It can be mentioned here that the industry experts involved in supporting and assessing the PBL projects were not from the industries the projects were sourced from. This was done in order to avoid any bias in the assessment process.

Assessment of the PBL project was managed through clear project guidelines and marking criteria with the allocation of 50% of marks across the unit for completion of the group project. As part of the project students were required to submit a proposal for their group project in Week 4, with feedback provided by the unit coordinator (the first author) in the following week to ensure that the designed projects are in line with unit objectives. Ongoing support across ERP development was provided through three one-to-one support sessions, scheduled in Weeks 3, 7, and 10. Each group was allocated 15 minutes to discuss any

problems regarding the project with a member of the teaching team and an industry expert. Groups were also able to make additional appointments, or communicate via email, with the unit coordinator and industry expert at other times across the semester. Completed projects were jointly assessed by academic staff and industry partners.

In order to support the aims of the PBL approach, the design and delivery of the entire unit was revised. As the students are required to use many theories and models in their ERP programme (e.g. forecasting model, product structure), it is necessary that throughout the unit they are exposed to and develop competence in these models and theories. The unit, through the PBL approach, creates an intersection between theoretical, or abstract, knowledge and understanding, and the practice orientation and experience of the project. It is this intersection which mirrors the pedagogical practice of WIL in which work (or professional practice) integrates with learning, providing new understandings and permitting experiential formats of learning. Figure 1 highlights the connection and intersections of theory and practice evident in this unit.
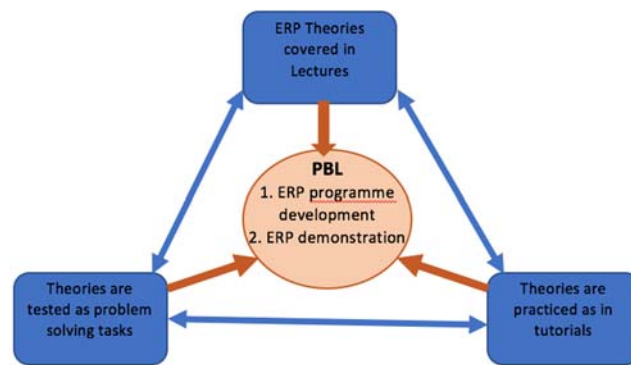

Figure 1: Intersection between theory, models of understanding and PBL

To complement the practice-oriented learning of PBL, students are also engaged in a parallel exploration of theory. The structure of the unit is such that all theories are covered in lectures within the first four weeks of the semester, then across Weeks 5 to 8, the theories are practiced in tutorial classes in the form of problem solving. In Week 9, the capacities of students are tested through an in-class problem solving task. Through engagement with theory students have the opportunity to develop expertise which can be applied to the development of their ERP programme. Further, areas of support are also identified through the teaching across the first parts of the unit, enabling more targeted individual interventions in the PBL component.

Critical to the success of PBL and WIL experiences is the incorporation of and connection with industry experts. The design of this unit included the engagement of industry experts in at least half of the lecturers and teaching episodes, in addition to the feedback and discussion sessions. Through these, industry experts shared 'real world knowledge' with the students, guiding student decision making and solution development. However, the engagement of industry experts did increase demands on resources within the unit through additional teaching expense, though the additional funding was made available due to the manner in which the unit supported realisation of the broader university strategic vision.

The design of the PBL experience presents as a cycle of problem identification and solution development, commencing, progressing and concluding with engagement with industry. It is these ongoing explicit connections with industry and working towards solutions that relate to real problems in industry which

reflects key aspects of WIL, thereby providing an intersection of WIL and PBL which enables students to enhance capacity and further develop professional identities.

5.   Results and Discussions

5.1 Student experience with new PBL

Evident in student responses was a consistent and highly positive response to the various aspects of the PBL experience. Students were asked to respond on a Likert scale (1 = strongly disagree to 5 = strongly agree) to a range of question about improving their understanding of theory and practice, ability to work in groups, experience of PBL and improved capabilities. In all questions responses produced a mean score response greater than 4.4, indicating that across all measures students self-reported better understanding, improved capacities and a positive learning experience. The following table presents a summary of this data with the mean score responses for each question.

