



WIL in Science: Leadership for WIL

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Australian Council of Deans of Science

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Executive summary

WIL in Science: Leadership for WIL has successfully initiated a national movement to shift practice towards improved employability for science graduates. Conducted by the Australian Council of Deans of Science (ACDS) and funded by the Office of the Chief Scientist, the project has promoted sustainable work-integrated learning (WIL) in science programs as a means to build graduate employability. This follows upon the 2015 ACER report *Work Integrated Learning in STEM in Australian Universities*, commissioned by the Office of the Chief Scientist, that showed higher education courses in the natural and physical sciences to have the least industry engagement among STEM disciplines.

WIL in Science: Leadership for WIL has established a national network of science WIL leaders, created a national conversation about work-integrated learning in science degrees, begun the task of building capacity to design and deliver WIL programs, and trialled approaches to WIL program development. It has raised awareness amongst faculty executives and initiated peer-to-peer mentoring between science faculties in Australian universities to create the foundations for a widespread lift in WIL leadership and WIL activity in science and mathematical sciences. It is the first step in an ongoing program to grow and support work-integrated learning in science and mathematical sciences.

WIL in Science: Leadership for WIL was conducted over an eighteen-month period commencing in July 2015 and concluding in December 2016. It has worked with 35 universities and through its alliance with the ACDS Teaching and Learning Centre provides an ongoing activity hub for work-integrated learning in science.

Specific project outcomes are:

- establishment of the WIL in Science network comprising Faculty nominees from 35 Australian Universities, informal WIL leaders and WIL specialists,
- 2 national fora on WIL in Science and three regional workshops (Victoria, NSW, Brisbane),
- self-reported information on the current state of WIL leadership and WIL practice in Science Faculties to complement the foundational report commissioned by the Office of the Chief Scientist (Edwards, Perkins et al. 2015),
- 6 action-learning projects in science faculties that explore key issues in WIL implementation and provide case studies for peer learning,
- follow-on funding secured for the development of tailored resources and support via the Office for Learning and Teaching,
- a roadmap for continued development and integration of work-integrated learning in science degrees to improve graduate employability.

WIL in Science has developed from an initial project into an **ongoing program** that has been endorsed by the ACDS and explicitly identified in the ACDS strategic plan. Continued commitment recognizes that development of work-integrated learning is a form of curriculum renewal and must be a part of a long-term integrated view of learning and teaching. WIL requires the deft interplay of many factors to achieve success: a clear and defensible strategy, aligned institutional priorities, processes and policy, investment in building capacity and in delivery, cultural change leadership and management for all stakeholders (staff, students and partner employers) and clear-eyed evaluation and review.

The WIL in Science program focusses on peer learning as a sustainable approach to building capacity. It recognizes that Science Faculties are at varying stages of development for WIL and uses that diversity to provide appropriate and relevant advice and mentoring. It draws on the considerable research literature and experience of other disciplines to guide adaptation to science and mathematical sciences and to find tailored solutions for Science Faculties.

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1 The context for WIL in Science

Graduate employability for Australian science graduates

Graduate employability is a matter of keen interest to all stakeholders in higher education: students, universities and their teaching staff, employers and industry, funding bodies, and governments. Graduate employability (is the graduate prepared for work?) is not the same as graduate employment (did the graduate get a job?), although obviously related. Graduate employment is influenced by many external factors, for example economic conditions. Graduate employability is much more tightly linked to graduate learning outcomes. Universities emphasize the centrality of graduate employment and employability in their mission statements and in the design and delivery of courses through learning outcomes statements.

Longitudinal survey data from recent graduates¹ shows graduate employment outcomes have decreased over the last decade, despite increasing participation in higher education (GCA 2016a and 2016b). Data for generalist degrees such as B Science, B Arts, B Commerce or B Health Sciences, generally shows lower employment outcomes in the first year after graduation than more vocational degrees, however it also shows a higher proportion of graduates continuing into postgraduate education from generalist degrees. The employment gap between vocational and generalist degrees reduces considerably three years out from graduation but B Science graduates still lag behind peers in engineering, IT, health and education. These findings have prompted concern over the value of generalist science degrees (Norton 2013) and calls for better alignment between university science degrees and future employment (Chubb 2014, Prinsley and Baranyai 2015, PWC 2015).

Universities can contribute to improved outcomes for graduates through teaching and learning approaches that explicitly build graduate employability. All Australian universities are now required to construct and use clear learning outcomes to guide design and delivery of courses² and most universities publically publish learning outcome statements for their courses ((Bowman 2010). These statements generally align well to the skills and knowledge nominated by employers as those sought by industry. However, graduate employability also requires an orientation to future employment or careers (Oliver 2015) so that students can explicitly link and adapt their learning to their subsequent career.

Graduate outcomes that support graduate employability have been studied from multiple perspectives including institutions, graduates and employers (Yorke 2006, Hernández-March et al. 2009, Martín del Peso et al. 2009, Velasco 2012). Typically, employers seek well-developed communication skills, analytic and problem-solving skills, and professional and inter-personal capabilities in addition to foundational disciplinary knowledge and skills (Hernández-March et al. 2009, Martín del Peso et al. 2009). These capabilities/attributes align well to those nominated by Australian universities as the intended learning outcomes for their degrees. However, there are perceived gaps between the intent of university graduate learning outcomes and the experience of graduates reported by employers (Jackson 2010). New capabilities have also emerged in response to a changing industry landscape (Bridgstock 2009).

Work-integrated learning (WIL) is curriculum that is designed to embed the world of work inside student learning. Work-integrated learning was recognized as a key mechanism to build graduate employability in the *National Strategy on Work-Integrated Learning in University Education* published collaboratively by higher education peak bodies (Universities Australia, Australian Collaborative Education Network Ltd (ACEN)) and industry peak bodies (Australian Chamber of Commerce and Industry, AiGroup, Business Council of Australia). The national statement made a direct link between work-integrated learning and graduate employability.

WIL facilitates the transition between preparing for and operating in a high skills work environment. It empowers students to understand, adapt to and apply skills in the workplace. It helps ensure they are equipped to plan, instigate and navigate careers in an environment where conceptual, adaptive, personal, technical and vocational skills – their human capital – will be continually drawn on and challenged (p2, Commerce, Industry et al. 2015).

¹ Data on graduate outcomes was collected and published by Graduate Careers Australia from 1972-2015. From 2016 data will be published by the Australian Government QILT website

² Higher Education Standards Framework (Threshold Standards) 2015, Commonwealth of Australia, available from <https://www.legislation.gov.au/Details/F2015L01639>

The National Statement calls for action from all stakeholders: ‘(a)n integrated framework is needed to accelerate growth in WIL, as is a shift in culture. What is needed now is national leadership.’ Advancement of work-integrated learning requires collaborative and co-ordinated action from universities, students, and employers, supported by regulators and with appropriate funding (summarized in Jackson (2015)).

The National Statement recognizes that work-integrated learning can take a wide range of forms depending on the nature of the discipline and industry, placement within the curriculum design and the intended learning outcomes. It uses a definition of work-integrated learning developed by Patrick et al (2009):

(an) umbrella term for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum” (Patrick, Peach et al. 2009)

Work-integrated learning can also be defined in terms of its relationship to work. Oliver (2015) defined work-integrated learning as learning tasks.

*Work integrated learning occurs at various levels across a range of tasks that are **authentic** (the task resembles those required in professional life) or **proximal** (the setting resembles professional contexts). ((Oliver 2015)*

This project has used a broad, inclusive definition of WIL, and envisaged WIL as wide-ranging, integrated learning activities with external stakeholders, not only those activities with a narrow industry-specific focus. It uses the premise that WIL supports the role of graduates as beginning professionals and potential change agents rather than inductees into an existing work environment to allow for a dynamic and adaptive employment and careers.

Graduate employability requires repeated learning opportunities that reinforce learning (Yorke and Knight 2006, Smith, Vinson et al. 2014, Jackson 2015). An isolated experience is much less valuable than intentional integration within a coherent learning design. Hence work-integrated learning requires consideration across the breadth of learning design, delivery and governance of university courses.

Work-integrated learning in STEM

In 2015, the Office of the Chief Scientist of Australia commissioned two studies into work-integrated learning in the broad area of science, technology, engineering and mathematics (STEM). This grouping includes highly vocational disciplines (engineering, information technology) and generalist degrees exemplified by the Bachelor of Science. Edwards et al (2015) reported on the nature and distribution of work-integrated learning in STEM disciplines in all Australian universities.

The study found that work-integrated learning was difficult to identify within curricula apart from placements in workplaces. Comparison between STEM disciplines showed marked variation in the provision of placements ranging from a core placement requirement for registration of engineering graduates³ to extra-curricular access to placement for many generalist degrees. The study found that students studying in a Bachelor of Science were much less likely to complete a work placement.

Based on the indicative data, the figures suggest that almost three of every four ICT bachelor students in Australia undertakes an industry based project during their degree, compared with about one in four agriculture and environmental studies students, and about one in seven science students. (p66)

The second project commissioned by the Office of the Chief Scientist explored the employer view of work-integrated learning in STEM. At its core, work-integrated learning requires an active and constructive collaboration between employers, students and universities. Atkinson et al (2015) reported findings from 74 in-depth interviews and focus groups with STEM employers ranging from small to large enterprises. The study found that Australian employers reported similar issues as international studies.

As the literature suggests and our findings confirm, two major challenges in improving employer engagement are convincing employers that WIL is worthwhile, then finding a balance between a desire to be more involved and having the available time and resources. (p10)

These two studies highlighted the challenge for science disciplines to increase work-integrated learning in generalist science degrees. Despite some examples of excellence in some programs (Edwards, Perkins et al. 2015) and a clear desire from universities and employers to improve graduate employability, growing work-integrated faces significant barriers (Prinsley and Baranyai 2015). The lack of existing work-integrated learning in science

³ Engineers Australia requires all registered programs for professional engineers to include learning activities at least ‘equivalent to at least 12 weeks of full time exposure to professional practice in terms of the learning outcomes provided’ (Engineers Australia (2008) [G02: Accreditation Criteria and Guidelines](#)).

degrees is compounded with institutional factors inside universities including a relatively low priority placed on work-integrated learning in science disciplines, the inexperience of science teachers in working collaboratively with employers, lack of expertise in designing and delivery work-integrated learning activities and programs and perceived low engagement with students regarding work-integrated learning. Similar problems are seen in other disciplines prompting national calls to improve leadership for work-integrated learning (Patrick, Fallon et al. 2014). The urgent task is to build commitment to and leadership for work-integrated learning in science, and to facilitate the efforts of Science Faculties to grow WIL at scale.

Growing WIL through curriculum leadership

Work-integrated learning is most effective when it is embedded within the formal curriculum (Yorke and Knight 2006). Improving the provision of work-integrated learning is closely allied to broad-scale curriculum renewal and requires the same holistic approach. For WIL, the curriculum stakeholder group expands from students and teachers to include employers with consequent increase in complexity. The design and delivery of WIL programs is based on three-way relationships that move beyond the university environment (Patrick, Peach et al. 2009). Supporting systems and tools must manage a diversity of employers and organizations and, as for all broad-scale curriculum renewal, must be flexible enough to accommodate disciplinary variation – notably accreditation requirements. Growing WIL is dependent on informed and effective curriculum leadership.

Patrick, Fallon et al. (2014) proposed a model for leadership for work-integrated learning that draws together the complex range of factors that must combine to deliver effective WIL programs. The authors describe five domains of action for WIL leadership, setting the agenda for development of WIL leadership.

The capabilities required by WIL leaders are similar across tertiary institutions, disciplines and industry, and can be grouped into five domains:

- **shaping** vision and policy;
- **communicating** and influencing WIL;
- **creating** sustainable WIL relationships to strengthen WIL culture;
- **fostering** engagement, expertise and learning in WIL; and
- **driving** outcomes that serve the needs of WIL stakeholders. (p 5)

The *WIL in Science: Leadership for WIL* project was established by the Australian Council of Deans of Science (ACDS) to begin the task of building leadership for work-integrated learning within science and mathematical science disciplines. It was based on the premise that Science Faculties could achieve change most efficiently by: establishing explicit leadership and expertise, learning from each other, and building on existing curriculum reform in science degrees.

The WIL in Science project

The Australian Council of Deans of Science (ACDS) is the national peak body for Science Faculties in Australia⁴. It reaches into all Australian Universities that offer science degrees and for many years has supported curriculum renewal within Science Faculties through fostering leadership in learning and teaching, and facilitating sector, disciplinary and institutional connections. The ACDS specifically fosters excellence in learning and teaching in science through:

- national meetings and conference for educators (Australian Conference for Science and Mathematics Educators) and teaching and learning leaders (ACDS Teaching and Learning Conference),
- targeted projects and commissioned work and,
- the ACDS Teaching and Learning Centre (including member network and website)

The ACDS Teaching and Learning Centre was used as the mechanism to draw Science Faculties together to work collectively towards broad-scale adoption of work-integrated learning in science degrees.

WIL in Science: Leadership for WIL was initiated to:

- establish a national network across faculties and schools of natural and physical sciences that would build capability and sustain growth in programs of work-integrated learning in university science

⁴ The ACDS membership is constituted by the nominees of the Vice-Chancellors of each Australian University that are considered by the University to be the most appropriate representative. For this report, ACDS members will be referred to as Deans although they may have alternative designations.

- develop an approach and strategies for work-integrated learning for science faculties in Australian universities

Project deliverables

WIL in Science: Leadership for WIL aimed to establish new capabilities and activity within Science Faculties, noting considerable variation between Science Faculties in the reported practice of WIL (Edwards, Perkins et al. 2015), and the wide spectrum in leadership for WIL and readiness for change observed by this project. Through the national forums, faculty workshops and the ACDS Teaching and Learning Centre website the network has:

- identified and shared the experience of a spectrum of WIL activities, and an understanding of their key characteristics, and requirements for success and outcomes
- identified and shared academic standards and course structures that make WIL successful and support judgments of quality
- examined organizational structures needed to foster WIL, such as leadership, administrative support, central versus local aspects, etc.
- provided advice and examples of effective relationship building at a variety of levels with industries and other organisations
- provided a point of contact for the ACDS with peak organisational bodies for WIL.

It has also trialled mechanisms for peer-to-peer learning and opportunities for professional development for nominated leaders for WIL in Science faculties and schools. Progress against the original deliverables of the *WIL in Science: Leadership for WIL* project is presented in Table 1.

WIL in Science: Leadership for WIL was conducted over 18 months from June 2015 to Dec 2016. All the activities identified in the grant proposal were completed which has established a firm foundation for further work at national scale. In 2016, funding was sought and granted from the Office of Learning and Teaching to expand the WIL in Science program and continue mentoring and support of Science Faculties. This second project, *Successful WIL in Science*, builds on the initial *WIL in Science: Leadership for WIL* project by establishing regional communities of practice and creating a national WIL resource for Science Faculties complementary to existing resources and tailored for Science degrees.

Project Governance

This project reported regularly quarterly to the ACDS Executive and was advised by an **Expert Advisory Group** chaired by Dr Roslyn Prinsley, Advisor to the Chief Scientist. The Expert Advisory Group included representation from industry and industry groups, University Australia, and the Australian Collaboration Education Network (ACEN) (see report cover). Members of the Advisory Group attended project events including ACDS WIL in Science Fora, project workshops and Faculty planning workshops.

