IMPROVING THE AUTHENTICITY OF THE PBL MODEL THROUGH LEARNING AND THE WORKPLACE AND COMMUNITY APPROACHES

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ABSTRACT

This paper reports on a recent research project undertaken by the Office for PBL at Victoria University (VU) which explored strategies for enhancing the 'authenticity' of the curriculum in the problem-based learning Bachelor of Engineering programs through learning approaches such as industry placements, service learning and industry-sponsored projects. The aim was to recommend approaches which both met a recent mandate by VU that 25% of all course assessment relate broadly to students' learning in the workplace and community (LiWC) and were consistent with VU's PBL model. A literature review, interviews with academic staff and interviews with representatives from industry and community organisations that had hosted students were conducted. The findings indicated that various learning in the workplace and community approaches were complementary with problem-based learning and in particular that projects with an industry or community partner could enhance the 'authenticity' of VU's approach while retaining some of the advantages of a classroom-based learning model. For this reason it was recommended that mainstreaming projects with an industry or community partner throughout the course was the most appropriate option for meeting the University's requirement. However, improvements were identified as needed to ensure that all parties accrued benefits from involvement and that assessment of the projects better utilised feedback from the industry and community partners. The results have informed a re-design of the PBL engineering curriculum.

KEYWORDS

Problem-based learning, engineering education, work-integrated learning, cooperative education, projects, industry-based learning.

INTRODUCTION

Victoria University (VU) has recently committed to ensuring that a substantial component of all courses is based on learning that occurs in the workplace and community. Learning in the workplace and community (LiWC) is used as an overarching term for educational approaches which involve students learning *in* and *through* work in both industry and community settings and which are variously known around the world as work-integrated learning (WIL), industry-based learning, work-based learning, professional learning, workplace learning, cooperative education, and practice-based learning.

VU's approach to LiWC focuses on active, self-directed learning which constitutes an assessable and therefore integral component of the course. It is driven by a desire to improve

students' work, career and future readiness. This initiative has necessitated the need for rethinking the curriculum in all courses including those in engineering, which converted to a problem-based learning approach in 2006. The introduction of PBL importantly led to a re-design of the engineering curriculum around students working in teams on problems of varying duration throughout the four years of the course. There was a greater focus on students' developing self-directed learning behaviour, and the courses also incorporated explicit instruction and support for students to develop problem-solving, project-management, communication and teamwork skills. In addition, less traditional forms of assessment were adopted which not only sought to measure student attainment but also to enhance student learning such as portfolios. Although, a final year capstone project was a prominent feature of the programs prior to the introduction of PBL, and was often sourced from industry, there was also an increase in the number of problem/project opportunities sourced externally in the earlier years of the course, although this varied between the engineering courses. On the whole most of the problems were devised by the academics and were industry and community relevant or related rather than directly sourced from industry.

PURPOSE

The purpose of this study was to provide evidence-based recommendations on how to embed and support LiWC approaches in engineering within a PBL framework to achieve the target of 25% of the course assessment. Our research questions were:

- What LiWC approaches are consistent with PBL?
- What is good practice in LiWC in engineering?
- Where are LiWC approaches currently used in the PBL Bachelor of Engineering curricula and how does this compare to evidence-based good practice?
- What are the support needs of members of the industry and community organisations directly involved in working with students? What models do they prefer?

METHODS

The project had three different components. An extensive review of the literature was conducted to explore current practice in LiWC in engineering and within PBL and identify some models which may be adopted in the VU context. Eighteen engineering academic staff in the mechanical, civil, architectural and electrical engineering programs were interviewed to explore current practice and perspectives on LiWC and ten semi-structured interviews with industry and community partners involved in LiWC were conducted. This paper primarily focuses on the last component of the research but also draws from the literature review.

