Work-integrated learning: linking research and teaching for a win-win situation

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Work-integrated learning: linking research and teaching for a win-win situation

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This paper establishes a framework for linking research and teaching (LRT) by developing industry-oriented student projects based on work-integrated learning theory (WIL). The major components of the WIL experiences and their relationships are identified. The scope of student projects may vary from a minor assignment project to a medium submission, such as a final year or honours project, to a more complex research undertaking, such as a Master or PhD project. A range of practical examples for linking research and teaching and work-integrated learning (LRT-WIL) are described. This study demonstrates that by synthesising work-integrated learning, research and teaching, a win-win situation is created for students, academics and industry partners.

Keywords: work-integrated learning; linking research and teaching; win-win; synergy; industry-based projects

Introduction

Work-integrated learning (WIL) is defined as formal or informal workplace learning that integrates theoretical training with workplace application within a designed curriculum (Patrick et al. 2008). This integration helps universities address the research/teaching balance as a collective issue rather than two conflicting issues, and enhances students’ work-readiness upon graduation (Billett 2009). Yet, there are many challenges in implementing WIL, such as communication and coordination between the different parties and unrealistic expectations and competing demands (Patrick et al. 2008; Lester and Costley 2010). Even so, the opportunity WIL presents as a platform for research-informed teaching is of particular value to academic staff and their institutions.

Linking teaching and research has become an important issue in higher education (Healey 2005; Posch and Steiner 2006), particularly around how to balance them adequately. According to Pocklington and Tupper (2002), the quality of teaching is compromised by an over-emphasis on research. Scott (2002) argued all students, especially postgraduates, must be trained as researchers in a ‘knowledge society’. Healey (2005) reviewed the current literature on the link between research and teaching and found that student learning was enhanced when the two were closely integrated. Other researchers have found similar results (Ramsden and Moses 1992; Hattie and Marsh 1996; Jenkins 2010).
Even so, Karagiannis (2009) has found that in current practice there are conflicts in the research–teaching nexus. For example, busy academics are often pressured to meet increasing research demands (research brings prestige and research funding to the university, contributes to the body of knowledge, and helps with career advancement), while also carrying a significant teaching load (teaching brings in tuition fees and educates the next generation in the field) (Lucas 2006). Often the balance between research and teaching is struck according to factors specific to each university and so may be arbitrarily set and changed.

There are different ways of linking teaching and research. For example, Healey (2005) summarises seven such ways that use inquiry-based learning principles and discusses some case studies on how to implement them. His seventh method, ‘Giving students first-hand experience of commercial consultancy (e.g. as an “intern”, as a work-based learning activity, as a consultant assistant or as a supervised consultant)’, was adopted by this study to integrate research into teaching practice. While this approach engages students through authentic learning experiences, it also provides opportunities for developing research-oriented teaching and may be the key to resolving conflicts around the teaching research nexus (Jenkins, Healey, and Zetter 2007).

The aim of this paper is to present and discuss a WIL approach to learning, research and teaching in order to create a win-win situation for students, academics and industry. The pros and cons of WIL will be explored through examples of four case studies. The case studies were used to develop a framework that could be applied to any active learning process involving students, academics and industry. The case studies are related to Spatial Sciences in Australia and illustrate WIL in action at three different levels: final year of an undergraduate degree, Honours degree, and Master level or PhD project.

The structure of the paper is organised as follows. Firstly, teaching strategies for research and teaching – work-integrated learning (LRT-WIL) is presented. Next, a LRT-WIL framework is discussed, which is a practice summary of LRT-WIL teaching strategies. This is followed by case studies for implementing LRT-WIL teaching strategies. Discussions, conclusions and opportunities for future studies are provided in a summary.