The Project Steering Committee advised the project on initial setup and assisted with evaluation of the Lighthouse Projects. Members of the Project Steering Group were also active contributors to project events.

Table 1: Intended outcomes, outputs and deliverables for WIL in Science: Leadership for WIL project

Grant Proposal Outcomes, June 2015	Project Output	Deliverable
1. Establish a steering committee to develop the network	Steering and advisory committees established.	Expert Advisory Group includes representatives from higher education (including ACDS) and industry peak bodies (see Project Governance).
2. Identify a variety of potential models of WIL in science Faculties and schools	Case studies of WIL development in science (Lighthouse Projects)	Models for WIL delivery developed through Lighthouse projects (action-learning projects)
3. Identify potential leaders of WIL in science faculties and schools (June-December 2015) 4. Identify and assemble relevant parties responsible for work integrated learning in Science faculties	WIL in Science network	Senior leaders in WIL for Science & Maths identified in participating Science Faculties and form WIL in Science network (95 participants from 35 universities) WIL in Science program embedded in ACDS TL Centre
5. Hold a Forum in December 2015 with these relevant parties to develop a roadmap for work integrated learning in Science faculties in Australia	WIL in Science Forum Dec 2015 WIL in Science Forum Dec 2016	WIL in Science 2015 Forum connects nominated WIL leaders from Science Faculties and introduces the national WIL landscape (75 participants from 31 Universities and 8 other institutions) WIL in Science 2016 Forum presents change leadership model and pathway for broad-scale lift in WIL within science degrees (53 participants from 24 institutions and 5 other institutions)
6. Develop a roadmap for Science Faculties to achieve the key recommendations and actions arising from two studies on work integrated learning commissioned by the Office of the Chief Scientist and also those outlined in the National Strategy on Work Integrated Learning in University Education.	Model for change leadership development for Science Faculties	Models for WIL development guides interaction with Science Faculties and provides mechanisms for tailored peer-to-peer learning Second stage of WIL in Science is formulated and secures funding through the Office for Learning and Teaching (Successful WIL in Science Grant ID16-5420, Jul 2016-Jun 2018)
7. Prioritise, implement and evaluate pilot activities and initiatives for funding for the implementation of the roadmap developed in (6).	Lighthouse project case studies Successful WIL in Science grant	<i>WIL in Science: Leadership for WIL</i> activities and resources disseminated via ACDS TL Centre Continued funding for <i>WIL in Science</i> program to Aug 2018
8. Commission a suite of action learning projects that establish the operational role of the network – to identify, trial, disseminate and support models of WIL in science (Sept 2015 – Jan 2016)	Action-Learning Projects (Lighthouse Projects)	Lighthouse Projects complete (see Appendix 4 for individual case studies) and initiate (1) local institutional change and (2) partnerships between universities
9. Hold metropolitan workshops around WIL action learning projects (June-August 2016)	Faculty Planning Workshops	Faculty Workshops held August-September 2016 in Melbourne, Sydney and Brisbane with 60 participants from 19 institutions
10. Hold a national forum in December 2016 to disseminate learning and attract new champions.	WIL in Science Forum Dec 2016	WIL in Science 2016 Forum presents change leadership model and pathway for broad-scale lift in WIL within science degrees (50 participants from 24 institutions and 5 other institutions)

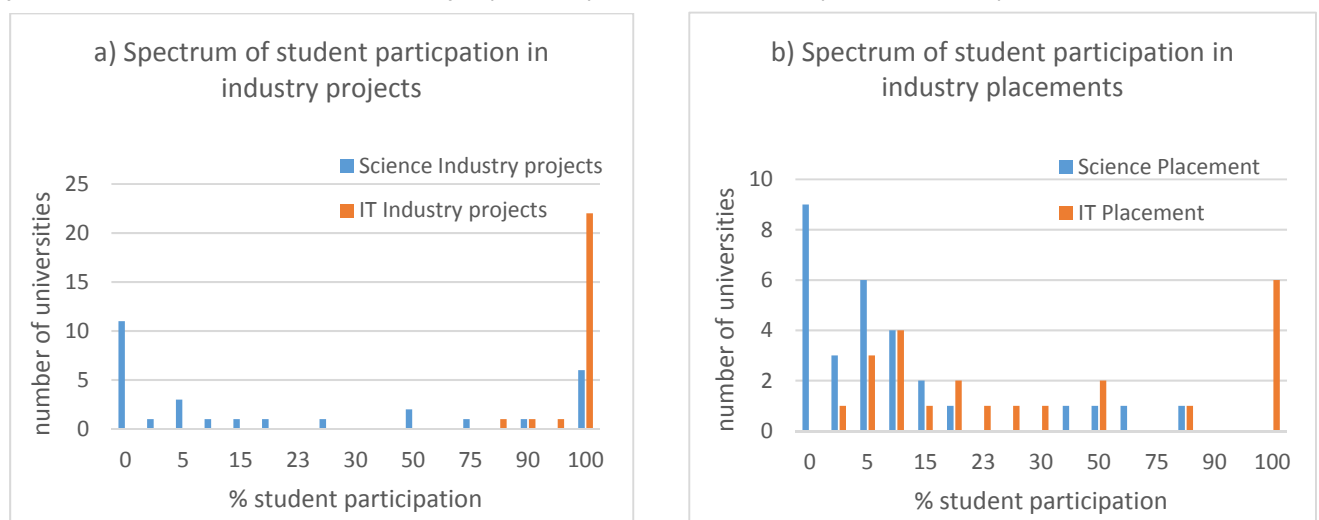
2 WIL Leadership: a roadmap for growing WIL

Curriculum renewal is a challenging and slow task (Oliver 2015). Sustainable change requires shifts in culture and practice, and course renewal usually requires development of new expertise, trial of new approaches and data-driven evaluation.

Meeting faculties where they are

Sustainable change requires recognition of the current state, since it is the foundation for development. In their comprehensive study of work-integrated learning in STEM disciplines, Edwards, Perkins et al. (2015) found considerable variation in the practice of work-integrated learning in natural and physical sciences. Universities reported variation in participation in WIL for natural and physical sciences ranging from 0 to 100% participation by students (Fig 1). This contrast with other STEM disciplines where '(o)n graduation the vast majority of engineering students in Australia have undertaken an internship or placement' and 'almost three out of every four ICT bachelor students in Australia undertakes an industry based project during their degree' (Edwards, Perkins et al. 2015). Work-integrated learning in engineering and ICT is strongly encouraged or required by professional accreditation. Science disciplines do not have an accepted, dominant mode for work-integrated learning nor do they have the external imperative of professional accreditation.

Figure 1: Variation between universities in student participation in a) industry projects and b) industry placement comparing natural and physical sciences and ICT. Science Faculties have large variation in engagement with WIL (blue bars, noting different scale for projects and placement graphs. Data is derived from Edwards, Perkins et al. (2015), self-reported by universities and re-presented with permission.



Edwards and colleagues (2015) also described considerable variation in institutional approaches to WIL varying from structured, institutional processes and systems to 'unstructured' activities solely depending on an individual academic or disciplinary group.

In institutions where overall there is an 'industry oriented' approach to WIL across the university, centralized systems and administration of WIL was likely to exist. The more common approach, in which WIL is 'bolted-on' to the curriculum, is characterised by decentralised approaches with less formal structure. (p73)

Universities with well-developed approaches to work-integrated learning can provide models for peers who are building their capacity to delivery work-integrated learning.

A small number of universities have, or are finalising, highly developed processes for coordinating, administering, and supporting WIL activities. In the main, these structures relate to placements and internship programs within the institutions, but in some cases they also facilitate project based work. (p73)

However, variation in funding and support has a profound effect on the capacity of Faculties to deliver

WIL programs (Patrick, Fallon et al. 2014). The best mentor may be ‘access to a ‘fellow traveller’ in the same role but further down the same learning (i.e. change) path with whom to compare tactics’ as described by Prof Geoff Scott in seminal work on leadership in Australian universities (Scott, Coates et al. 2008).

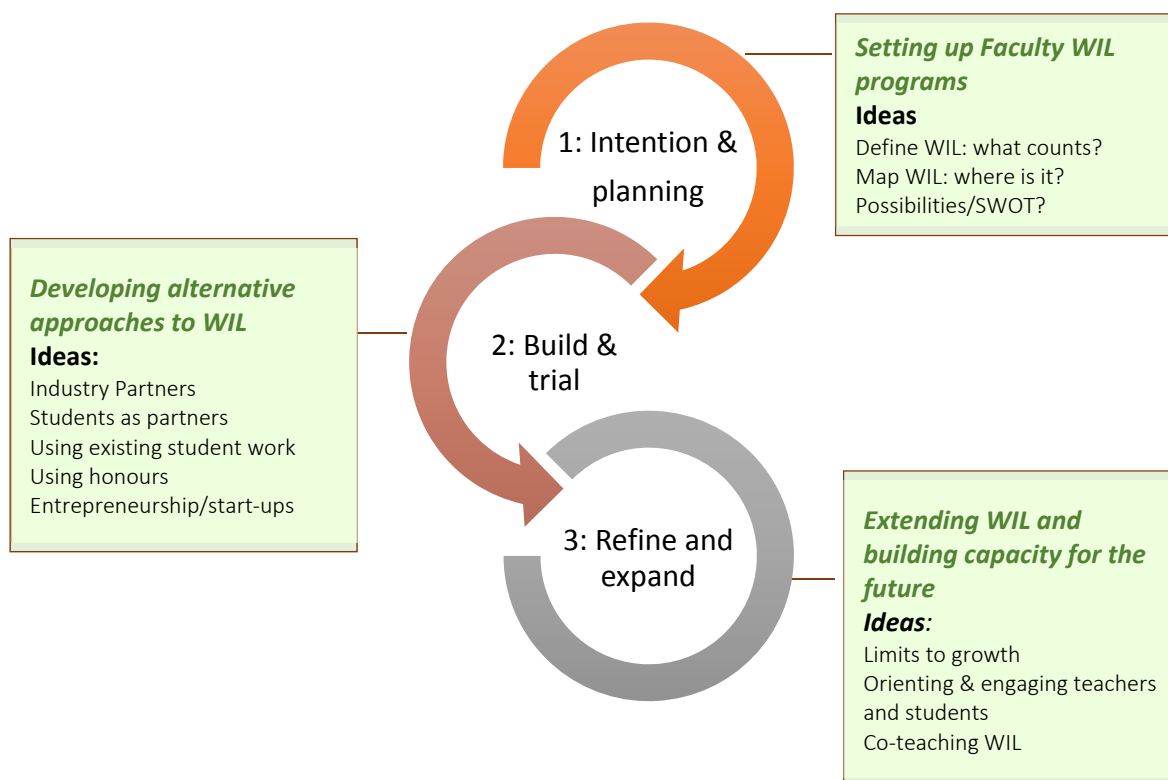
Findings from national reports on WIL implementation (Patrick, Peach et al. 2009, Orrell 2011, Patrick, Fallon et al. 2014, Edwards, Perkins et al. 2015) have guided the development of the WIL in Science program. The variation between Faculties of Science prompted a partnership model for supporting Faculties that recognizes the current position and context for each Faculty. WIL in Science therefore:

1. recognizes qualitatively different issues for Faculties at different stages of development of WIL programs;
2. recognizes variable degrees of preparedness to grow WIL, notably variation in centralized support and strategy, specified WIL workforce and leadership;
3. values peer-to-peer learning coupled to adaptation to the local context; and
4. aims to assist Faculties to create tailored solutions and use resources appropriate to their local context.

A model for development for WIL in Science

The observed variation in current practice of WIL in Science Faculties has led to the formulation of a change model that allows Faculties to identify and learn from peers with similar interests and issues. The variation in Faculty development also became evident when Faculties were invited to propose projects to explore implementation of WIL. The Lighthouse projects were designed as case studies to illustrate good practice in WIL implementation (see Section 2: Case studies for change). Proposals for Lighthouse projects could be categorized into three phases of development and prompted the metaphor of a journey of WIL development (Fig 4). This developmental model encourages Faculties to build capability and expertise to deliver effective WIL over time. It is explored further in Section 2.

Fig 4: Developmental model for building WIL in Science Faculties



Establishing the WIL in Science network

The WIL in Science network was designed to be a key connector for Faculties to develop work-integrated learning through collaboration. The objective of the network was to grow understanding of and expertise in WIL for Science and Maths, provide opportunities to articulate shared standards for WIL activities and outcomes, and to share good practice.

Identifying network members

The first step towards national leadership for work-integrated learning for science was to draw together nominated leaders from Faculties of Science. Recognizing the variation in institutional support and development of WIL, *WIL in Science: Leadership for WIL*, via the ACDS, asked Deans to nominate a leader for WIL for science disciplines from their Faculty. This approach was designed to raise awareness of work-integrated learning amongst Faculty executive and to identify a contact point in each Faculty for future activities. WIL leaders and specialists were also invited to participate in the network via project events, the ACDS Teaching and Learning Centre website and the ACDS newsletter. In December, 2016, the WIL in Science network comprised 95 members from 35 universities and a further 9 members from industry/government and higher education peak bodies.

A survey of WIL in Science network members in August 2016 showed that many Faculties do not have a designated leadership position for work-integrated learning (Figure 2). Representation may rest with the

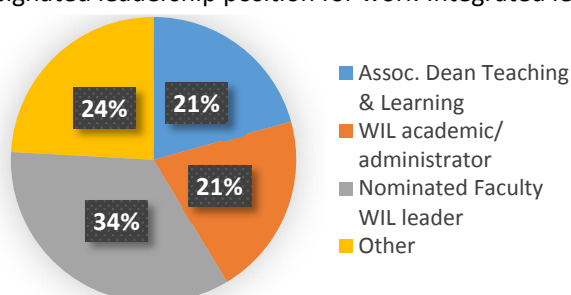


Fig 2: Proportion of WIL in Science network members in designated leadership roles (29 respondents, 21 universities)

Associate Dean Teaching and Learning (or equivalent) or with a WIL specialist, either academic or professional.