A total of ten semi-structured interviews with participants from both industry and community organisations were conducted. They included four participants in learning and development roles and the remaining six participants held management roles and had experience in directly supervising students. Participants were asked about the types of activities they offer to engineering students and how they organised and facilitated these activities within their organisation, the challenges and benefits for their organisation, their perception of how these activities are supported and facilitated by the tertiary institutions, including how they are assessed and evaluated, and the effectiveness of the tertiary institutions' communication with the organisation prior to, during and after the activity. Interviews were audio recorded and transcribed. Interview transcriptions were then analysed using the qualitative analysis software application, NVivo.

The table below indicates the type of organisations included in the sample. Five of the six industry organisations were large organisations, of these three were large multinational companies and the other two large Australian-based multi-site organisations.

Table 1
Sample

Sector	ANZSIC divisioni	Size of organisation	No. of organisations
Non-profit, non-government	Education and training	Small	1
	Education and training	Large	1
Government agency	Public administration and safety	Large	2
Profit	Manufacturing	Medium	1
	Manufacturing	Large	2
	Mining	Large	1
	Professional, scientific and technical	Large	2

FINDINGS

Literature review

It has long been thought valuable for engineering students to experience engineering practice while undertaking professional education programs. Periods of industrial experience of varying degrees are a common feature of professional engineering education around the world and longer-term or alternating placements such as co-op or sandwich models are particularly common in engineering education in the US, Canada and the UK. In addition, projects with an industry partner are also a well utilised approach, particularly in the final year of professional engineering programs.

A number of recent Australian reports have highlighted the importance of expanding these experiences for all students to improve students' work-readiness and to develop generic and lifelong learning skills[ii] and most Australian universities have recently made more overt commitments to this teaching and learning strategy[iii]. In a project from 2008 entitled 'Addressing the supply and quality of engineering graduates for the new century' which was coordinated by the Australian Council of Engineering Deans one of the recommendations was 'Engineering educators and industry practitioners must engage more intensively to strengthen the authenticity of engineering students' education through increasing formal industry experience and greater exposure to industry practitioners within the course[iv].
In Australia most students (including VU students) are required to undertake a minimum of 12 weeks placement in industry, as recommended by the accrediting agency, Engineers Australia. Universities approach this in different ways but it is often a 'hurdle' task in meeting graduation requirements rather than a credit-bearing unit of study and the focus is generally more on gaining unspecified work experience than on achieving defined learning outcomes. However, this is considered only the baseline level of exposure to practice[iv] and some universities have opted for students to have more substantial periods of time in industry

which are credit bearing components of the course. Central Queensland University (CQU) has combined periods of industry-based study within a problem-based learning curriculum.

The project with a real client is also a fairly common approach in engineering programs in Australia and in the rest of the world, often functioning as a final year capstone task. Harvey and Geall et al describe this model as 'project-linked work experience' and note that they can be divided into two categories – those that are embedded within the course and those that are external to the course and have little or no academic staff involvement.[v] Final year projects in engineering tend to be the former type but there are also a number of project opportunities, particularly service learning type projects, which are external to the course. It is also common in courses using a problem-based learning approach to use projects for real clients. Aalborg University describes its approach as project-oriented problem-based learning (POPBL)[v] and uses some industry projects with its students. Nielsen in discussing Aalborg's use of industrial projects states that it is often difficult to find industrial projects which are suitable in the earlier semesters so as a result most student projects tend to be 'university formulated laboratory projects using dedicated equipment to illustrate the theories in focus'.[vi] But in later years there are better opportunities for 'establishing relevant industrial projects' because there is less specificity in the study plans and students' knowledge has increased.[vii]

In the project model the level of interaction between students and the client will vary as will the level of involvement of the client in each phase of the project, such as in designing or developing the project concept, monitoring the work of the student/s, responding to project outcomes, student assessment and project evaluation. In one example in a design project the client was involved in presenting the project at the outset and in the assessment process at the end.[viii] It is generally recognised that in both PBL and LiWC approaches the range of people involved in assessment needs to be extended beyond that of the supervisor, and it is fairly standard, particularly in LiWC approaches, to collect some sort of feedback from employers about students' performance, although the exact role employers play in assessment is often not clear.