**Teaching strategies for LRT-WIL**

Synergy was adopted as the teaching strategy to help implement LRT-WIL in the context of higher education thinking. Synergy means ‘the whole is greater than the sum of its parts’ (Covey 1989). The four dimensions of LRT-WIL synergy are:

**Industry–academia–student synergy**

In the creative collaboration between instructors, industry partners and students it is possible to build on the strengths of some and compensate for the weakness of others so that more can be achieved collectively than could be achieved separately (Ferguson 2011). Ideally, the teaching and learning process does not aim solely to deliver knowledge and develop the skills of students, but should also contribute to solving practical, real-world problems. Working with industry partners who have commercial or statutory obligations may cause discomfort for instructors and students as the focus is not on purely academic or research-oriented goals. Yet, this dichotomy can produce a creative tension that leads to innovative solutions to real problems (Patrick et al. 2008) and may also create capitals to industry partners and their overall capacity.
The relationships between instructors, students and industry partners are more open, more giving, more trusting and less political. Everyone is deeply involved in the whole process and unexpected insightful results can emerge from this meaningful synergy (Covey 1989). However, this partnership can be problematic due to the ‘high-cost, with long lead in times and significant amounts of abortive effort required’ (JM Consulting 2003); different cultures and standards; and misaligned priorities between academia and industry (Reeve and Gallacher 2005). How to make this process more efficacious is still an unsolved problem.

**Work–study interface**

Forsythe (2013) applied WIL in balancing work and study for undergraduate students in construction management programs. The study emphasised student-driven learning, such as reflective learning, and implemented WIL by building a student/industry network. The initial act was to develop a web database as a channel for student and industry interaction and also as a tool to control the work and study balance of students, especially junior students. Other researchers (Lingard 2005; Patrick et al. 2008) also support this view.

**Teaching–research linkage**

As a matter of course, academics must balance research and teaching, which sometimes results in conflict and competing ideals (Elton 1986; Lester and Costley 2010). Facing this dilemma, Griffiths (2004) developed a research–teaching nexus to turn research and teaching into a symbiosis by introducing research-led (research findings emphasis), research-oriented (research process emphasis), research-based (inquiry-based activities) and research-informed (systematic inquiry into the teaching and learning process itself) co-operation. These four ways can be wholly or partially integrated into the WIL process.

**Business and education integration: intellectual capital**

As discussed in Garnett (2001) the role of a university is not only as a knowledge provider but also to engage individual academics in developing the intellectual capital of organisations, including human capital, structural capital and client capital (Stewart 1997):

- **Human capital** – developing knowledge and capabilities of individuals and groups of workers by partnering with universities. These workers can be university students or organisation employees.
- **Structural capital** – the organisation captures, develops, transforms and shares knowledge for further application, which means converting knowledge into business products.
- **Client capital** – the products, knowledge, and systems of the organisation will tap into human and structural capital of client organisation.

Knowledge, workers’ skills, and business products are combined together to add capital to industry partners and enhance their overall capacity.
LRT-WIL framework: a practice summary

The LRT-WIL framework developed from this study (see Figure 1) provides a general structure for the LRT-WIL methodology. The ultimate goal of this methodology is to create a win-win situation for students, academics and industry partners or communities by combining education, work experience, and knowledge generation.

LRT-WIL provides students with opportunities for *learning to be* a professional by working and communicating with professionals, creating human capital for organisations (Garnett 2001); for *learning to learn* by developing skills such as problem solving and critical thinking based on an integrated research system such as research-oriented or research-based system (Griffiths 2004); and for *learning to do* research by inquiry-based learning to generate new knowledge (Healey 2005).

LRT-WIL allows academics to link research and teaching. In this case, they are not only transmitters of traditional knowledge, but more facilitators or brokers in connecting industry professionals with students, understanding industry needs, formalising problems for students and facilitating students’ research and problem solving. The research may be applied research, pure basic research, experimental research, or strategic basic research (Australian Bureau of Statistics 1998). Applied research undertaken by students may also attract research funding, motivate scientific publications, and add to the body of knowledge in the field. This is an effective channel to link teaching and research together (Healey 2005).

For this approach to be successful, academics must incorporate industry practice into research and implement research in industry practice, by creating structural and client capital for the organisation (Garnett 2001). The scope may vary from small, such as an assignment project; to medium, such as a final year or honours project; to a more complex research undertaking such as a Master or PhD project.

![Figure 1. Work-integrated learning framework.](image_url)
The challenge for academics is to understand and identify industry partners’ problems and formulate the problems as projects for students. Academics need to foster the skills to communicate with industry partners in simple and practical ways with the aim of understanding their problems, to break down a complex problem into manageable components for students, and to effectively manage multiple projects at the same time. In order to be successful under a LRT-WIL framework, academics need a paradigm shift from teachers and problem solvers to academic leaders with highly developed interpersonal and leadership skills. This is essential for nurturing successful partnerships with industry (McEwen and O’Connor 2013).