Evident in the student responses was an overwhelmingly positive learning experience. The responses to the Likert scale questions were validated by the qualitative comments from students. Students wrote "loved it", "all good", and "good experience and learnt a lot". However, beyond the somewhat superficial enjoyment of the PBL experience, students also identified the opportunities within the experience to develop new knowledge and skills. More than half of the responses from students indicated some recognition of the learning that occurred. One student, as an example, wrote, "very informative and provides fundamental knowledge on ERP", whilst another wrote "very good for skill development". One student expressed that the "unit was the most practical one among others and I am sure it would be very beneficial for my future career. I would keep all the materials to use them for my job". Beyond student satisfaction ratings and self–reported outcomes, the benefits of the PBL experience have also been evident in the level of interest from industry to employ students as a direct outcome of their experience in ENN570.

TABLE I STUDENT QUESTIONNAIRE RESPONSES

Statement	Mean score
1. PBL has improved my understanding of the theories I learned in this unit	4.6
2. PBL has improved my understanding of the practical aspects of enterprise resource planning	4.6
3. My confidence and ability to develop a real-life ERP has been enhanced	4.5
4. The ERP project has helped my ability to work in groups	4.5
5. The ERP project was like practical training in applying tools and techniques	4.6
6. The ERP project increased my depth of knowledge in this field	4.5
7. I now have a better knowledge and capability of applying theories to solve real life problems	4.5
8. Project support sessions were helpful	4.6
9. Involvement of industry people was helpful in solving problems	4.4

The student responses in this questionnaire are also reflected in longer term feedback on the unit with high attendance and low attrition rates evident across several semesters, and student satisfaction scores on university evaluation surveys consistently being among the highest across the university. Critical to these positive student experiences, evident in both the questionnaire data and feedback through university surveys, was the role of the academic staff and industry experts. Several students made personal comments thanking the staff for their support, whilst others commented on the overall framework of the unit and how it supported the project process.

5.2 Understanding student engagement

Whilst the questionnaire elicited good data around student satisfaction and self-reported knowledge and skill acquisition, of interest to the researchers were the interpretations and engagement of students in the PBL learning process. Interviews with students highlighted that those with different levels of prior experience engaged differently with the PBL experience. As previously argued in this paper, WIL has previously been conceptualized as a mechanism for developing work-ready students, and therefore focused mostly towards undergraduate students with limited work experience. However, the application of WIL principles, in this case through the PBL experience, in the postgraduate space requires accounting for students who already bring a breadth of work experience and understanding. Within the data in this study it appeared that there was a difference between those students with less than 3 years work experience, that is still in the novice stage of development, and those with more than 3 years experience, that is emerging or stable expertise. Within the cohort of students there was a range of experience, with the higher end being up to 9 years professional experience. Most students came to the course with between 3 and 5 years of experience, which is consistent with the stage of professional development in which students engage with postgraduate study, and in this case, begin seeking managerial advancement.

5.3 Experience as a tool for reflective practice

For students with minimal work or professional experience there was evidence of them not understanding the complexity and opportunities of the PBL experience. Whilst they were successful in completing the task, comments in interviews suggest that they did not experience the same level of transformative learning as those who were capable of reflecting on personal experience. For example, one student with no professional experience commented that felt "in every university, no one is working on the practical basis, or what are happening in the industry, or in real life" (P12). This student was able to list a range of knowledge that they gained from the PBL experience, such as, inventory management and forecasting management, but did not draw direct connections between these understandings and professional practice. For another student with only one year professional experience, he approached the task with a model of learning drawing on abstracted literature and advice and trying to replicate what this literature considered good practice: "first I gone through the previous report, so I got an idea of how we had to write, how much data we needed and all, and it required a detailed literature review, so I just searched the QUT library website, for ERP books, and all … so I just made the same" (P5). The challenge for students with limited professional experience appears to be the ability to critically reflect on the PBL experience, drawing from previous learnings, to consider how this may inform future professional practice. Within the unit students were not explicit taught or assessed on their ability to reflect on learning, and this may present as an opportunity for future development.

In comparison, a participant with eight years professional experience was more capable of identifying the connections between the PBL experience and professional practice, and articulating how they were challenged in the process to change their personal professional practice. They commented that; "now I'm