Although there are many differences in how PBL is practiced internationally and within different disciplines, a consistent focus in PBL is on 'real life', 'real world', 'authentic' or relevant problems and activities. For example, in a recent definition by one of PBL's founding fathers one of the key characteristics of PBL is that 'the problems chosen are those apt to be confronted by the learner in life and career'[viv]. He further asserts that the value of the approach lies in that fact that the student 'realizes that the learning required to solve and understand the presented problems is useful and appropriate'[x] and in that the problems are presented to students as 'unresolved ill-structured problems'[xi] as they are in real life. However, it is much less clear in PBL how to go about selecting authentic problems.

In many cases, however, the problem may be authentic in origin but it may be modified considerably by teaching staff and involve no meaningful interaction with a client. Radinsky et al notes that many curricula labelled as problem-based learning are characterised by a 'simulation model of authenticity' rather than a 'practice model of authenticity'.[xii] In this model, the activity of the professional community is simulated within the context of the classroom. Radinsky et al notes that 'By simulating professional practices, these designs attempt to expose students to the aspects of the target audience community of practice which are most fruitful for learning, while sheltering them from irrelevant or possibly harmful elements.'[xiii] This is distinct from a participatory model of authenticity, where the value of the leaning experience relies on learners participating in the 'productive practices of a

community'.[xiv] This model is more typical of those placement models of LiWC such as internships and co-op whereby students, albeit temporarily, join a professional community.

Radinsky et al argue that both simulation and practice curricular models afford different teaching and learning opportunities. However, they suggest a third and alternative curricular design for authenticity which they term the 'mutual benefit partnership' which is based on the participation model and

> *seeks to engage students and teachers as partners in the productive work of a partner professional community. The terms of the partnership are negotiated between the two communities around a central task, problem or project, the resolution of which provides value to both partners'.*[xv]

Patrick et al draw attention to the benefits of project based work experience noting that it retains the 'educational/academic emphasis, while exposing the students to workplace environments and interactions'.[xvi]

The literature on LiWC in general affirms the importance of preparing students for learning in a workplace or community context. PBL itself can offer a good general preparation for LiWC because of its emphasis on explicitly developing teamwork, communication and problem-solving skills as well as its reliance on students at least to a certain degree assuming responsibility for their own learning. In addition, the use of assessment approaches such as portfolios and the emphasis on self-assessment in PBL are also highly compatible with the way in which LiWC are typically assessed. Indeed CQU introduced PBL in 1998 to 'enhance and complement the [existing co-op] program'. The developers noted that this was based on the realisation that cooperative education 'achieved only part of the aim of better preparing students for the engineering workplace of the 21st century'[xvii] and 'From an educational point of view, the PBL approach to learning is ideally suited to preparing students to hit the ground running in their work placements…'[xviii] As Radinksy et al state 'Communicating across different communities can create its own set of challenges' because students don't necessarily understand the 'expectations and limitations' inherent in the community in which they are involved.[xviv] Therefore, there are also specific things that students need to be prepared for when they interact with external partners.

Industry and community partners in engineering education

Industry placements

Six of the organisations that were involved in the study indicated that their main involvement with engineering students was through a vacation placement program. In five of these organisations the program functioned as a means of screening students for potential graduate employment. For this reason their recruitment processes were rigorous and in one case psychometric testing was used to make sure the student was an 'appropriate fit for the business'. These organisations commented that they directly benefited from being able to recruit students who they have been able to closely assess in the workplace. They also benefited from recruiting students who had had the opportunity to clarify their career direction and test their suitability for their chosen career prior to taking up a graduate position. In two of these organisations, they were almost exclusively only interested in students who had participated in their vacation placement program or who had had experience elsewhere in a similar engineering context such as the resources sector.

On the whole these programs appeared to be well-structured and supported. In most cases, participants reported that students were engaged in real engineering work which was often project-based. However, in the two large engineering consulting organisations they had developed special projects to engage students. Some of the organisations also had the option of part-time work in the final year. These programs were mostly independent of universities and most participants indicated that there were few challenges in hosting students for vacation placement. In terms of what universities can do to improve practice, they highlighted the importance of helping engineering students develop resume writing and interview skills and writing skills more generally.