Partnering with universities enables industry partners to access cutting-edge research at relatively low cost. Through LRT-WIL activities that incorporate an industry experience, partners also benefit by facilitating work-ready graduates and streamlining recruitment pathways. To ensure an optimal LRT-WIL experience, industry partners need to be heavily involved in the students’ learning process as resource and funding providers, as monitors of progress, and as exemplars of professional practice (van Rooijen 2011).

In order to integrate business needs into the LRT-WIL student experience seamlessly, industry partners must be willing to invest time and effort in nurturing students, understanding and accepting academic thinking, and have the capacity to translate academic theories and methods into business needs and practices. This translation is a complex process and requires considerable commitment on all sides (Reeve and Gallacher 2005).

Case studies for implementing teaching strategies

The above section discusses the teaching strategies from two perspectives: synergy (theoretical) and framework (practical). This section will use four case studies to illustrate WIL in action at different levels: assignment project (for both full-time and part-time undergraduate and postgraduate students), final year undergraduate project, Honours project, and Master project or PhD project.

It is a regularity requirement that qualifications in the Australian education sector are pitched at specific levels of attainment. This mandate ensures nationally consistent qualification outcomes which facilitate greater transparency for institutions, increased opportunities for pathways between educational sectors, and clarity of graduate outcomes for external stakeholders (Australian Qualifications Framework Council 2013). This hierarchy of qualifications also enables scaffolded learning experiences for students whereby skills are developed incrementally as students progress through different qualification levels. The intention is that the higher the qualification, the more complex the student learning outcomes. Carefully constructed assessment tasks are integral to the integrity of qualification outcomes as students’ artefacts produced through assessment tasks should reflect the appropriate level of complexity and higher order thinking articulated in the relevant outcome. The assessment tasks are evidence of student proficiency against the intended outcome. The case studies described below have been carefully designed to align to the learning outcomes and the descriptors for the qualification level as prescribed in the Australian Qualifications Framework.

Case study 1: assignment project

Purpose

This case study used a research-oriented teaching methodology. The industry problems were posed as geospatial project assignments in which students in geographic
information system (GIS) project management units applied the project management knowledge and skills they had learned in class to solve real-life problems of the organisation. The assignments were designed with the following learning outcomes in mind:

- explain basic principles and techniques involved in conducting a GIS project in the spatial information industry;
- apply project management skills to geospatial applications;
- apply sound written and oral communication skills for gathering, analysing, and reporting requirements; and
- work both independently and collaboratively in project teams.

**Context section**

Prior to the commencement of the semester, the lecturer contacted different industry partners and arranged a meeting to discuss the potential student projects. Typically, five to eight projects were organised for each semester. In the first week of the semester, students were asked to form small teams of three to five members. They chose a name for their team, designed their logo, and selected one of the pre-arranged projects on a first-come, first-served basis. From here the students acted as consultants and contacted clients to initiate the projects.

Assessment was based on three assignments, one presentation and final examination:

- assignment portfolio 45%;
- presentation 20%; and
- final examination 35%.

The industry partners played the role of clients and also provided mentoring to students to maintain timelines and focus for the project. The lecturer acted as a facilitator and provided necessary support when the students faced difficulties and needed assistance solving problems. Because no real money was involved in the project, students used their time as a budgeting device: each work breakdown item was estimated in advance and the students tracked the time spent on completing the task to determine if they were over or under budget.

Any intellectual property belonged to the student team. The students were encouraged to write conference or journal papers if the project produced high quality data and to consider the potential of commercialising outcomes and ideas.

**Implementation challenges and lesson learned**

Despite many benefits of the WIL experience for both students and the industry partners, many challenges were encountered.