In their 2014 study of leadership for WIL, Patrick, Fallon et al. (2014) argue for a strong institutional support for a distributed network of leadership for WIL. They note that:

WIL leaders can be, and usually are, drawn from many levels within institutions and organisations and are defined by the activities in which they are engaged rather than by titles such as director, manager or other similar terms. (p4)

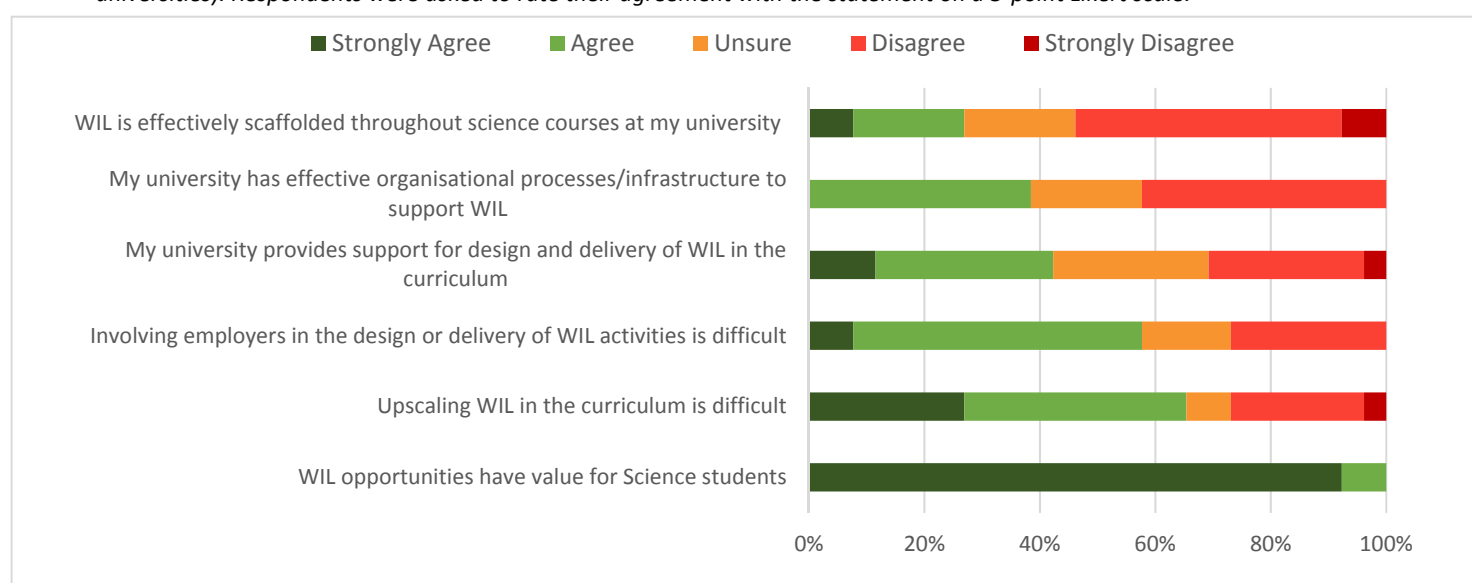
Comments from network members confirmed that leadership for WIL is very variable. Most participants described shared responsibility amongst variable combinations of the following roles: unit (or subject) coordinators, course (or program) coordinators, other discipline or WIL specific representatives from schools or faculties including WIL coordinators and administrative support roles, representatives from central teaching and learning or career centres, and leadership roles including Head of Schools, Associate Dean's, PVC's and DVCE's. Several participants also noted that students shared responsibility for seeking and securing their own placement opportunities.

WIL in Science: Leadership for WIL suggests that explicit acknowledgement of WIL leadership helps Faculties to prioritize work-integrated learning and can also be inclusive enough to acknowledge different types of leadership.

Perceptions of WIL practice amongst network members

WIL in Science network members were asked to report on the state of work-integrated learning in their Faculty. The general picture is that work-integrated learning is considered valuable but that implementation does not match the recognised value (Fig 3).

Fig 3: Perceptions of work-integrated learning practice from WIL in Science network members (29 respondents, 21 universities). Respondents were asked to rate their agreement with the statement on a 5-point Likert scale.



The WIL in Science network member survey collected information on the pressing challenges associated with building work-integrated learning programs in Science Faculties and explored how discussion with peers in the network could assist (Table 2). This information has guided network events and priorities.

Table 2: WIL in Science network member perceptions of challenges and opportunities for peer-learning. Starred items* were also identified in feedback from WIL in Science Forum evaluations.

Challenges with growing WIL	Discussion Topics: learning from and with peers
Managing student perceptions, expectations and experiences • Getting buy-in • Managing expectations of the types of opportunities available • Making WIL meaningful – e.g. engaging students in reflection • Providing career development and determining career destinations – several participants infer that students need to choose a career path so that they can choose an appropriate placement.	• Making WIL meaningful – encouraging student reflection and integration of WIL with other learning, learning outcomes • Entrepreneurship as a learning tool associated to WIL
Identifying appropriate placements • At scale for large cohorts • Quality of placements (e.g. aligned with discipline, preferred mode) • Constraints imposed by student's other commitments • Constraints imposed by geographical distance or region • Supporting students to identify their own placements	• Debate pro's and con's of students finding their own placements • Negotiating legal agreements with partner organisations*
Managing industry/stakeholder relationships* • Getting buy-in and commitment* • Finding time and resources for relationship management* • Legal agreements and protecting students	• Managing relationships with external stakeholders, finding placements and persuading employers of the value to their organisation (including non-science organisations)*
Engaging other staff* • Getting buy-in and changing culture –more difficult in some disciplines e.g. physical sciences, pure sciences, mathematics.* • Coordination to avoid repetition, gaps and inconsistent practices • Develop understanding of the range of WIL opportunities	• Instigating cultural change, engaging academics and implementing across curriculum*

Program design* • Making time and space in the curriculum • Making embedded WIL more overt • Integrating WIL with other curriculum elements • Identifying appropriate assessment • Streamlining WIL	• Sharing leading practices and case studies of WIL* • Opportunities for simulated/virtual experiences and authentic assessment • Models for working around rigidity of teaching calendars • Information management
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Building the national network

Communities of practice are a powerful way of building capacity and are often self-sustaining once established. They are maintained by common interest and are most successful with control resting with the community. The WIL in Science network has been initiated by a peak body (the ACDS) but aims to support members through peer-to-peer relationships with the ACDS Teaching and Learning Centre as a facilitator. The intent is to build a long-term, self-sustaining community that is an integral part of teaching and learning in science and mathematical sciences.

The first actions for the WIL in Science network have been to connect members through:

- Two national fora that brought together WIL leaders from Faculties
- Faculty planning workshops that brought together regional groups as a first step to building local nodes for the WIL in Science network.
- A regular newsletter that provides information about the network, and teaching and learning events.

Details of the project dissemination are listed in Appendix 3.

ACDS WIL in Science fora

The 2015 WIL in Science Forum was held December 11, 2015 in Melbourne as the first public event of the nascent WIL in Science network. Seventy-eight participants registered representing 33 universities, CSIRO, Universities Australia, the ATN network and ACEN (Australian Collaborative Education Network). Representatives from OLT-funded WIL projects in Health and Arts/Humanities also attended which enabled connection to WIL projects in other disciplines. The program emphasized information about the current state of WIL in Science and industry engagement. The workshop was opened by Dr Alan Finkel (incoming Chief Scientist, Australia) and featured presentations from industry representatives, the Office of the Chief Scientist and university leaders (see Appendix 3). Feedback from participants was strongly positive, emphasizing the need for models for effective WIL and sharing more experiences. The objective of the meeting was to raise awareness and to connect network members.

The 2016 WIL in Science Forum was held December 2, 2016 in Melbourne. For this second national meeting, the program emphasized action to grow WIL with presentations from the Lighthouse projects commissioned as part of the *WIL in Science: Leadership for WIL*, and learning from other disciplines with presentations from national leaders in WIL (see Appendix 3). Fifty participants from 24 institutions discussed plans for action and challenges particularly with delivery of large-scale programs and effective integration in the curriculum. Subsequent feedback from participants noted the shift in the tenor of the group discussion by participants from the awareness-raising evident at the 2015 Forum to a more nuanced and actionable agenda for change. Again, participant feedback was strongly positive.

Faculty planning workshops

Regional workshops were held in Melbourne (Aug 18, 15 registrants, 6 universities), Sydney (Aug 24, 16 registrants, 7 unis), Brisbane (Aug 25, 14 registrants, 6 unis). These smaller, more informal meetings were designed to foster closer links between Faculty WIL leaders and to provide a venue for discussion and reflection of local or institutional issues. The program included real-world ideas and challenges surfaced through the Lighthouse projects and simple planning exercises designed to identify local issues for discussion. Most participants were involved in developing WIL programs in their university.

Feedback from participants noted that the workshops had:

- increased motivation to continue program development
- helped to identify the 'next step' for their own work

- initiated collaborations with peers in other institutions

Further activity at regional level will continue as part of the OLT-funded project *Successful WIL in Science*.

ACDS newsletter and national conferences

The ACDS Teaching and Learning Centre publishes a newsletter approximately bi-monthly to members of the Faculty of science teaching and learning leaders (notably Associate Deans Teaching and Learning and other influential but informal leaders), WIL in Science network members and participants of the annual Australian Conference for Science and Mathematics Education (ACSME) which is the premier national meeting for university science and mathematics educators. The newsletter is posted online to 1,714 members and is a mechanism for these three groups to be aware of parallel work and ideas.

Cross-fertilization was also achieved through presentation and discussion at national teaching and learning conferences. Science Faculty leaders attend the annual ACDS Teaching and Learning Conference which included presentations on *WIL in Science* in 2015 and 2016. ACSME is a practitioner and researcher conference which attracts a wide diversity of participants involved in the leadership, design, delivery and evaluation of learning and teaching in science and mathematical sciences. In 2016, ACSME had work-integrated learning as one of its core themes and included a presentation on *WIL in Science: Leadership for WIL*. The project also presented at other national fora (see Appendix 3).

Alignment to the broader field of learning and teaching for science and mathematical sciences is particularly important to sustain effective work-integrated learning in science degrees. Work-integrated learning is most effective when embedded within the formal curriculum (Patrick, Peach et al. 2009, Orrell 2011) and building graduate employability is the responsibility of whole curriculum (Yorke and Knight 2006, Oliver 2015, Kinash, Crane et al. 2016).

The WIL in Science Roadmap: action to grow WIL nationally

WIL in Science: Leadership for WIL project sought to create a sustained interaction with Science Faculties that maintains action for the longer term and is responsive to each local context as well as the broader sectorial view. The project and its network cannot mandate action by Universities but it will create a national voice on WIL in Science that drives national standards and facilitates action.

To achieve widespread change, work-integrated learning must be integral to science degrees as a normal and expected component of every degree. This degree of change is comparable to the shift to outcomes-oriented curriculum design which is now mandated as part of Australia's Higher Education Standards. Course renewal towards this principle is slow but inexorable. For Science disciplines, the creation of national threshold learning outcomes for Science (Jones, Yates et al. 2011) was a turning point, generating activity at discipline and institutional levels and establishing national standards. The ACDS proposes that work as a guide to sectorial adoption of work-integrated learning.

Priorities for WIL in Science

Embedding WIL needs a sophisticated view of course design and delivery. Faculties and course teams developing WIL within science courses need to align contributing factors (Patrick, Fallon et al. 2014). So far, the WIL in Science network has identified a number of priorities for its members.

1. **shared intent:** WIL must be a priority for the Faculty and its staff, students and employers to be provided with the support required. This is a cultural shift which will occur over time. It needs consistent activity to raise awareness, build expertise and experience and make the benefits of participation evident.
2. **supportive context:** institutional and Faculty systems and processes context must facilitate for curriculum redesign and provide adequate resources for delivery – particularly for building and maintaining relationships with employers
3. **professional development:** course teams need to build their own understanding of work-integrated learning and to draw upon the expertise of WIL specialists
4. **change management:** when work-integrated learning is thoroughly embedded, it becomes the shared responsibility of all those contributing to the course. Faculty and course leaders need to be able to bring colleagues with them in a sustainable way

5. **access to tools and resources:** although many resources, examples and case studies are already available, studies of curriculum change indicate that educators respond best to peers and disciplinary examples that can easily be related to their own experience (Johnson, Bird et al. 2012)).

The WIL in Science network has begun to address these issues, but it is in its early stages of development and will require support for some time to achieve sustainability. For at least the immediate future, the network needs a 'home' and facilitation to ensure that participation is valuable for members. The ACDS will provide both a central hub and, through the *Successful WIL in Science* project, funding for building resources and network events to grow productive collaboration.

Roadmap for action

WIL in Science has created a roadmap to guide the broadscale adoption of WIL in Science Faculties (Fig 4). The program will continue to build its activity through the ACDS Teaching and Learning Centre (Roadmap actions 1 and 4) and its second phase project, *Successful WIL in Science* funded from Aug 2016 to Aug 2018 (Roadmap actions 2 and 3).

New projects will be needed for further collaboration with industry, regulators and other disciplines (Roadmap action 4). A future goal is the creation of effective standards for WIL design and delivery which requires national consensus to be compelling. Once created, these standards would underpin collective action and could contribute to future regulatory requirements.

Figure 4: National Roadmap for WIL in Science

ACTION	DELIVERY
1. Consolidate the WIL in Science network through: - local and national events (ACDS WIL in Science forum, ACDS TL conference, ACSME, regional workshops) - newsletter to members	Ongoing, supported through ACDS Teaching and Learning Centre
2. Foster peer-to-peer learning through: - Regional groups and collaborations - Sharing of case studies and exemplars in science and mathematical sciences	<i>Successful WIL in Science</i>
3. Create and adapt resources to inform and develop WIL in science and mathematical sciences as the WIL in Science Guide published via the ACDS Teaching and Learning Centre including - WIL basics: foundational information about work-integrated learning - WIL case studies from science and mathematical sciences - Stories of WIL from students, graduate and employers - Link to International tools, resources and perspectives	<i>Successful WIL in Science</i>
4. Increase connection to employers, regulators, other disciplines and stakeholders through: - Collaboration with Australian Collaborative Education Network (ACEN), employer peak bodies, higher education peak bodies to contribute to sectorial activity - Collaboration with other disciplines to share good practice - Collaborative research & evaluation for WIL in higher education - Cross-dissemination to discipline networks and university groupings	Existing collaborations Contribution to National WIL strategy New activities
5. Set indicative standards for WIL practice for science degrees Create national consensus for standards for practice of WIL in Science building from the educational literature and the evidence of practice	New activity

3 Case studies for change | Lighthouse projects

Exemplars and peers close to the lived experience of teachers can be powerful forces for change. This has been observed in curriculum change programs where teaching and learning leaders and their projects have significant impact as trusted colleagues that understand the discipline and practices that can readily be adapted to the local context (Johnson, Bird et al. 2012, Matthews, Crampton et al. 2015). Examples of good practice were created for Science Faculties to showcase how to embed/assess/deliver new curriculum based on the Science Threshold Learning Outcomes⁵. A parallel approach was undertaken for *WIL in Science: Leadership for WIL* to use local projects to explore significant issues for Faculties via the trial and dissemination of models of work-integrated learning in science degrees.

Creating local action

The WIL in Science Lighthouse Projects were short, local projects within Science Faculties to test and explore local implementation of WIL in science programs. The projects were designed to deliver immediate local benefit to their host Faculties to ensure local support and to illustrate possible pathways for WIL development for other universities and the sector.

Intended outcomes for Lighthouse projects and criteria for selection

1. make a step change for embedding effective WIL into course delivery within the Faculty (local)
2. create effective leadership and organisation for WIL in the Faculty, including a clear point of contact and pathways for industry engagement (local)
3. link to institutional organisation/resources/policy where present, and promote improved institutional capability to support and foster WIL (local)
4. identify and leverage other opportunities (industry research, philanthropy, etc.) where possible (local)
5. inform development of WIL in science in other institutions (sector)

Projects were selected by competitive bids and were funded up to \$10000 by *WIL in Science: Leadership for WIL* with matching funding from the home Faculty. Bids were reviewed by an expert panel of drawn from the Project Steering Group and the Expert Advisory Group, and evaluated based on the likelihood of achievement of the intended project outcomes and relevance to the sector as a whole. Projects were expected to complete within 12 months but, interestingly, all funded projects have continued work on their initiatives and expect to translate them into broader application.