learning to see another perspective. I mean, from my experience, I had to handle a lot of situations, and I had to learn about some other things, more than the technical things that I had to do, … but now this is like I don't know, like next level" (P11). For this participant, the real-world nature of the PBL experience was more evident: "I'm always using my previous experience, because this is what I say, this is how it's real world" (P11). And as another participant commented: "if someone has experiences, they will do professionally, but [if] he didn't have any experience about this, they cannot do it, or maybe they will do, but not professionally" (P13). For this student, the concept of 'professionally' encompassed the idea of hard work and commitment, as well as in a 'manner that would be expected in the workplace' (e.g. efficient, focused, purposeful). For this participant, a key indicator of the professional was the ability to divide the required work, and to remain focused on their allocated component. A professional practice akin to the experience of the workplace. Prior professional experience, and vicarious observation of others in the prior workplace, provided the benchmarks for what was considered ideal practice in the PBL experience. A weakness of PBL as WIL, as compared to *in situ* workplace learning experiences, is the absence of an expert practitioner that the student is able to mimic (Billett, 2014). In the delivery of learning in this unit an attempt was made to provide mentoring and guidance from an industry expert; however, the ability to mimic the practice and decision making of a professional in the workplace remained absent. Therefore, the ability to draw upon prior experience was important for improved learning success. Though, through students working in groups it was possible for the more experienced students to share their experience with others.

5.4 PBL as a mechanism for expanding practice

Emerging in the interview data was reinforcement of the PBL experience as a mechanism that supported the transformation and expansion of professional practice. This was more evident amongst participants with an existing level of experience in the workplace, particularly where they had been in a role for a reasonable period of time. As one student remarked: "One example, is like I said, inventory, I had to handle this inventory, but as a field engineer, to me it was only important to have the things that I needed, so for me it was better to have a lot of things, so I was sure that I had all these things in case I needed them, but now I can see that it's not like that, because it's not how the business works" (P11). Evident in this comment is an example of one aspect of professional practice which the PBL experience challenged and changed; namely the management of inventory. As a field engineer this participant had developed highly accomplished skills and knowledge which enabled the practice of his field. However, the PBL experience required this participant to integrate new knowledge and practice which broadened their appreciation and understanding of wider business practice.

The relationship between PBL and practice was not always linear or uni-directional, that is, PBL experience directly led to expanded practice. Instead the relationship between the PBL experience and practice expansion was, in most instances, a mutually complementary relationship, in which prior experience informed actions in the PBL, and PBL informed broader practice. Within this relationship was a third element of the input from teaching staff and industry experts. The 'formal' learning of the lectures, staff interactions and problem-solving sessions, worked alongside the 'informal' learning of the PBL experience, and reflexivity of prior experience, to generate new understandings. As one participant commented: "I can say whatever knowledge I am able to get in ERP, it was something from the project, something from the lectures, and that last point, something from my experience" (P15). In this example, this participant used 'experience' to both describe their previous professional experience as well as the PBL experience. It was through the integration of these two experiences that students were able to expand understanding of practice.

5.5 PBL as a basis for future work and employment

Beyond the expansion of practice, PBL provided to students the opportunity to re-conceptualise future employment opportunities, thereby enabling professional transformation. It has been argued in this paper that unlike the experiences of undergraduate students, WIL for postgraduate students is less about employability and more about professional transformation. The PBL experience offered to students' direct connection to professional practices in the workplace. With one participant commenting: "project-based is good for [your] future if you start working, especially for engineering, you have lots of projects in the real world, in the real, working environment you've got projects, and in the project, you will not be working alone. Yeah, so projects are good to prepare you for the future work life" (P7). This participant had only 3 years work experience. They were able to connect the experiences of the classroom to the workplace, such as group work to working as part of a team, and PBL to working on real projects. For this participant, the PBL experience offered an opportunity to continue to enhance their professional skills.

Similarly, another participant commented that: "The thing, which I am able to realize [is] that gaining an experience will improve your efficiency towards a project. The more you work on real things, the more knowledge you gain and improve yourself" (P15). For this participant PBL offered the opportunity to practice and improve key skills. However, evident in this quote is the extension of the experience from just being skills oriented towards a greater personal / professional transformation. For this participant, the learning journey and experience was as important as the outcome of the project. They saw value in the opportunity of the PBL experience to provide for personal and professional reflection and consideration of how to change or improve their own practice.

5.6 Shaping professional identity

The construct of professional identity has been informed by Ibarra (1999), who proposes that it can be understood as the relatively stable matrix of attributes, beliefs, values, motives and experiences which people use to define themselves professionally. Professional identity are the lenses through which individuals make meaning of work and represent themselves to others. As had been suggested earlier, the engagement of students in the PBL / WIL experience provided the opportunity for the (re-)shaping of professional identities as students became more aware of their self-concept and how this relates to their future professional self. The relationship between the PBL experience and future practice or employment was not always clear for every participant. Each participant expressed different motivations for undertaking the course, and therefore took from the PBL experience different learnings and outcomes. Student expectations and future directions shaped how they experienced the PBL. For example, one participant commented that: "while I was doing [the project], I did think of this future employability, yeah but before I did this course, I had no idea what it was" (P6). Highlighting how this participant's experience was one of discovery and unpacking of new opportunities, rather than being part of a thought-through professional learning plan.