*The client dilemma.* Some students discovered that their clients were very hard to contact, which meant it was hard for the projects to maintain momentum. For example, some clients expressed interest in helping the students at the beginning of the project, but work pressure and other commitments meant they could not always provide timely responses. This challenge was also identified by Svensson (2004).
To counter this, it is essential that expectations of time and effort required are established during initial discussions between the lecturer and industry partners. Time management sheets or templates may also be used to target this problem. Each team’s project manager had to reiterate this expectation with their client at the start of the project and be ready to mitigate the effects of an unresponsive or tardy client.

**Changing requirements.** Some clients, especially those new to WIL, tended to change project requirements and objectives along the way, which created challenges for students. In such cases, open and regular communication between the clients, students and the lecturer was critical. The lecturer avoided becoming involved in detailed project management, but advised students how they might negotiate with the client to agree on what could be delivered within the determined time frame. The lesson learned from this challenge is to prepare students for the possibility of changes and how to negotiate with clients to reach an agreement on a revised plan. Students gained workplace proficiency and confidence in their own skills to manage employer demands.

**Tight deadlines.** Because students had only three months to finish the project and the final deadline was non-negotiable, careful planning was essential to avoid issues that had the potential to delay completion. Lecture and tutorial topics on time management, risk management, and prioritisation helped in this regard and regular progress reports identified any teams that needed help. The tight deadlines are common practice of industry business. After exposure to this challenge, students gained greater awareness timeframes in an industry context.

**Team organisation.** Each team chose a project manager who played a crucial role in keeping the project on schedule. If the team members or the lecturer identified that progress was hindered and not progressing as intended, the lecturer called a private meeting with the project manager to discuss action to rectify the situation. As a last resort, the lecturer selected a new project manager.

**Involvement of off-campus students.** Approximately 40% of students (total around 10–20) enrolled in GIS management units to study off-campus including locations across Australia or overseas. To provide equitable opportunities for all students there was a stipulation that each group must comprise at least two on-campus and one off-campus student. The lecturer set up a group discussion forum, a chat room and a web page for each team so that the dispersed team members could stay in touch. The lecturer showed the students how to set up a communication plan and responsibility matrix (see Tables 1 and 2) so that each team member was aware of their responsibilities. The lesson learned from this challenge is that it is important to build an effective communication channel to overcome location barriers. The online tools proved to be useful, especially for sharing information and tasks.

Several honours projects and six undergraduate and postgraduate final year projects have been organised with our industry partners over the last three years.
Case study 2: honours projects

The honours projects were based on the Curtin-Landgate linkage project. This funding scheme comprised a dollar-for-dollar agreement and was a seed grant for an Australian Research Council (ARC) Linkage project. The project provided scholarships for two honours students who completed their studies in 2010 and 2011 respectively. Each wrote an honours thesis, which was examined by external reviewers, and each gave presentations to both Curtin and Landgate. Landgate is ‘Western Australia’s primary source of land information and geographic data, providing the accuracy Government, business and individuals rely on’ (Landgate 2012). Two journal papers from these studies are under preparation for publication.

The supervisor organised weekly meetings with the students to discuss their work and provide direction and guidance. The supervisor, students and industry partners met quarterly to discuss progress. The students presented first and discussion followed. This process facilitated valuable feedback for students and ensured the project stayed on track and remained relevant to the needs of the industry partners. The open, respectful and insightful discussion strengthened the partnership between Curtin and Landgate. Landgate staff were very keen to support the projects and freely shared their experience, thereby motivating the students and supervisor to develop more creative methods. In turn, the students sought to explain their theories and methods in ways appropriate to a diverse audience.

A key lesson learned from these projects was the need for clear goals and firm project structures from the start. Time was spent before the projects were initiated in getting these details right so that all parties had a clear understanding of expectations. The LRT-WIL practice added great value to the Honours projects: students gained opportunities to understand and solve real-life problems; obtained critical feedback from industry partners; and had the opportunity to work with possible future employers in a practical and professional manner. Also, through regular feedback and encouragement, students’ creative and intellectual curiosity was tweaked. For example, one

<table>
<thead>
<tr>
<th>What information</th>
<th>Target audience</th>
<th>When?</th>
<th>Method of communication</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project objectives</td>
<td>Group 7*</td>
<td>Week 2</td>
<td>In person, email</td>
<td>Group 7</td>
</tr>
<tr>
<td>Project requirements</td>
<td>Group 7, Client</td>
<td>Week 5</td>
<td>Email, phone, Skype</td>
<td>Project manager</td>
</tr>
<tr>
<td>Milestone reports</td>
<td>Group 7, Client</td>
<td>Fortnightly</td>
<td>Email, phone</td>
<td>Group 7</td>
</tr>
</tbody>
</table>

*Group 7 is the one of student groups for a project in GIS Project Management units.