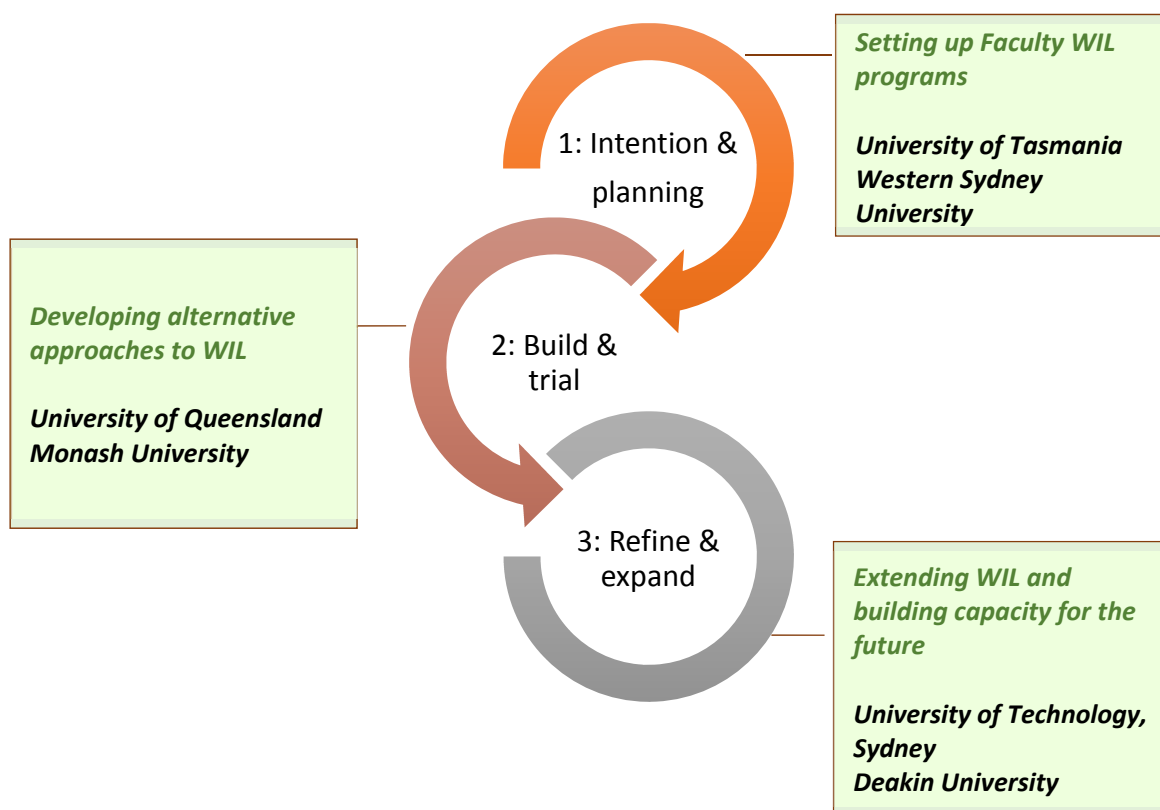
Lighthouse projects were asked to structure their teams to foster sustained engagement with work-integrated learning. Each team included a Faculty nominated WIL leader and at least one other Faculty staff member mentored through participation in the project. The team structure and focus on sustainability was modelled on the experience of a preceding sector-wide curriculum development project, the SaMnet scholars (Matthews, Crampton et al. 2015).

Six submissions were funded from a pool of ten submissions. The selected projects explored the three spaces in the WIL development model (Section 2), intention and planning, build and trial, refine and expand, thus providing three alternative points of connection for peer Faculties (Fig 4). The six projects also addressed key issues identified by the WIL in Science network:

- mapping WIL in the curriculum (University of Tasmania, Western Sydney University)
- alternative WIL designs - using WIL for honours (Monash University) and using student's existing work commitments (University of Queensland)
- cross-disciplinary WIL units/subjects (University of Tasmania, University of Queensland)
- scaling up industry placement (University of Technology, Sydney)
- building WIL capability amongst course directors and teaching teams (Deakin University)

⁵ The collected Good Practice Guides created for implementation of the Threshold Learning Outcomes for Science are collected in the Science TLO program pages of the ACDS Teaching and Learning Centre website (<http://www.acds-tlcc.edu.au/science-threshold-learning-outcomes-tlos/science-threshold-learning-outcomes-tlosscience-tlo-good-practice-guides/>)

Fig 4: Lighthouse projects correspond to stages in the WIL development model



The Lighthouse Projects

The Lighthouse projects were commissioned in March 2016 and were still running at the completion of the WIL in Science Project in Dec 2017. Findings from the Lighthouse projects addressed (1) design and delivery of effective WIL programs and (2) advice to Science Faculties on the implementation of a WIL strategy. Primary reports (case studies) from each project are presented as case studies in Appendix 4.

WIL development stage: Intention & Planning

1. The University of Tasmania, School of Land and Food

Project: Unifying WIL in Science at the University of Tasmania

Project lead: Assoc. Prof. Tina Acuña, Dr Andrew Seen, Mrs Nicole Herbert, Dr Shane Powell, Dr Rebecca Gehling, Mr Robert Kingsley, Ms Susie Haley.

Project description and scope: This project created a generic WIL program for Science courses leveraging experience from allied disciplines (engineering, ICT, agriculture) and developed a faculty-level approach to industry engagement via an Advisory Board that fosters cross-disciplinary links. The project illustrates determination of current state in staff perceptions and curriculum mapping as initial steps required to embed WIL in a Science curriculum. The project describes factors to consider in development of a generic program for on and off-campus WIL in Science and related disciplines.

Key Findings:

Design and delivery of WIL programs

- Design of a generic (Faculty-wide) WIL placement subject must cater for student preferences. Teaching staff and students noted many students either undertake or prefer placement over summer.
- Industry partners appreciate flexibility in placement/project structure to accommodate capacity and available supervision in the workplace and also seek flexibility in placement timing.

- Science WIL programs can be successfully modelled on professional degree WIL subjects and experiences from partner Universities.

Implementation of WIL programs

- The project found significant variation between science teaching staff in orientation to and understanding of WIL. Poor understanding and skepticism was more apparent in disciplines with little previous exposure to WIL.
- A defined project is effective at generating interest within the Science Faculty and creates a point of linkage with other Faculties and with the University
- Industry engagement requires considerable consultation and an open view of how relationships such as Industry Advisory Boards operate

2. Western Sydney University, School of Science and Health (Parramatta Campus)

Project: Providing WIL across complex interconnected science degrees

Project lead: Dr Jo-Anne Chuck, Dr Chris Jones, Professor Thomas Millar, Dr David van Reyk

Project description and scope: This project mapped WIL activities in order to develop opportunities to embed WIL in the curriculum of an entire suite of Science courses. The project identified, categorized, and compiled current activities in the science degrees that constitute WIL and used the analysis to identify where new/existing activities could be explicitly incorporated into the BSc programs. The project worked individually with teaching teams to plan development of WIL activities appropriate to the discipline, course, student development and intended WIL learning outcomes, and to create space for students to complete placements/volunteer opportunities with academic credit. The project also initiated design of a generic WIL placement subject that could be embedded into multiple courses.

Key Findings:

Design and delivery of WIL programs

- Definitions of WIL need to be developed in the local context and with consideration of disciplinary variation
- Detailed mapping of existing curricula identified considerable 'hidden' WIL where teachers address graduate employability although the connection may not be apparent to students
- Mapping should identify type and mode of WIL activity, explicit vs hidden, authenticity of the activity, scaffolding, skill transferability and alignment with learning outcomes.

Implementation of WIL programs

- Direct linkage of the Faculty WIL strategy to a University strategy creates strong impetus for engagement and action
- Individual conversations with course and subject co-ordinators are a very effective way of building engagement, capability and confidence, although this is time-consuming
- Mapping provides the basis for gap analysis and course-level thinking and dispels the perception that WIL is only achieved through industry placement
- Partnership with University Careers Services creates valuable resources for Faculty implementation
- A visible project at Faculty level provides a mechanism to influence University strategy, support and systems

WIL development stage: Build & Trial

3. The University of Queensland, Faculty of Science and Institute for Teaching and Learning Innovation

Project: Exploring alternate models for WIL in Science: Linking Work with Learning

Project team: Assoc. Prof. Susan Rowland, Prof. Peter Adams, Dr Deanne Gannaway, Ms Robyn Evans

Project description and scope: This project developed an innovative model for WIL that academically expands on extant student work experience, that is, the current paid work in which students engage outside of their study, with the aim of broadening opportunities for engaging with WIL. The project tested a prototype curriculum with volunteer students, prior to 2017 implementation of a formal elective course (unit of study) in multiple Faculty of Science degrees. The project also provided an opportunity to identify and build relationships with community and industry work placement sites in order to expand formal WIL placements in the future.

Key Findings:

Design and delivery of WIL programs

- Transferable skills derived from existing paid work can be successfully embedded in an academic program to support graduate employment
- Transferable employability skills can be successfully applied to science career education through critical investigation and reflection
- Science students may have had little opportunity or encouragement to reflect on their own skills but are engaged and enthusiastic when supported to present themselves as professionals

Implementation of WIL programs

- Academic's reactions to generic skills programs (including career education) are mixed with some concerned that expressing WIL programs will not achieve academic appropriate academic rigour or that career education skills should be co-curricular

4. Monash University, School of Biological Sciences

Project: Development of professional skills in science students through a work integrated learning honours stream

Project team: Dr Rowan Brookes, Dr Chris Thompson, Lisa Happell, Dr Tim Connalton

Project description and scope: This project has developed materials and supported curriculum design for a WIL honours year in an elite undergraduate science program which the Faculty is trialling as a model for a future implementation in the Bachelor of Science. The elite degree, Bachelor of Science Advanced - Global Challenges (Honours), will commence its inaugural WIL-focused honours stream in 2017. The students will collaborate in teams to deliver a project that addresses an authentic workplace challenge provided by the partner organisations; the outcomes of which will form the student's honours projects. This project has refined the curriculum design and resourcing for the WIL honours year and created three online skill development modules, specifically targeted to areas that employers and students have identified as important for science graduates.

Key Findings:

Design and delivery of WIL programs

- Skill development modules for WIL should be co-designed with industry partners and students to ensure relevance and future engagement
- Where possible, learning activities for employability skills should be designed for re-use in multiple programs
- Alumni are an important resource for universities to model transition to employment

Implementation of WIL programs

- Dedicated resources and expertise are needed to build and maintain effective industry relationships

WIL development stage: Expand & Refine

5. University of Technology, Sydney, Faculty of Science

Project: Scaling-up Professional Experience Programs: developing a framework to support broad-based WIL

Project team: Prof. Peter C Meier, Dr Blair Nield, Prof. Graham Nicholson, Dr David van Reyk, Ms Shima Baradaran Vahdat, Ms Vikki Banks

Project description and scope: This project developed an integrated Faculty strategy to extend WIL activities in science and related degrees through curriculum renewal, scaling and development of individual placement programs, and the creation of administrative processes to streamline and support internship activities. The aim of the project was to create a flexible and responsive Faculty environment that could accommodate internship or internship-like experiences for all students as required by the University. The project included (1) restructure of degree programs to ensure there was capacity for students to take a session (semester) free block in programs to allow for a minimum 12-week internship placement, (2) construction of a suite of Faculty internship units of variable length to suit employer needs and (3) mapping and curriculum design to embed authentic assessment linked to WIL. These initiatives will be further developed in 2017.

Key Findings:

Design and delivery of WIL programs

- Large-scale industry placements (internships) require a flexible timing to accommodate varying employer needs
- Mapping of WIL activity across Faculty programs identified both explicit (directly linked and assessed) and implicit (indirectly linked and possibly assessed) WIL in curricula
- Making WIL available to all students will require innovative approaches such as placements outside conventional science workplaces or online placements

Implementation of WIL programs

- Faculty-level strategy and authoritative leadership is crucial to remove organizational and structural blocks to broad-scale WIL
- Development of WIL programs is tightly linked to other forms of curriculum renewal and must be aligned with curriculum development initiatives
- Large-scale placement (internship) WIL requires consistent systems and processes to manage organizational issues such as insurance, voluntary vs paid placements, academic assessment by host organisations, work health and safety requirements etc
- National standards for WIL implementation would enable Faculties to benchmark their progress

6. Deakin University, Faculty of Science, Engineering and Built Environment

Project: Learning to Work, Working to Learn: Curriculum design and teaching practice for WIL in the Natural and Physical Sciences

Project team: Prof. Malcolm Campbell, Assoc. Prof. Stuart Palmer, Assoc. Prof. Jo Coldwell-Nielson, Dr Karen Young, Mark Tolson

Project description and scope: This project created resources, exemplars and workshops for course directors in order to build leadership for WIL and achieve a coordinated and broader approach to employment opportunities for students. The project established a Faculty WIL Steering Group that worked with course directors to create shared definitions of WIL, how WIL should be scaffolded within courses and what constitutes appropriate assessment of WIL. These interactions have created a WIL community of practice and have identified and recognized WIL leaders within the Faculty.

Key Findings:

Design and delivery of WIL programs

- Mapping of WIL in courses records intentions rather than outcomes which are the true measure of success, however mapping is a useful activity to initiate discussion
- WIL can be described by authenticity (how closely the learning activity aligns to tasks within the workplace) or proximity (the closeness of students to existing practitioners)
- Individual WIL activities may not achieve both authenticity and proximity so WIL activities should be planned across each degree and scaffolded to ensure value for students

Implementation of WIL programs

- Recognition of expertise and leadership of WIL encourages champions to invest in further activity
- Communities of practice are powerful and self-sustaining mechanisms to embed WIL for the long-term and spread good practice
- Creation of development resources for course leaders provides prompts for discussion and a focus for action

Outcomes from the Lighthouse projects

Case studies for WIL

The Lighthouse Projects offer models for WIL development and delivery. Project teams have prepared a primary case study reports from their project for publication through the ACDS Teaching and Learning Centre. The information collected via these primary reports will be edited to create six case studies developed for application in other Faculties. The objective of the case studies is to provide insight, prompt new thinking and consider factors in adaptation to local contexts. The primary case study reports

are presented in Appendix 4. Edited case studies will be published in Q2, 2017 via the ACDS Teaching and Learning Centre.

Emergent themes

Themes emerging from the Lighthouse projects reinforced findings from the WIL in Science network and uncovered insights to assist Science Faculties. These themes align well to the research literature on work-integrated learning. The following observations are drawn from the Lighthouse reports, key findings and presentations during the project.

Design and delivery of WIL programs

Student preferences and engagement are key factors in creating successful WIL programs. Program leaders should incorporate consultation and testing with students as part of program development. (Projects 1 and 3)

Employers should be equal partners in designing and delivering WIL programs. There are large advantages in engaging industry partners throughout design but to be successful, partnerships must allow for industry constraints such as available time and capacity. University curriculum structures and types of WIL must be flexible enough to accommodate a variety of types of industry engagement, and Faculties will need to invest time and resources into building and maintaining relationships (Projects 1, 4, and 5)

Broad-scale uptake of WIL needs **innovative and varied solutions** including generic placement subjects that can be embedded in multiple courses (Projects 1, 2, 3, 5), use of non-science work placements/experience to build transferable skills (Project 3), models from professional degrees (Project 1). Sharing ideas between Faculties assists WIL leaders to think outside the box and test their ideas.

Each institution will need to arrive at a **local definition and application of WIL** (all projects) that aligns to local constraints and intentions and caters for disciplinary variation. Construction of a shared definition is a useful tool to build engagement with teaching teams and is particularly important for generalist degrees such as the Bachelor of Science that incorporate many sub-disciplines. Faculties need to develop shared understanding of priorities.