For another participant, the PBL experience affirmed for them their ability to venture into their own business, drawing upon their personal experience as well as connections with other students in their group. As they commented, "I didn't know, that this software can help me a lot in my startup. So, now this thing is what I am thinking about. I can efficiently manage my resources, using this software" (P7). For this participant, their expanded practice was to move away from the organizational concept that they had been experienced in and towards entrepreneurial engagement with future work.

Underlying student motivation for participation in the Masters course, and subsequently this unit, was a drive towards taking on future leadership and managerial roles. Cain and Cocco (2013) describe the value of PBL in developing student leadership through experiences in working as part of multidisciplinary teams requiring effective communication and managerial skills. Within the responses to this experience similar phenomena were evident, where students were evolving their self-concepts as leaders with capacity to work with diverse groups. The PBL experience provided for students the opportunity to work in teams, inhabiting different roles within these groups, and being able to exercise, to varying extents, leadership and management capabilities. As one student described the PBL experience: "Project-based learning is basically managing different departments, different challenges, which come in front of you" (P1), and as another student commented, PBL as part of a team, is difficult as you are challenged in "getting everyone together, structuring the work, dividing the work, getting it done in a group, making sure it's equally distributed as well, making sure there are no disputes in a team" (P2).

Navigating the different personalities of a team was a key challenge in working towards success in the project. However, the model adopted in this unit, alongside the combination of a diverse international cohort, extended this challenge requiring students to draw upon and further develop their capacities to work in intercultural spaces. As one student commented: "I learned working with people from various cultural backgrounds. I did that before, but not to the same extent, because if you're in India, you're exposed to only the Indian cultures there" (P2). Navigating diversity was not always viewed as a negative, with some students considering the experience as enhancing their ability to work collaboratively; as one student remarked: "you get to coordinate between different people, and you're not just doing it by yourself, I really like that whole concept where other people can help you and everybody, it's like a combined effort" (P3).

6. Conclusions

Evident in this study is the transformative power of education, particularly for postgraduate students, and the ability of PBL approaches to draw upon WIL principles in providing for students opportunities to engage in this transformation. The strengths of the pedagogical approach adopted in the ERP unit were founded in the integration of theory and practice, and orientation of activity towards a future-professional-self for students. Engagement with PBL approaches to learning have previously been demonstrated to enhance student learning and engagement, providing an authentic and challenging learning experience for students (Kokotsaki, Menzies, & Wiggins, 2016). This study supports these previous claims around PBL, but presents evidence that these outcomes can be enhanced through the adoption of the principles of WIL, in particular the explicit integration of theory and workplace practice. WIL encourages a direct connection with industry partners, with students engaging in real and meaningful work practice. When connected with a model of PBL, it has been demonstrated in this study that there is greater potential for these pedagogies to drive emergent professional identities and the expansion of understandings of professional practice, thus indicating that the combination of WIL and PBL may have transformative potential for student learning.

The practice of PBL and WIL have largely been focused on the learning of undergraduate students. PBL and WIL present as opportunities for students, even within postgraduate higher education, to evolve new concepts of self, and subsequently new forms of professional identity, shaping future employment. This study highlights the applicability of these pedagogies to postgraduate learning providing for transformative learning experiences for students. Within the Australian higher education sector, with QUT being no exception, there is a general push towards the greater inclusion of WIL experiences for students. At QUT this aim has been expressed as delivering a WIL experience for all graduating students

by 2020. To achieve such an aim it is necessary to engage models of WIL applicable to postgraduate students. The approach outlined in this paper provides a possible model for the design of postgraduate WIL experiences, and this study highlights the importance of any adopted approach focusing on creating space for students to challenge and transform their practice and professional identities, rather than simply becoming 'work ready'. Such ideas have the capacity to transfer to other areas of postgraduate studies, with, for example, Stewart (2017) highlighting the opportunities for the application of WIL in postgraduate learning for mental health practitioners. Given the dominant focus of research in work integrated learning within the undergraduate space there is need for more exploration of the nature and success of different models in postgraduate studies.

There are some limitations of this study. It was understood that a feedback from the respective industry on the PBL project would improve the quality of the work and practicality of the ERP programs. However, due to the disperse locations of the industries (including overseas locations) and time and resource constraints, this could not be implemented. The authors hope to gradually establish this feedback loop. Another limitation of the study is that the results are based on only one unit of a postgraduate course. Implementing the method in other units will improve the generality of this new method.

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