Table 1. Communication plan template.

<table>
<thead>
<tr>
<th>Task</th>
<th>Cecilia</th>
<th>Craig</th>
<th>Rona</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial main roads meeting setup</td>
<td>R*</td>
<td>S*</td>
<td>S</td>
</tr>
<tr>
<td>Develop first-pass user requirements documents template</td>
<td>S</td>
<td>S</td>
<td>R</td>
</tr>
<tr>
<td>Intro/background/problem definition – confirm areas of missing info from main roads</td>
<td>R</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

*R = responsible and S = support.

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honours student saw an opportunity to develop a mobile application, beyond the scope of the original project, which the industry partner found useful.

**Case study 3: final year project**

A partnership was established with Mainroads Western Australia in 2009. Mainroads is responsible for Western Australia’s highways and roads (Mainroads 2013). It generously provided geo-referenced vehicle crash data and relevant information. Based on this information, a research framework was developed for students undertaking final year projects. Six students followed the framework and conducted research on the spatial and temporal distribution of vehicle crashes. Publication of a journal paper and a conference paper resulted with further publications still underway.

The successful collaboration with Mainroads could be attributed to three factors:

- The willingness of Mainroads to support university research.
- The clear research framework for students to follow.
- The coaching and preparation the students received in research theory and techniques from the lecturer who is teaching Geographic Data Analysis units, Spatial Analysis units and Spatial Modelling units.

The course materials are updated each year so they remain timely and relevant to this research area, meaning students are more able to quickly apply what they have learned in class to real-world problems. Mainroads were satisfied with the research outcomes with the results providing evidence to support policy and safety amendments. In turn, the students were excited about undertaking applied research and dealing with experienced professionals facing practical issues. One of undergraduate student’s work has been published in the A* prestige journal *Accident Analysis and Prevention*. In addition, based on one undergraduate final year project, we successfully applied for ARC Linkage funding with the University of Western Australia, Department of Planning, Department of Transport and Public Transport Authority in 2011.

Most students do not intend to pursue academic careers, but still benefited greatly from this research exercise. For example, by participating in these industry projects, students developed professional networks with industry people with some students receiving job offers after the project.

**Case study 4: Master and PhD projects scholarship scheme**

In order to establish a WIL experience for Master and PhD students, Curtin and Landgate developed a Master and PhD scholarship scheme for local or international students, while the Department of Research and Development paid the tuition fees. The research topics, based on Landgate’s business needs, were developed jointly by Curtin researchers and Landgate staff. Intellectual property rights and commercialisation were negotiated between Curtin and Landgate.

Research students met their supervisors once a week to discuss their progress and supervisors worked as mentors to assist the students with research methodology and guide them to develop innovative approaches to solve the research problem. A quarterly meeting was held with Landgate during which the students presented progress of their work and sought feedback from the client. Students were instructed by their supervisors to write each thesis chapter as an academic paper that could potentially
be submitted to a conference or journal. They had opportunities to attend national and international conferences to present their work and develop academic networks for future careers.

The major challenge of this scholarship scheme was negotiating intellectual property rights and commercialisation. These negotiations focused mainly on the percentage split and confidentiality. For example, from the students’ perspectives, it was important to be able to publish their results, but Landgate, as a semi-autonomous government department, had concerns about privacy and commercial confidentiality. A compromise was reached in which students were able to publish their work which didn’t include intellectual property or commercially sensitive information. Likewise, the intellectual property split (usually 100% in favour of industry partners) was negotiated based on the stakeholder’s contribution to the project and with an eye to future collaborations.

**Discussions and conclusions**

This paper presented a framework to discuss the methods and strategies for linking research and teaching based on a WIL model using four case studies that implemented LRT-WIL strategies and practices and related student outcomes at different levels of engagement: assignment, undergraduate project, and Master/PhD projects. Table 3 shows a comparison of the different levels of engagement (sources: Krathwohl 2002; Healey 2005; Patrick et al. 2008).