Mapping WIL across the curriculum of a degree can also be a very useful tool (Projects 1, 2, 5, 6).

Mapping WIL activities and their characteristics builds a picture of the coherence of the consolidated WIL activities and the gaps which leave students without access to WIL. Mapping assists course leaders and teaching teams to understand scaffolding and the component skills that contribute to a valuable WIL program. Mapping also assists teachers and leaders to make WIL explicit to teachers and students. However, mapping generally only records intention and should be accompanied by evidence of outcomes to evaluate the success of a WIL curriculum.

WIL builds **transferable employability skills** valued by employers such as self-management, teamwork, communication or critical thinking. These skills can be built through science career education activities (Project 3), re-usable online learning activities (Project 4) as well as reflection on work placements/internships (all projects). Development should be scaffolded through each degree so that students build their confidence over time and can relate their skills to various applications.

Implementation of WIL programs

All projects commented on the value of **alignment** of their projects with Faculty and University priorities. In all cases, visible links to institutional strategy and initiatives created credibility, encouraged engagement and supported long-term efforts. Alignment also helps to ensure that university systems support WIL programs and that processes encourage WIL. Faculties should ensure they work closely with other stakeholders and resources within their University.

Similarly, **visible Faculty leadership** facilitates initiatives (all projects). In particular, Faculty leadership simplifies approvals and governance arrangements, and helps to make the case for investment of resources. Explicit and endorsed leadership roles catalyze action.

Development of WIL programs must be aligned to other **course development** actions. Course mapping is one example of a tool that draws together all elements of the curriculum. Development of WIL programs is inherently complex involving many stakeholders. To be successful, course leaders and teaching teams must be able to build it into their processes for curriculum development (Project 6).

Projects reported the importance of **working with teaching staff** to build confidence in work-integrated learning and acknowledge and address concerns (Projects 1, 3 and 6). Limited previous engagement with WIL means that teaching staff may have negative pre-conceptions about the value of employability skills and connection to course content. Specific projects can create a springboard for broader action. Informal professional development occurs as course leaders and teachers engage with the project, particularly where the project works with individuals on local problems. Faculties need to invest in engagement with teaching teams.

Leadership and dissemination

The WIL in Science Lighthouse projects have achieved many outcomes beyond the implementation of a specific WIL activity. They have helped to develop a new group of WIL leaders, prompted discussion across universities and disciplines, and created peer collaborations.

Building leadership for WIL programs was a key objective of *WIL in Science: Leadership for WIL*. The Lighthouse projects were designed as action-learning projects, that is, project teams would learn and build their own skills through project implementation. Action-learning projects have been successfully used to build leadership in learning and teaching as well as subject knowledge and skills (Sharma, Rifkin et al. 2014). It is clear that Lighthouse project leaders are recognized as WIL leaders within their home institutions and are now active contributors to the national discussion.

Alignment of the focus of the Lighthouse projects with the issues identified by WIL in Science network members has ensured the relevance of these projects to Science Faculties. Lighthouse project teams have presented their projects, findings, challenges and innovations to science teaching and learning leaders at *WIL in Science: Leadership for WIL* events (WIL in Science Fora, Faculty planning workshops), prompting rich discussion and testing assumptions and ideas.

Lighthouse projects have also been presented to broader audiences. Presentation at ACSME 2016 (Australian Conference for Science and Mathematics Education) reached a broad range of university science educators (210 participants, Brisbane, Sep 2016). Collaboration with the Australian Collaborative Education Network (ACEN), the peak professional association for work-integrated learning, enabled two national webinars for *WIL in Science: Leadership for WIL* to reach a cross-disciplinary audience.

Mentoring and connections: critical friends

The WIL in Science program is based on a peer learning model. Lighthouse project teams have created internal collaborations amongst teams, have developed collaborations with other Universities and have acted as critical friends for peers. The role of a critical friend has proved valuable in other curriculum development projects. In the SaMnet Scholars program to develop curriculum leadership, critical friends from a partner institution with teaching and learning experience acted as mentors and created a reflective space for critical evaluation of progress and planning (Sharma, Rifkin et al. 2014). A critical friend does not need to be an expert but does need relevant experience and a genuine interest in the project being considered. *WIL in Science: Leadership for WIL* created a collegiate network where members feel empowered to seek assistance from others and are given space to reflect on progress. Peers from other universities in the network who are working in the same space and experiencing similar issues are appropriate critical friends. This approach will be continued via phase 2 for WIL in Science, the OLT-funded *Successful WIL in Science* project.

4 Impact and next steps

WIL in Science: Leadership for WIL has achieved its immediate goals to establish national leadership for work-integrated learning within Science Faculties, create a national conversation about work-integrated learning in science degrees, begin the task of building capacity to design and deliver WIL programs, and to trial approaches to WIL development (see Section 1, Table 1). All of these outcomes will develop further over time as the network grows and extends its activities.

Impact and Evaluation

WIL in Science: Leadership for WIL used formative evaluation during the project to guide implementation, and summative evaluation at the conclusion of the project to prompt reflection and advice for the next phases of this work.

Two evaluators contributed to the evaluation: Dr Trina Jorre de St Jorre, Deakin University led the collection and analysis of formative feedback from project events and member surveys, and Dr Siva Krishnan, Deakin University conducted the summative evaluation including a review of project activities and interviews with Lighthouse Project leaders.

The evaluation strategy was based on evaluation resources of the Office for Learning and Teaching⁶. It includes evaluation of immediate outcomes with short-term measures and poses questions to be considered over the longer-term (Table 3).

Surveys and feedback

Feedback was collected from attendees at each **WIL in Science forum** on take-home messages, suggestions for action/resources to build and expand WIL and suggestions for future events. Emergent themes were used to refine the project and guide the future development of the program. Selected findings from surveys of network members are presented in Section 2.

Participants were strongly supportive of the WIL in Science program, the national fora and particularly the emphasis on networking, peer learning and practical advice. One respondent from the 2016 National Forum noted:

Thank you for the forum and for the continued support of this network. It is impressive how far we have come between the first forum and this one.

Participant feedback was also collected from the **Faculty planning workshops** and used to refine subsequent activities. For these workshops, participants were usually already active in WIL but commented that the workshop had provided new contacts, resources and motivation.

Evaluation of the Lighthouse Projects

Evaluation of the Lighthouse projects is presented in Appendix 5. The evaluator concludes:

To conclude, the project activities seem very appropriate and timely to build graduate employability outcomes within Science related disciplines for the reason the project team identify. The lighthouse projects in particular have provided the impetus for building capacity, to design and deliver WIL programs through collaborative discussions and sharing of strategies and practice through the national network of Science WIL leaders and peer-to-peer mentoring activities.

Discussions during the interviews and triangulation of the interview data with the project aims and intentions, and data from participant surveys confirmed the formulation of a renewed community of practice to raise awareness of the place and importance of WIL in Science related disciplines.

⁶ See: <http://www.olt.gov.au/evaluation>

Table 3: Evaluation approach for *WIL in Science: Leadership for WIL*

Project Outcome	Short-term outcomes		Longer-term outcomes	
	Evaluation question	Evaluation data	Evaluation question	Evaluation data
Senior leaders in WIL for Science and Maths	Are senior WIL leaders evident and active in Faculties of Science?	Survey of WIL in Science network members	Are WIL Leadership roles widespread amongst science faculties?	Number of formal WIL leadership roles in Faculties of Science Responsibilities of WIL leaders
Network of WIL for Science and Maths	Does WIL in Science meet the needs of its members?	Survey of WIL in Science network members Commentary from the Expert Advisory Group.	Does WIL in Science take a collective leadership role in advising on WIL in Science and Maths?	Commentary from Executive of participating Faculties
Action-Learning Projects	What is the impact of action-learning project?	Interviews with action-learning project teams	Have WIL programs derived from the action-learning projects been embedded and sustained in science degrees	Commentary from Associate Deans Teaching and Learning of participating Faculties
Professional development for WIL leaders	Do professional development activities meet the needs of WIL in Science members?	Survey of workshop participants Survey of WIL in Science network members	Do WIL in Science members contribute to development of WIL in their institution?	Commentary from Executive of participating Faculties
National report on models for WIL leadership in science faculties	Does the report offer new insight or ideas for WIL in science and mathematical sciences?	Commentary by expert reference group	Does WIL in Science provide useful resources and/or a forum for development of WIL in Science	Commentary from network members and ACDS

Extending WIL in Science: *Successful WIL in Science*

In 2016, the ACDS partnered with four universities, Deakin University, Monash University, Curtin University and the University of Newcastle, to secure funding from the Office for Learning and Teaching for the second phase of the WIL in Science program: *Successful WIL in Science*.

Successful WIL in Science builds on the foundational work of *WIL in Science: Leadership for WIL* to create tailored resources and advice that will support Faculties to build employability skills for the future for graduates in science and mathematics. It recognises the large body of advice and experience with WIL from related discipline areas (e.g. engineering, ICT), from completed OLT and predecessor bodies' work and from the learning and teaching literature. It will add to these resources with authentic and integrated case studies of implementation of WIL in science, and the experience of students and recent graduates. The project will translate these resources into action by creating tailored tools for science faculties coupled with institutional peer mentoring. At the completion of this project, science faculties will have further developed leadership for WIL and the WIL in Science network, will have an expanding set of resources for WIL and, most importantly, stronger links to industry for students studying science and mathematics. *Successful WIL in Science* is funded from Aug 2016 to Aug 2018.

Commitment to the WIL in Science program was strongly endorsed by the Annual General Meeting of the ACDS in October 2016 and explicitly identified as a priority area for Faculty Deans. The ACDS crucially provides continuity of effort and reach into all Australian universities offering science awards. Its commitment to WIL in Science is an integral part of its ongoing, and funded, investment in learning and teaching in science degrees.

Successful WIL in Science Project Team:

Prof Liz Johnson, Deakin University and ACDS Teaching & Learning Centre

Prof John Rice, ACDS

Prof Cristina Varsavsky, Monash University

Prof Jo Ward, Curtin University

Prof Malcolm Campbell, Deakin University

Dr John Holdsworth, The University of Newcastle

Dr Trina Jorre de St Jorre, Deakin University

Appendix 1 | Certification

Certification by Professor Elizabeth Johnson

I certify that all parts of the final report for this Office of the Chief Scientist grant provide an accurate representation of the implementation, impact and findings of the project.

Name:

A handwritten signature in black ink, appearing to read 'Elizabeth Johnson', written in a cursive style.

Professor Elizabeth Johnson,
Director, ACDS Teaching and Learning Centre
Date: 21 March 2017

Appendix 2 | Financial report

- Budget Expenditure
- Final Financial Acquittal

Budget Expenditure

Funded by the Office of the Chief Scientist: WIL in Science Project 2015 to 2016

ACDS EXPENDITURE - DEAKIN UNIVERSITY Expenditure Category	BUDGET	EXPENDITURE			BALANCE
		Actual 2015	Actual 2016	Planned Expenditure 2017	
Personnel Project leader Rice (in kind) Team Leader Johnson (in kind) Project manager/Research Officer (0.6 x HEW 8.4 + 28%) <i>Sub total</i>	 \$70,798.00 \$70,798.00	 25,321.00 25,321.00	 \$53,024.00 \$53,024.00		 -\$7,547.00
Project support Steering group meetings x 3 Website and communications <i>Sub total</i>	 \$1,500.00 \$1,500.00	 \$3,000.00 \$3,000.00			 -\$3,000.00 -\$1,500.00
Project activities WIL in Science fora x2 (Dec 2015 and Dec 2016) Travel grants to unsuccessful WIL project submissions Professional development workshops (regional meetings) • Faculty planning meetings x 4 • Lighthouse teams x2 Action-Learning Projects (6 x \$10,000) <i>Sub total</i>	 \$22,500.00 \$10,000.00 \$60,000.00 \$92,500.00	 \$0.00	 \$2,886.25 \$1,000.00 \$2,043.00 \$3,476.55 \$60,000.00 \$69,405.80	 \$4,222.99* \$1,485.27** \$5,708.26	 \$15,390.76 -\$1,000.00 \$10,000.00 -\$3,528.27 -\$3,476.55 \$0.00 \$17,385.94
Deakin University - Total ACDS Expenditure	\$164,798.00	\$28,321.00	\$122,429.80	\$5,708.26	\$8,338.94

ACDS DIRECT EXPENDITURE Expenditure Category	BUDGET	EXPENDITURE			BALANCE
		Actual 2015	Actual 2016	Planned Expenditure	
Personnel Project leader Rice (in kind) <i>Sub total</i>	 \$0.00	 \$0.00	 \$0.00	 \$0.00	 \$0.00
Project support Steering group meetings Website and communications <i>Sub total</i>	 \$0.00	 \$0.00	 \$1,375.00 \$1,375.00	 \$0.00	 -\$1,375.00
Project activities WIL in Science fora x2 (Dec 2015 and Dec 2016) Travel grants to unsuccessful WIL project submissions Professional development workshops (regional meetings) • Faculty planning meetings x 4 • Lighthouse teams x2 Action-Learning Projects (6 x \$10,000) <i>Sub total</i>	 \$0.00	 \$6,963.94 \$6,963.94	 \$0.00	 \$0.00	 -\$6,963.94
Total ACDS Direct Expenditure	\$0.00	\$6,963.94	\$1,375.00	\$0.00	-\$8,338.94
WIL IN SCIENCE PROJECT TOTAL	\$164,798.00	\$35,284.94	\$123,804.80	\$5,708.26	\$0.00

*costs incurred 2016, payment made in 2017

** WA workshop scheduled for February 2017



FINAL FINANCIAL ACQUITTAL

Project: WIL in Science 2015 - 2016

	\$ Excl GST
Income:	
Total funding	\$164,798.00
Expenditure:	
Personnel	\$78,345.00
Project support	\$3,000.00
Project activities	\$75,114.06
Total expenditure	\$159,089.74
Balance	\$-5,708.26
Commitments:	\$5,708.26
Final Result	\$0.00

I, Catherine Simandl, have reviewed the above statement. I can confirm that this is a true and fair representation of expenditure associated with the OCS grant, and the funds were expended on the conduct of the project and in accordance with the funding agreement.

A handwritten signature in blue ink that reads 'Catherine Simandl'.

Catherine Simandl
Business Manager
Office of the Deputy Vice-Chancellor
Deakin University

108000/9525344
IPA CPA

Professor Elizabeth Johnson
Project Leader

Appendix 3 | Events and dissemination

WIL in Science National Fora 2015 and 2016

Universities	Attendees 2015 Forum	Attendees 2016 Forum
Australian Catholic University	1	1
Australian National University	2	
Central Queensland University	1	
Charles Darwin University	1	
Curtin University	2	1
Deakin University	5	6
Edith Cowan		1
Federation University	2	
Flinders University		1
Griffith University	5	2
James Cook University	2	
La Trobe University	2	4
Macquarie University	2	2
Monash University	4	3
Murdoch University	1	
Queensland University of Technology	1	3
RMIT University	4	2
Southern Cross University	1	
Swinburne University of Technology	4	2
University of Adelaide	1	
University of Canberra	2	1
University of Melbourne	2	4
University of New England	1	1
University of New South Wales	1	1
University of Newcastle	1	2
University of Queensland	5	1
University of South Australia	1	
University of Southern Queensland		1
University of Sydney	2	
University of Tasmania	2	1
University of Technology Sydney	2	3
University of the Sunshine Coast		1
University of Western Australia	2	
Victoria University	1	1
Western Sydney University	2	2
Attendees	65	47
Institutions	31	24

Industry/peak bodies	Attendees 2015 Forum	Attendees 2016 Forum
ACDS	2	2
Universities Australia	1	
ATN University Network	1	
CSIRO	1	
Office of the Chief Scientist	2	1
Standards Australia	1	
AiGroup	1	1
Career Lounge	1	
AMSI Board		1
Judyth Sachs Consulting		1
Attendees	10	6
Institutions	8	5
TOTAL ATTENDEES	75	53

Faculty planning workshops

	Participants	Universities	Industry
Melbourne (Deakin University)	14	6	1
Sydney (University of Technology Sydney)	16	7	0
Brisbane (University of Queensland)	13	6	0
	43	19	1

Future workshops: A further workshop is to be conducted in Perth and one online in February 2017. Findings from the evaluations will inform these 2017 workshops and webinar.