Projects for a real client

Four of the organisations that were interviewed for this project had previously been involved as partners in team-based student projects. Their motivations for involvement were less about recruitment and more about obtaining assistance with useful but non essential projects as well as contributing to the community. All the participants were keen for useable results, however, they all acknowledged the students' status as learners rather than professionals. While the process for developing these projects varied, in two instances the students themselves took a lead in problem identification and in scoping the specific needs of the project while in others this was more or less directed by the teacher or the industry partner.

Some participants highlighted that they directly benefited from the results or in one case the results 'brought to light a whole lot of issues that we hadn't thought of and gave us better insights into what we should have been trying to achieve, in other words it helped us redefine and reframe the problem'. However, not all partners were satisfied with the process and or outcomes of the project. Most participants perceived involvement to be time intensive, although for most this was not considered too onerous. Participants raised issues relating to students' performance as well as the way in which the project was designed and supported. Some of the participants observed that students were contacting them too much and were not exhibiting the self-directed learning behaviour they expected them to as university students. While others reported that at times some groups had too little contact with them and that this reduced the likelihood of the project outcomes being useful. There were clearly differences between organisations in terms of what was seen to be an acceptable amount of contact between them and the students. While some gave students permission to contact them whenever they needed to, others put caveats on when students could contact them.

Other issues were less about students and more about the way the projects were designed and supported by the university staff. Some of the participants reported feeling that there was a lack of closure and follow up on the project. They expressed surprise that as clients they weren't asked to provide any formal feedback beyond being invited to attend the student presentations at university and thus had no real input in to the assessment. They expressed a view that they should have a role as the industry partner because 'the engineers can provide them with the real industry feedback'. Things like whether the project met their needs, whether students had followed the brief and how well they had communicated with and interacted with the industry partner during the project were all aspects that they could provide feedback on. Some of the therefore participants appreciated that there was both a process and a product element to the project. One participant suggested the need for more checks and balances to be built into the project to ensure that all parties (including the academic supervisor) were aware of how the project was progressing.

SUMMARY AND CONCLUSION

LiWC approaches are well utilised in engineering education and there are examples of different types of learning in the workplace and community approaches in a problem-based learning curriculum. In particular the project with a live client is a project-oriented pedagogical model that fits well with PBL. It allows teams of students to experience real life problems and projects within a PBL framework and thus has the advantages of both a 'simulation' and 'practice' model of authenticity. The emphasis which the current PBL curriculum places on students developing communication, teamwork, project management and self-directed learning skills and the types of assessment that are already used are an ideal preparation for students working on problems or projects with an external partner, although explicit preparation is needed to orientate students to the expectations and limitations inherent in communicating across different communities. The mutual benefit partnership model as conceived by the Radinsky et al provides a potential model for enhancing the authenticity of the program within a PBL framework.

This project resulted in a number of recommendations which are helping to inform a curriculum development project in engineering. It was recommended that the industry and community partner model was the most appropriate option for meeting the University's requirement in the engineering undergraduate courses. The first year was considered inappropriate for this type of project because students work on smaller short term problems and don't have a base of engineering knowledge necessary. However, from second year onwards students work on semester long projects which could have an external partner. It was recommended that the focus be on projects with a community partner in second year and industry partners in the subsequent years. While some of the engineering courses and academics had already made headway in terms of increasing the use of projects with an industry and community partner this was inconsistent and not mainstream. It was identified that in order to mainstream this model there was a role for one or more people to source appropriate project opportunities and coordinate and manage all the relationships with partner organisations. This project also revealed shortcomings in the present approach and indicated a need for further development of this model. It was recommended that a consistent framework selecting, conducting and evaluating the projects was needed which was understood by all parties, and that preparation be provided for all parties which in particular focussed on protocols and practices to manage communication across the different communities. In addition, it was recommended that the industry and community partners should have a formal role in providing feedback on both the process and the final product as well as the overall experience of being involved in the activity.

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