Our LRT-WIL practice so far has provided some valuable insights in how we can link research and teaching and how to make it valuable for all parties:

**Synergy effort from industry partners, academia and students**

The aim of our WIL practice is to create a synergy among industry partners, academia and students. Therefore unexpected insightful results such as innovative solutions to real problems and capitals to industry partners, enhanced competency of students, and fruitful research outcomes from academia can be generated in a meaningful way. This synergy was realised by developing partnerships between the university and industries. Although in JM Consulting (2003) and Reeve and Gallacher (2005) this partnership was found to be problematic, our experience suggests the issue is easily manageable with proactive attention to bottlenecks, open communication, and a commitment to positive outcomes for all parties.

**Teaching and research linkage**

One emphasis of our WIL practice was to develop a methodology for teaching and research linkage by developing research-oriented and research-based assignment projects embedded in the project management teaching procedure. Students and faculty acted as consultants and researchers to interact with industry partners. Students learned project management concepts and skills in class and applied them in a work environment to manage their own project. The research-based projects allowed students and faculty to combine teaching with research, which led to fruitful academic outcomes, such as papers and funding for further projects. This practice was also shown to be effective by Healey (2005) and Jenkins, Healey, and Zetter (2007).
Reflective and action learning methods

Reflective and action learning methods proved to be effective in WIL practice. In particular, regular presentations by students to clients and faculty encouraged the students to reflect on what they had learned and achieved (Boyd and Fales 1983). Furthermore, faculty and the clients had to keep pace, which helped maintain momentum and interest in the projects.

Aim for a long term partnership

Industry partners were encouraged to view the partnership with the university in the long-term so that any minor project failures or misunderstandings could be seen in the context of a broader relationship. Therefore, taking the time to build trust and demonstrating a high-degree of professionalism was key (Patrick et al. 2008).

Be flexible with your partners

According to Patrick et al. (2008), the rigidity of typical university timetables makes it difficult for students to accommodate long-term projects or those in which the scope

<table>
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<th>Table 3. A comparison of different levels of engagement.</th>
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<tr>
<td>Assignment project</td>
</tr>
<tr>
<td>Volume of learning</td>
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<tr>
<td>Depth of learning</td>
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<tr>
<td>Linking research and teaching methods</td>
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<td>WIL models</td>
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<td></td>
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<tr>
<td>Workload of supervisors</td>
</tr>
<tr>
<td>Industry partner involvements</td>
</tr>
<tr>
<td>Role of supervisors</td>
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<tr>
<td>Role of industry partners</td>
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might change unpredictably. It was therefore important for lecturers and students to manage the expectations of their industry partners and be flexible with deadlines or scope wherever possible.

**Involve all the parties in learning and the knowledge generation process**

Knowledge generation is a complex research process. All the parties involved need to learn alongside the students in order to get maximum benefit from the project. To help in this regard, the regular progress meetings incorporated some background on research methodologies, experimental design, and the nature of academic writing. In this way, the business partners were able to appreciate why certain steps had to be taken in approaching a problem and why results were couched in certain ways.

**Develop an effective mechanism to monitor and control the quality of projects**

Even though we encouraged our industry partners to view our working relationship over the long term, a poorly executed project would reflect badly on the university and might jeopardise future projects. Therefore, different approaches were developed to monitor and control the quality of the projects such as regular student presentations to industry partners, small assessments along the way (assignments, presentations, exams or tests), and publishing the research in peer-reviewed conference papers and journals.

**Conclusion**

In conclusion, the study provides evidence that LRT-WIL is an effective teaching strategy to create a win-win situation for students, academics and industry partners. The results of this study will be of importance to WIL practicians to understand the WIL process and advantages and disadvantages of different types of LRT-WIL exercises. The major contribution of this study is the development of a systematic approach for the LRT-WIL practice. The method is reproducible and generalisable internationally to other studies.

The next step for this research project will be to develop tools and templates to formalise the WIL learning process so that WIL practicians can incorporate it into courses; and to devise measures to empirically evaluate the effectiveness of the WIL framework.

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