Project presentations

Title and Venue	Presenters	Audience
<i>A Systematic Approach to Work Integrated Learning</i> 2015 ACDS Annual General Meeting Oct 19, 2015, Canberra	Prof Liz Johnson	Executive Deans of Science Faculties (~40 attendees)
<i>ACDS: WIL in Science Leadership Project</i> ACEN Webinar series Nov 2015, online	Prof John Rice	National WIL community (~30 attendees)
<i>WIL in Science Leadership Project</i> Criterion Conferences: Aligning STEM Education with Employer Need Feb 17, 2016, Melbourne	Prof John Rice Prof Liz Johnson	
<i>WIL in Science and the Lighthouse Projects</i> ACEN Webinar series July 5 2016, online	Prof Liz Johnson, Dr Michael Whelan, Dr Jo-Ann Chuck, Dr Tina Acuna, Dr Susan Rowland,	National WIL community (~30 attendees)
<i>WIL in Science: A national project to develop work-integrated learning in Faculties of Science</i> ACDS Teaching and Learning Conference July 22 2016, Sydney	Prof Liz Johnson	ACDS TL Centre members (65 attendees, Faculty teaching and learning leaders)
<i>WIL in Science: A national project to develop work-integrated learning in Faculties of Science</i> ACSME 2016 Sep 29 2016, Brisbane	Prof Liz Johnson	Science and mathematical science university educations (210 attendees)
<i>WIL in Science: implications for generalist degrees</i> ACEN 2016, Sep 30 2016, Sydney	Prof Liz Johnson, Dr Michael Whelan, Prof John Rice, Dr Jo-Ann Chuck, Dr Rowan Brookes, Dr Blair Nield, Dr Karen Young, Mark Tolson, Dr Tina Acuna, Dr Susan Rowland,	National WIL community (~50 attendees)
<i>Work-integrated learning in biosciences: why, what and how?</i> ComBio 2016, Oct 4 2016, Brisbane	Prof Liz Johnson	Bioscience educators (~40 attendees)
<i>WIL in Science: A national project to develop work-integrated learning in Faculties of Science</i> 2016 ACDS Annual General Meeting, Oct 19 2016, Melbourne	Prof Liz Johnson	Executive Deans of Science Faculties (~40 attendees)

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Appendix 4 | LightHouse case studies

Unifying WIL in Science at the University of Tasmania

November 2016

Project Leader: [Dr Tina Acuna](#), Faculty of Science, Engineering and Technology

Project team: [Dr Andrew Seen](#), [Mrs Nicole Herbert](#), [Dr Shane Powell](#), [Dr Rebecca Gehling](#), [Mr Robert Kingsley](#), [Ms Susie Haley](#)

Objectives

1. develop a generic program for on- and off-campus WIL in Science and related disciplines at the University of Tasmania (UTAS)
2. develop a network of industry contacts for WIL in Science and related disciplines for Tasmania
3. create a Faculty Advisory Board for industry engagement

Background

The University of Tasmania (UTAS) is committed to providing real world experiences for students and equipping graduates with the skills required for participation in national and international work. Work Integrated Learning (WIL) is one mechanism by which students can attain such skills and experiences and improve their employability. The current University WIL policy (May 2011) provides for student placement in industry, but also for on-campus workplace simulations linked with authentic assessment.

The Faculty of Science, Engineering and Technology (SET), comprised of five schools and 11 disciplines, offers a generalist Bachelor of Science (BSc), with 17 majors. Uptake of WIL is far less in the Bachelor of Science than other STEM disciplines at UTAS (including ICT, Engineering, Surveying and Agriculture), many of which have a requirement for work placement for professional accreditation. This disparity is consistent with national trends (Edwards, Perkins, Pearce, & Hong, 2015).

Despite pockets of WIL activity in these other STEM disciplines, the faculty lacked a generic WIL program suited to broad implementation across its disciplines, or a mechanism by which to identify and engage with industry partners.

Project description

Academics, students and representatives from industry were surveyed or interviewed regarding their perceptions of WIL and employability of UTAS BSc graduates. They were also asked for their opinions on a generic placement or project unit to be undertaken for credit by intermediate-level (i.e. second-year) students. Approval from the Human Research Ethics Committee at UTAS was sought to enable the publication of project outcomes (H15699). The project team also liaised extensively with colleagues in other faculties and at other universities to discuss their approaches to WIL, especially in relation to administration, coursework, assessment and industry engagement.

Outcomes

Academics differed in the breadth of activities they classify as WIL independent of disciplinary area. Types of WIL currently offered in the BSc varied from limited to none in Mathematics and Physics, to use of authentic experiences in practical units in disciplines such as GIS and Spatial Science or research projects in Chemistry, Plant Science and Zoology, typically in third year.

Several academics stated that students in their disciplines undertook voluntary or summer vacation work that may meet the professional work requirements of the proposed unit. Consistent with this, 46% of BSc students who responded to the survey (n = 76) preferred to undertake such a unit in the summer semester.

Industry were in general supportive of the proposed WIL unit(s). In interviews, generic attributes of communication, team work and a broad general knowledge were regarded as important to graduate employability. The flexibility in mode of delivery of the unit was positively received, with large organisations more receptive to students working in groups on an industry project, whereas smaller

businesses had a preference for hosting one to two students. The timing of some business activities was in some instances noted to be out of step with the UTAS semesters, which needs to be taken into account when planning for WIL professional placements.

Subsequently, the STEM WIL unit (intermediate level, 12.5% credit KAA205) was approved by Faculty and University Learning and Teaching Committees for delivery in 2017. The unit includes options for students to undertake either a placement or a group project for an industry client, and will embed a new online resource, ResumePLUS, coordinated by UTAS Career Services.

Additional outcomes

In addition to the development of the STEM WIL unit, the project provided a number of extra benefits for the faculty.

- The project provided the opportunity for the Faculty to aggregate within-school activities in WIL. All staff were made aware of the project and unit coordinators invited to participate in project workshops.
- It provided the impetus for the new Faculty Executive to consider how it engages with industry, including the potential inception of a Faculty Advisory Board to facilitate consultation with existing industry stakeholder groups on issues pertaining to learning and teaching, research and community engagement.
- The inception of a Faculty Industry Reference Group or another model will promote consultation on industry linkages in learning and teaching, research and community engagement.
- The general sciences are now represented as a discipline in the UTAS Community of Practice in WIL.
- The development of the STEM WIL unit aligned with a new White Paper on curriculum renewal at UTAS, which includes a commitment to expanding WIL across the university.
- The coordination of WIL across UTAS is proposed to be undertaken by a new Centre for Experiential Learning and includes additional investment in the placement management software, InPlace, to connect students with the workplace.
- The project promoted intra-faculty team work and provided an opportunity for professional development in the scholarship of learning and teaching of junior staff
- The project leader received faculty acknowledgement with a promotion to Deputy Associate Dean Learning and Teaching, and her secondment to the UTAS-wide Curriculum Renewal Project

Recommendations/ advice

A key observation when developing a new WIL in Science unit is to build on the experiences and resources from within the university and other institutions. This however must be contextualised to the degree structure, student needs, industry capacity and available resources.

Next steps

The introduction of the new STEM WIL unit is just the beginning. The project team is currently working on:

- Complementary units, including an advanced-level and extended duration (25% weight) units
- The systematic embedding of WIL in the majors and units in the BSc through the Curriculum Change Project
- Upscaling WIL in Science through facilitation by a new Centre of Experiential Learning and the adoption of placement management software, InPlace – outcomes of the curriculum renewal White Paper.
- Finalising the process for the Faculty Executive to consult with industry.

Reference

Edwards, D., Perkins, K., Pearce, J., & Hong, J. (2015). Work Integrated Learning in STEM in Australian Universities. Final report submitted to the Office of the Chief Scientist. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/ACER_WIL-in-STEM-in-Australian-Universities_June-2015.pdf

Providing WIL across complex interconnected science degrees at Western Sydney University

November, 2016

Project Leader: [Dr Jo-Anne Chuck](#), School of Science and Health, Western Sydney University

Project team: [Dr Chris Jones](#), [Professor Thomas Millar](#), [Dr David van Reyk](#)

Objectives

The project had three specific aims:

1. Identify and compile current activities in the science degrees at Western Sydney University (WSU) that constitute WIL.
2. Determine which new/existing activities can be explicitly incorporated into the Bachelor Science (BSc) programs with a particular emphasis on the appropriateness of the activity with respect to curricula, student development and WIL learning outcomes.
3. Provide an opportunity for students to complete placements/volunteer opportunities and gain academic credit for the activity via reflection on WIL outcomes.

Context

There are eight science degrees offered at WSU, through the School of Science and Health, and only one of these has an explicit WIL requirement. This WIL component is a 'mastery requirement' which has no credit point value, and is completed outside of semester. It is highly likely that there are current WIL activities being undertaken in many of our science degrees, although they are not explicitly articulated or scaffolded. In addition, many students deliberately seek part-time work in their professional area (either voluntary or paid), which could also be considered WIL and should be recognised as such. Others are cognisant of the need for work experience to develop their work readiness skills but, without an explicit course requirement, lack the incentive to attempt this before graduation.

The primary purpose of this project was to provide a platform for introducing WIL as a clearly defined and identifiable component of science degrees at WSU. The project links directly with the University's mission statement and the University Strategic Plan 'Securing Success 2015-2020' which states that WSU is to be a 'distinctively student-centred university' that will 'transform(ing) its teaching and learning environments.... with innovative curricula and work integrated learning' and 'develop more employment-based and volunteering programs and experiences that promote personal development, industry and civic engagement and career readiness'. The draft Teaching and Learning Plan (2016-2020) also explicitly articulates developing WIL experiences in all undergraduate courses. These documents and their timely release indicate the priority given to incorporating WIL in the curriculum and the explicit support for the development of WIL in science.

Implementation

To identify existing WIL activities, we reviewed the learning guides from all core or alternate core units within the eight science programs, using the descriptors of WIL activities outlined by Edwards et al. (2015). We then interviewed unit coordinators (n=71) to verify this information, and map WIL activities against the learning objectives identified by Edwards et al. (2015). Specifically, we focused on:

1. whether WIL activities were present in the unit and if so what type (based on the typology of WIL activities in Edwards et al., 2015)
2. whether there is evidence of scaffolding and linking of the activity in the curriculum
3. a description of the activity including learning outcomes and names of industry/community groups involved
4. whether WIL was clearly articulated in the learning outcomes of the unit.

Academics were also interviewed (with Human Ethics approval) on their perceptions of WIL in the context of science.

Our initial findings indicate that there is more hidden WIL in earlier stages of courses compared with later years. This may be due to academics identifying the need to develop skills, but not communicating how activities relate back to the workplace. We have found variable coverage of WIL learning outcomes and almost no scaffolding of WIL learning outcomes in the science degrees.

To encourage students to be proactive in finding placements during their studies, we developed a unit (level II) that enables students to gain credit for such activities. This unit also includes activities to help students identify and reflect on work ethic, workplace skills, communication, teamwork, independent learning and temporal changes in attitudes and expectations during the experience. In addition to recognizing and awarding credit for the valuable work experience a significant number of our students already engage in, this unit also expands the university's engagement with industry.

Achievements and impact

We now have the data to validate our impression of WIL in our current courses. This has provided the basis for reconstructing some of our courses. We have identified both hidden and explicit WIL, have an understanding of the level of authenticity of the experience and whether it is scaffolded and covers the learning outcomes articulated in Edwards et. al. (2015).

Through our discussions with unit co-ordinators, we have dispelled the ideas that all WIL involves a placement and that embedding WIL always requires radical change from existing practice. For instance, just presenting material with a different emphasis can make WIL more explicit in units. The interviews with the unit co-ordinators, while extremely time-consuming were worthwhile as it also gave us a chance to discuss changes in modern pedagogy, learning outcomes and the engagement levels of the diverse student cohort which we now teach. We are reinforcing the term 'Science Professional' as well as 'Scientist' as an outcome of our degrees and encouraging professional behavioural characteristics from first year.

These discussions also stimulated collaboration between the Health and Science sides of the school, resulting in the sharing of knowledge and practical support with placement administration. The development of the WIL unit involved collaboration with the Careers service, resulting in a stronger relationship and better integration of careers in science.

We have embedded WIL in the minds of academics across Science. As staff are being asked to consider WIL in university documentation, they have responded that they now feel they are empowered to identify and embed WIL in a confident manner. The project team have been asked for input into WIL activities outside of the programs in Science and to work with some professional accreditation bodies to assess meaningful WIL. The profile of the team, with the support of external funding and the power of government report outcomes, has meant that now WIL has a very high profile in our school.

Through the roadshows around the Lighthouse project, several universities have discussed the methods the project has been using to identify WIL and the rubric. Most have commented that our methods are an achievable way to start invoking change in the attitude of staff to WIL.

A summary of our recommendations from this process include:

- identification of WIL activities must include transferability of skills to non-traditional science careers
- listen to staff and communicate – use WIL champions to share knowledge and support, and to build profile
- embedding WIL does not always require radical change from existing practice – some WIL is simply 'hidden', and only needs to be described more explicitly
- reinforce the concept of 'Science Professional' (to both staff and students) as an outcome of a science degree

Emerging Issues and next steps

It is imperative that students graduate not only with core discipline knowledge, but also with professional skills and capabilities. We are yet to evaluate how the first groups of students engage in the new WIL unit, and entry is restricted until the unit has been trialled. Implementation will determine: demand for the unit; developing appropriate and genuine assessment, and placement of the unit as an alternate core in the B.Sc. (Advanced) and B. Med. Sc. (Advanced) competing with traditional lab based research projects.

Areas yet to be addressed include:

- defining what is the minimum WIL that should be provided via courses and which WIL learning outcomes could be delivered by other areas of the university (e.g. Careers)
- reviewing WSU degree structures with WIL prominent in these discussions
- creating WIL as 'having a sense of belonging to the profession' which encourages a cohort network amongst students and supports targeted activities earlier.

Role of the WIL in Science project

The project has had a significant impact on WIL in Science at WSU. As outlined in this report, a review of the science courses is underway, and will consider WIL alongside discipline threshold learning outcomes and graduate attributes. As a direct result of participation in this project, the Dean and the university acknowledge the project team as sector leaders and 'champions' in sharing knowledge and application of WIL in science.

Exploring alternate models for WIL in Science: Linking Work with Learning at the University of Queensland

December 2016

Project Leaders: [Assoc. Prof. Susan Rowland](#) and [Professor Peter Adams](#)

Project team: [Dr Deanne Gannaway](#), [Ms Robyn Evans](#)

Project summary

This project explored an alternative model of WIL in Science, linking students' extant work to explicit learning about their skills as science undergraduates and their employability in science and non-science-focused jobs. We propose that students in any type of work (science or non-science) are gaining valuable skills for employment; what they lack is the ability to recognise and articulate these skills. We aimed to develop an academically rigorous curriculum that (i) enabled students to evidence and articulate their development and understanding of multiple transferable skills that are commonly gained during work and (ii) helped students explicitly link these learned skills to their future careers in science. Our pilot project used a small group of student volunteers and an abbreviated "course" to examine how our proposed curriculum would work for Science students.

Context

This project was conducted in the Faculty of Science (FoS) at the University of Queensland (UQ). UQ is a large public university, and the FoS is a large Faculty, comprised of 7 schools. FoS courses serve over 10,000 enrolled students each year, and classes in first and second year Science programs regularly exceed enrolments of 500.

WIL in FoS is delivered in a fragmented and uncoordinated way, championed by individual academics. There is no central WIL office or staffing group. Despite staff keen to see students and industry engage, the FoS struggles to offer industry placements to large numbers of students, particularly those who are not "elite" academic performers. This paucity of WIL opportunities is consistent with a recent Australia-wide study that showed the proportion of science students who engage in WIL is very low [1]. This project aimed to address the issues of scale and varying student abilities and interests by providing a way for students to get course credit for paid work or volunteering that they are already doing.

The proportion of our students who can participate in this program is substantial. In 2011, about 50% of Australian students aged 15-24 worked part time, while 42% of students aged over 25 worked full time as they studied [2]. Students on international visas can work up to 40 hours per fortnight during semester [3]. UQ students have work patterns that echo these statistics. For many students, paid work is a financial necessity, which may limit their capacity to engage in WIL placements. For many others, it is a healthy social outlet that develops core life and employment skills.

We argue that any form of work is likely to develop non-technical, generic, transferable employability skills such as problem solving, interpersonal communication, professionalism and organisational skills. Clearly this is of value – STEM employers identify critical thinking and problem-solving capability as the most important graduate attributes for new hires [4]. Crucially however, work experience does not automatically result in students being able to explicitly articulate their learning [5]. This type of metacognition requires a reflective process that supports a transformation in understanding [6]. Conversely, teaching employability skills has little effect on employability unless a student is also placed in a workplace [7].

Approach to implementation

In this project we (i) developed a transformational curriculum model; and (ii) tested and evaluated a prototype curriculum prior to implementation as a formal course in 2017.

This curriculum differs from conventional WIL experiences in that it revolves around work that a student is already doing (or may have done recently). Unlike WIL curricula commonly used to raise awareness of gains in generic employability skills, this project aimed to raise students' metacognitive skills by facilitating a deeper understanding of learning gains and explicitly foregrounding science learning in

workplace settings. As a foundation for the curriculum the project team engaged in much friendly and philosophical discussion to build the four Learning Objectives shown below; we also presented these Objectives to colleagues in the FoS for comment and discussion. We named the program SCIWILWORK as a placeholder, until a proper course name can be decided.

Learning Objectives for SCIWILWORK

Upon completion of the proposed course a student will be able to

1. Critically reflect on experiences in the workplace and explicitly link those experiences to potential employment opportunities as a science-based professional.
2. Have awareness of strengths and capabilities cultivated in a BSc and be able to articulate how those attributes can be applied in a workplace
3. Critically read the literature related to science employability and apply this knowledge to a reflection on current work experience
4. Present a learning portfolio that charts their development through the course, reflects their skills and interests, and provides a plan for their career development

The prototype curriculum to address these Learning Objectives was built on a series of five fortnightly evening meetings, each two hours in length. We recruited a group of volunteer students as participants and offered compensation of \$100 to students who completed all aspects of the program. Students were given a light dinner at each workshop and students who completed a “half-time” and a “post-pilot” interview with the research team were given an additional \$20 for each completed interview. Our initial group of recruits consisted of 35 students; there was significant attrition after the first information session (probably because students realised the commitment required to be part of the pilot). Fifteen students attended the first program workshop, and 12 students finished the program.

During the workshops students drew on their extant experience of work and discussed set readings of scholarly literature about work-related learning, work-related behaviour, and self-management. Students engaged in scaffolded critical analyses of these papers, reflected on how the findings contributed to their understanding of their workplace, and conducted self-evaluations. In one workshop five recent BSc graduates came and spoke with the students for 90 minutes about their pathways to work. Academic staff members facilitated the workshops, and discussions in the classes were lively, insightful, and sometimes surprising.

Out of session, students completed a series of activities that included peer mentoring, reflective exercises, interviews with our research team, and interviews with science graduates. At the end of the program students submitted and presented a “Me in three” talk in which they explained what they had learned from the project. Evaluation data were collected from multiple source, including student and facilitator perceptions of curriculum effectiveness and student learning gains via surveys, interviews, and examination of learning artefacts (written responses and talks given by the students).

Achievements and impact

This project provided a platform for discussion and discovery, with our academic colleagues expressing mixed opinions about whether it was an appropriate offering for Science students. Some colleagues were very supportive of the initiative – they expressed their concern about students and indicated that, in their opinion, our duty of care to students meant we should definitely be working to help students build their employability. Other colleagues saw the initiative as “soft”, lacking in rigour, and superfluous to a Science degree – they indicated that students should not do this activity in a for-credit course because it interfered with their deep content learning and disciplinary mastery.

In developing the curriculum for SCIWILWORK we are walking the line between helping students develop transactional employability skills and helping them develop a deep a set of transformational understandings about themselves and their identities as scientists. Although we sense that science academics at our university are willing to allow the transformational component to be part of the for-credit curriculum, we suggest they are less enthusiastic about the transactional learning. There is a feeling amongst our colleagues that transactional skills should be taught in co-curricular programs (e.g., by student services). What we found, however, is that many of the activities in the program helped develop both the students’ transactional skills and their understanding of the transformational value of a science education and of work. Additionally, although all the students had access to UQ student services,

they had not used them to any great extent, suggesting that co-curricular implementation of the SCIWILWORK activities is likely to have minimal uptake and impact.

This work helped us understand that our students need help understanding and articulating their value as Science graduates and their places in the continuum of the science community. One student stated, “Scientists are not creative”, while others questioned the value of understanding the history of one’s discipline. When asked to write down their strengths, one student was unable to write anything other than “knows science”, and many were surprised to find that they had multiple skills and attributes they had not previously considered saleable.

Our students also need help with the basics of finding work. For example, none of the students understood that (i) job advertisements have explicitly articulated or implicit selection criteria, and (ii) these criteria should be addressed in an application. They also lacked basic awareness of how to articulate their skill sets to others in an interview situation. Clearly they need instruction and practice in these basic skills.

Very pleasingly, not everything we learned from the students was a cause for concern. The classroom discussions were lively and fun. Students were keen to meet each other and support each other as they learned and progressed. As they described their weaknesses to each other they offered to help by teaching skills, acting as critical friends, or taking other students into social situations that they found challenging. The students were also eloquent and articulate, once they learned that they were required to prepare for and speak in the classroom. They had interesting opinions, and they developed the capacity to argue with one another in a positive and respectful way. They asked that one of the rules of the classroom be “in the beginning of each workshop we take 5 minutes at our table to get to know each other”. They also quietly came to academics in the room, presented problems at work, and asked for help using their newly learned phrase: “I would value your advice”.

The feedback during the “Me in Three” sessions was extremely positive. Quotes from three students are shown below.

Me in three quotes from three student participants

I learnt that I need to market myself not as a student but as a future professional. Engaging with everyone as a potential person that may know someone to employ me has made me optimistic about how I can grow my network. (Student 1)

Through the program, and really identifying the skills I already had and the skills I was learning in my Science degree, I have actually applied and interviewed for a job (after really addressing the selection criteria!!). Without completing the SCILWORK program, I would not have even considered applying for this role. So, all being well, this is the direction my career will take from now. (Student 2 – post-script: the student did get this job!)

The most impressive session for me is mentor and mentee activity. As a mentor, I needed to get myself well-prepared and tried to link the message to the daily activities of the mentee. By doing so, I can engage and interact more with the mentee. As a mentee, it is a great opportunity for me to learn from others. During the process, I paid extra attention and showed great interest. I found that asking questions is an effective way to interact well with the mentor. (Student 3)

Our experience suggests there is a need for a tailored, for-credit offering like SCIWILWORK in the BSc program at UQ. We believe that what we have done is embedded beyond the project and that it will continue to evolve as an initiative that will be offered to students in the FoS.

Emerging issues and next steps

We will continue to develop this unit during 2017. The curriculum and its evaluation will be presented to academic staff in FoS and other engaged stakeholders for consultation. After any required amendments, the curriculum will be submitted in 2017 for establishment as an elective course in FoS degree programs.

Our next challenge is to embed employability and work-readiness training into the BSc at UQ. There are several ways in which we can do this. One option is to provide a full 2-credit course that is dedicated to developing employability – something very similar to SCIWILWORK, but in an extended form with a full set of workshops and assessment items. Another option is to develop a set of activities that can be fitted into courses at various levels of the degree to help students develop their employability. Both approaches

have merit, and both will be explored in 2017 through a UQ Teaching Fellowship awarded to team member Rowland.

The UQ Student Strategy will also provide funding for each Faculty to develop a WIL program. Our team will work closely with the FoS to help define how best to develop and sustain WIL for our students. We will begin by mapping all of the WIL activities that are currently offered in the BSc.

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Development of professional skills in science students through a work integrated learning honours stream at Monash University

January 2017

Project Leader: [Dr Rowan Brookes](#)

Project team: [Dr Chris Thompson](#), [Ms Lisa Happell](#), [Dr Tim Connalton](#)

Objectives

This project aimed to support honours students in learning how to engage effectively with industry partners to complete an industry-based group project. This involved the development of online resources targeting priority areas of learning and development for science graduates, as identified by employers and students themselves.

Context

At Monash University, WIL activities in science are primarily operated through the Faculty of Science office under the leadership of the Dean, although some WIL activities take place within specific Schools (e.g. Chemistry). The Short Term Industry Placement Program, an extracurricular program in which students do 80-hour placements in industry, has been run by the Faculty for several years. School-based activities include embedded industry-aligned practicals. To support WIL, the Faculty also has an embedded Careers Consultant. The provision of WIL activities, including placements, projects and internships, is supported by Monash University's strategic plan 'Focus 2020' and 'The Monash Better Teaching Better Learning Agenda' from the Office of the Vice-Provost (Learning and Teaching).

The Faculty offers three undergraduate science courses – the Bachelor of Science, and two advanced Bachelors of Science (Honours) – a Research program and a Global Challenges program. The Global Challenges program was introduced in 2014, and the honours year of this degree, due to run for the first time in 2017, is the focus of this Lighthouse project. The degree develops skills in leadership, entrepreneurship and science diplomacy along with a science major and has a strong focus on building employability skills. Students are required to complete two internships (including at least one international internship), as well as the WIL-focused honours year (the WIL Innovation Challenge). The degree is overseen by a Course Director, with input from an honours year coordinator and administrative support to assist with industry engagement (e.g. contracts) provided by the Faculty.

Implementation

For the WIL Innovation Challenge, we have partnered with a number of external organisations, who will each provide an authentic workplace challenge for students. The students will then work in cross-science-disciplinary groups to design creative and feasible solutions for their particular problem. The assessment is focused on how they are working towards delivering project outcomes, with the traditional research component of honours reduced to 20 percent of the assessment.

Sample challenge: Ever wondered what the air quality is like on your street? Or how noisy the local road is? Access to local environmental information is critical in helping people connect with their local environment and make informed choices about their health and wellbeing. Join the Environment Protection Authority Victoria to design, build and test the next generation of 'smart sensors' and assessment techniques for monitoring urban micro-environments.

The students will receive support from faculty staff, as well as input and mentoring from the industry partners. They will be based on campus with site visits and meetings with industry partners. To prepare students to work effectively with their industry partner, we developed a series of online modules:

- 'Getting to know your partner'
- 'Your skills in the workplace'
- 'Getting started on your project'
- 'Professional etiquette'

To ensure the online modules would effectively prepare students for their projects, we:

- held focus sessions with industry partners and alumni about their needs relating to the students professional skills and knowledge;
- obtained feedback from students and the project team on proposed learning outcomes;
- engaged with alumni to feature in the video content as subject matter experts.

The modules and other learning materials were designed and developed by an educational developer, the Faculty Moodle designer and a careers consultant.

The modules are hurdle requirements – students are required to complete them, but they are not assessed. We interviewed the industry partners talking about the types of skills and attributes they want students to exhibit, and have included parts of these interviews as videos throughout the modules. The modules are designed to encourage students to reflect on their skills and capabilities, what they might need to work on, and how they can apply their knowledge and skills to their projects.

Emerging Issues and next steps

The challenge that remains for 2017 is to successfully implement the inaugural honours year.

Some of the big unknowns include:

- Whether students are sufficiently equipped with skills and knowledge from their degree to work in this manner.
- What approaches the academic supervisors, industry partners and honours coordinators should use to work together to support the students.
- How the students best engage across the university and with industry partners to support their own learning.
- Whether the learning materials are appropriate for this degree.

Pending the successful implementation of the WIL Innovation Challenge with the Global Challenges cohort, the Faculty aims to extend this honours option to BSc students in 2018.

In 2017 the Faculty of Science will extend their WIL program with a new ‘for-credit’ industry placement unit. In addition, a new Masters program with an industry placement unit will also be launched.

WIL programs are enormously rewarding for all parties involved, but engagement with industry requires significant time, delicate negotiations and a strong understanding of industry and university needs. This type of role, and the workload associated, requires dedicated and highly competent staff. Appropriate resourcing of these units is one of the biggest considerations for the sustainability of WIL in the Faculty.

Scaling-up Professional Experience Programs: developing a framework to support broad-based WIL at the University of Technology, Sydney

January 2017

Project Leader: [Professor Peter Meier](#), University of Technology, Sydney

Project team: [Dr Blair Nield](#), [Professor Graham Nicholson](#), [Dr David van Reyk](#), [Ms Shima Baradaran Vahdat](#), [Ms Vikki Banks](#)

Objectives

This project focused on scaling-up existing WIL activities within the Faculty of Science at the University of Technology, Sydney (UTS) to:

- Make a step change in the level of WIL activity and comprehensively embed WIL in the curriculum across all Science disciplines;
- Create an effective leadership team to ensure ongoing engagement with academic and professional staff; and
- Ensure project sustainability through the creation of frameworks and structures that support the ongoing implementation of WIL.

The aim was to build upon existing programs and experiences within the Faculty and embed them in a more systematic and sustainable way. Attention was equally focused on the development of student skills and professional identity, as it was on industry-based placement of students.

Context

The University's strategic plan focuses prominently on the development of students' professional identity and a Vice Chancellor's directive has been focused on the delivery of an internship or internship-like experience for all students. This is supported through centrally-operated units such as Student Services and the Careers Service. Otherwise, Faculties are expected to deliver on programs developed within the context of their specific disciplines.

The Faculty of Science offers approximately 40 courses, including single and double degree options across 11 science disciplines. WIL activities, including clinical or research internships, industry placements, WIL-based learning activities and assessments are sporadically evident across different programs. One of the primary aims of the project was to systematise these approaches and ensure that WIL was effectively embedded and sustainable across all programs. Consequently the project was led from the portfolio of the Associate Dean Teaching and Learning with the support of the Associate Dean International and External Engagement.

Prior to the establishment of the WIL project, the Faculty was engaged in several WIL-focused activities, including:

- A for-credit elective subject Career Management for Scientists, run jointly between the Faculty and central Career Services unit, which focuses on students' ability to research and understand the requirements of employers of science graduates and to develop professional skills and behaviours
- Assessment activities that focus on employability e.g. writing job applications or mock interviews, embedded within several subjects (but not comprehensively within the curriculum)
- A comprehensive, internship placements program for Chinese medical students including international placements; internal placements (organised by UTS staff); and external placements (found and organised by the students) involving training and assessment activities
- The Professional Experience Program in Biomedical Science which is a Faculty supported program for the placement of students into industry-based internships and includes a screening, training and assessment program
- Research internship subjects offered to students on application but dependent on availability of suitable supervisors and projects. These can be taken internally or externally

This project was aligned with the wider institutional goals and closely aligned to the Faculty strategic plan. Project plans were subsequently embedded into Faculty processes and operational activities and senior management within the Faculty lead the project to ensure that it had sufficient gravitas.

Implementation

The team undertook an audit of current WIL activities and developed a set of strategies relating to curriculum renewal, scaling and development of individual placement programs, and the creation of administrative processes to streamline and support internship activities. Wherever possible, these activities were integrated into existing Faculty or University initiatives. For example, the Faculty is implementing the Learning. Futures initiative as part of a curriculum renewal process whereby student-centred blended learning activities are encouraged. Small project funds were made available to staff who proposed to develop and integrate WIL-based activities into their subjects. In another example, the University moved to a three-session, balanced period teaching calendar in 2016. As part of this initiative, the Faculty sought to restructure its programs to ensure there was a session (semester) free block in programs to allow for a minimum 12 week internship placement. This initiative was driven by feedback from host organisations indicating their preference to have students on site for a block period of uninterrupted time, which would not normally be possible if students had to attend standard classes. Those students not partaking in an internship or international exchange, or undertaking a part time placement could still enrol in standard subjects.

The individual components of the project such as course restructure, development of training programs, development of virtual internships etc were assigned to academic champions. Standard project management processes were applied and wherever possible, new projects were integrated with existing systems and processes. A small centralised administrative team was established to support academics in the implementation of the project and to deal with enquiries from host organisations and students.

Achievements and impact

There were several major impacts from this project.

Foremost, the project helped the Faculty focus its attention on WIL in a strategic way. This allowed the Faculty to leverage resources and ensure that WIL was effectively integrated into programs, rather treated as a bolt-on activity. This indicated the beginning of a cultural shift towards understanding the importance of WIL integration in an explicit, rather than implicit way.

Through the curriculum renewal process a number of achievements were realised:

- A number of subjects were redesigned to have authentic assessments based on WIL experiences which moved the emphasis away from content and focused on the process of learning. The learning activities were mapped against graduate attributes and threshold learning outcomes in a cumulative way across programs. The outcome of the mapping is yet to be finalised. This process clarified the need for the development of a graduate attribute that explicitly articulates WIL and this will be achieved in 2017
- Fifty percent of our courses were restructured to ensure that four elective subjects could be taken as a block in one session (semester) to facilitate external placements. This had an indirect benefit of supporting international exchange. The remaining courses will be restructured in 2017
- A suite of new subjects with 6, 12, 18 and 24 credit point structures were created to allow for the flexibility of students to take partial or full semester internships either stand alone or in combination with core subjects. These new subjects have been standardised for broad learning outcomes and assessment and have replaced previous subjects which allows for a more streamlined approach to the integration of WIL activities and learning outcomes.

A significant degree of work was undertaken to rationalise processes for external placements including issues around insurance, voluntary vs paid placements, academic assessment by host organisations, work health and safety requirements etc. As part of this, a very modest administrative support structure was implemented. Effective relationships were also built with central support units to ensure effective and streamlined communication protocols for host organisations were implemented. This involved partnerships in the development of pre-internship preparation workshops and application processes for placements.

The table below indicates some of the success achieved specifically in relation to professional placements. Of particular interest is that more than 30% of students find direct employment success through their internship programs (excluding the Chinese medicine program where students move into private practice after graduation).

Placement Program – percentage of students who find direct employment success through their internship programs	2015 (%)	As of Nov 2016 (%)
Professional Experience for Biomedical Science	26	52
Research Internship Subjects	67	73
Voluntary Placements – not for credit	51	46
Chinese Medicine Clinical Placements	60	60
Science Internship Project (new)	NA	10
Other (eg paid internships)	NA	2

Emerging Issues and next steps

One of the emerging issues identified was the need for clear definitions on what constitutes WIL activity, and within the context of the UTS environment, a definition specifically in relation to what constitutes an internship or internship-like experience. A debate over the definitions led to an audit of explicit (directly linked and assessed) an implicit (indirectly linked and possibly assessed) WIL within the Faculty. The outcomes of this audit will be known in 2017 and will assist the Faculty in further clarifying and embedding WIL within the curriculum. The outcomes of this project will result in the development of strategies that focus on WIL skills development and authentic assessment. To ensure sustainability of WIL, the project will be integrated fully with the Faculty curriculum review process and the University's Learning Futures initiative.

A major challenge identified through the project was the need to provide internships at scale within a competitive market. It is estimated that approximately 1000 placements per year would be required. This has prompted the Faculty to adopt new approaches to internships, including rethinking what an internship may constitute and how placements outside of the traditional science workplace may be integrated into a science course experience. The Faculty is also funding the development of a virtual internship program for students across Faculties within the University.

Fundamental to the success of any of these programs however is the need for the creation of formal leadership structures that recognise the work and value of staff contributions. Equally, while the Faculty has invested in administrative support, the degree of administrative support remains very small by comparison with other disciplines such as Engineering or Business. It is clear that if universities want WIL to succeed in Science in a sustainable manner, further and ongoing resources will have to be found.

It has also become clear that there will be an emerging need for a national benchmarking system for WIL which would involve the voluntary sharing of data and hosting of these data on a neutral site such as the ACDS. Potential points for comparison could include things like the number of students on placements, student and host organisation satisfaction, and employment success among other metrics.

Learning to Work, Working to Learn: Curriculum design and teaching practice for WIL in the Natural and Physical Sciences at Deakin University

January 2017

Project Leader: [Professor Malcolm Campbell](#), Deakin University

Project team: [Dr Adam Cardilini](#), [A/Prof Jo Coldwell-Neilson](#), [Dr Sharon La Fontaine](#), [A/Prof Stuart Palmer](#), Ms Shannon Rogers (Intern), [Mr Mark Tolson](#), [Dr Karen Young](#)

Objective

This Lighthouse project set out to build the capacity and capability of key faculty academics to design and deliver a coordinated approach to graduate employability through the development of scaffolded curriculum initiatives.

Employment rates for graduates from the discipline of Natural and Physical Sciences is poor in comparison to disciplines such as Engineering, Information Technology, Architecture and Built Environment, and to non-STEM disciplines. This is also true for the Natural and Physical Sciences at Deakin. As an institution, Deakin is redeveloping its graduate employment focus through new policy development, cross-faculty strategy groups and engagement with industry and corporate organisations. This focus is welcomed but requires student engagement to occur through course and discipline initiatives within the existing curriculum.

The Faculty of Science, Engineering and Built Environment (SEBE) at Deakin has had a longstanding curriculum initiative for all undergraduate courses to provide students with a WIL opportunity. Currently, these student offerings are not coordinated, scaffolded or organised to any large extent in ways that allow students to evidence growth in their learning about work, skills and employment. The curriculum initiatives are offered as a mix of faculty and discipline based units and while there is cooperation and sharing between teaching staff, differences exist in the understanding of academics around WIL, its purpose, its delivery approaches, but more importantly its assessment. Given the range of courses on offer in the Natural and Physical Sciences space (including environment), the project sought to provide resources, exemplars and workshops for course directors in order to build a coordinated and broader approach to employment opportunities for our students.

Context

At the beginning of this project, Deakin was in the early stages of developing an institutional approach to graduate employment. Two themes were developed. The first involved engaging faculties in improving student access to career education, linking students to employers through events and other activities, and building an on-campus 'freelancing' hub. The second required faculties to develop discipline-based WIL curriculum initiatives, however SEBE was already well down this path.

Over the past four years SEBE has been developing WIL initiatives across all undergraduate courses. Through a small cohort of dedicated academics, a range of 'professional practice' curriculum initiatives have been introduced. The faculty developed three implementation models which were developed as core units: A zero-credit unit which introduces students to WIL; a 80-120hr discipline-based placement unit; or a unit focused on developing professional practice (non-placement unit). Each course would only use one of these options. In addition to these WIL opportunities, SEBE also offered Internships and Industry-Based Learning opportunities as elective units.

In developing its WIL Strategy, SEBE has recruited a number of specialist academic and professional staff to support the program. Two WIL academics provide curriculum leadership and support to the discipline-based programs. These academics also deliver the elective Internship and Industry-Based learning program. One professional staff member provides the administrative support for the program including student recruitment and the management of industry scholarships. A more recent professional staff appointment was an Industry Engagement Manager who develops the industry relationships to support our programs.

Within the Science discipline in the Faculty we also have two academics who teach into the professional practice program. These academics have taken on this role in addition to their discipline-based teaching. Their role is to oversee the placements undertaken by students and to provide assessment tasks that evidence student learning. The School provides administrative support to manage placement contracts.

This WIL strategy has been successful in getting students into the workplace but in reviewing our WIL activities and anecdotal employer feedback, a number of issues were identified:

- the program survives on student-initiated placements, but students do not have a good understanding of the range of possible industries and employers that they can approach, leading to many students wanting to work with a limited range of employers
- students who go out on placements are well prepared in science but are often not well prepared for the workplace
- the development of workplace skills is not scaffolded very well within the curriculum
- WIL is not well understood by students and they misunderstand what is required to demonstrate learning
- WIL is not well understood by academics and therefore different explanations and expectations are projected to students.
- there were not well established assessment standards that allowed academics to have consistent approaches to learning and evidencing learning.

The WIL Lighthouse Project was an excellent opportunity to allow the Faculty to address some of these issues and develop solutions that will allow the program to deepen and grow.

Implementation

The goal of this project was to work with course directors to improve their understanding and ability to implement within curriculum, a range of WIL opportunities that students value and use to find employment, either within their discipline or outside their chosen discipline. Clearly, improved employment outcomes are a key indicator of success but these are never immediate and are often affected by external factors. Other outcomes indicating success include the way students apply knowledge and skills after having WIL experiences, the professionalism they demonstrate before or after graduation, the range of industries that are placing students, and the feedback that employers provide about our students. However, a key criterion for success will be increasing the number of academics who are engaged in delivering WIL experiences to students. We started with course directors but they will need to become the mentors for the academics who teach into their courses.

As part of this project, the Faculty created the WIL Steering Group, comprising the project team and the academics currently engaged in delivering WIL opportunities to students in the Science discipline. The Steering Group had two main tasks: to define WIL within our context; and to develop an understanding of how we could consistently assess students.

In delivering these two outcomes for the Faculty, the project team conducted three workshops with the course directors of Bachelor degrees in Biological Science, Biomedical Science, Environmental Science, Forensic Science, Science, and Zoology and Animal Science. All course directors attended at least one workshop. A number of course directors attended all three.

The workshops focused on identifying the current understanding of how course directors perceive WIL and how they think WIL should be located within the course curriculum. The project team took the outcomes of the workshops to identify how WIL should be defined, what curriculum activities can be classified as WIL and what is not WIL, and what would constitute appropriate scaffolding activities. This thinking was continually referenced back to the Course Director group.

The project intended to complete a formal survey of existing employers engaged with our WIL program, however this was not possible within the project timeframe. Instead, an informal discussion with a few employers was completed to collect their perspectives of WIL and the programs we offer.

Achievements and impact

The project has allowed the Faculty to formally present a coherent view of WIL to staff and students. We have been able to define what WIL is within our context and what it is not. The most significant part of the project was finally defining what WIL means to us:

Work Integrated Learning (WIL) describes the intentional learning activities that expose students to authentic and proximal opportunities to help develop the transferable skills for employment, further education and active participation in their community.

WIL activities should seek to provide students with the opportunity to learn how to apply specific discipline knowledge, skills & practice in the workplaces of the future.

We have embedded WIL in the minds of Course Directors across the science discipline. They have responded that they now feel empowered to identify and embed WIL in a confident manner and that this aspect of their work is important in the development of their courses.

The development of a community of practice has been the most significant aspect of the project. The WIL Steering Group established as part of this project has been retained by the Faculty and expanded to include each of the disciplines within SEBE. This is a great achievement and will lead to further development of WIL within new contexts. The Steering Group has members who are also part of the Deakin-wide WIL initiatives and so the ideas developed through this project will begin to gain a greater audience as we communicate our outcomes more generally.

The continuation of the WIL Steering Group also means that we can continue to drive subtle and then pivotal changes through good practice and scholarship. It has also allowed individuals to identify themselves as leaders in this domain and feel empowered to be innovative in their contextualised curriculum, to create space for creativity and try things is needed to allow curriculum to be enhanced. The Group have also developed a Faculty WIL Fact Sheet that describes WIL in our context and provides the language and concepts around which we build WIL.

Mapping of WIL in the curriculum has been a frustrating process, in that it maps intentions and not outcomes. Regardless of how good the chosen language and schematic of the unit curriculum description, or even the detailed unpacking of the meanings for each criterion through systems such as rubrics, the interpretation of the analysis of assessment levels and types to the mapping criteria will always involve an element of subjectivity. Only when we are better at evidencing the outcomes of learning will we be able to map WIL in the curriculum. However, we have continued with the current process of mapping, not because it provides something useful in its own right, but because it is a useful place to begin the conversation with course directors about what innovations are possible.

The outcomes from this project show that by increasing the level of authenticity (how closely the learning activity aligns to tasks within the workplace) or proximity (the closeness of students to existing practitioners) of assessment items allow students to have an industry-oriented and relevant course that will improve their opportunities for employment, wherever they choose to land upon graduation, and beyond. The difficulty is to situate authentic and proximal opportunities in a scaffolded way within the curriculum. One idea that the Steering Group will continue to follow is to focus on authenticity that is enhanced through proximity rather than striving for both. This will allow our programs to be more sustainable and scalable over time.

The project team identified a number of WIL opportunities that are not placement based. The challenge is to shift thinking that WIL is really about placements and placements are really just work experience. WIL is about learning outcomes and so, a focus on non-placement WIL will be a priority in the future.

We have made a number of observations in working with employers. Employers like to engage in placement WIL for a number of reasons. These are well documented in the literature and centre on accessing a talent pool of potential employees who bring new ideas into the workplace culture. However, we found that employers struggle with low return on investments, particularly with short-term placements, low take-up by some student cohorts, cumbersome paperwork and long lead times. These issues need to be addressed if we are to improve placement-WIL.

Emerging Issues and next steps

We continue to struggle with the term 'WIL' or 'Work Integrated Learning'. It is not a widespread term that is well understood by industry, students or academics. The project team thinks that a more engaging and universally accepted term would make the concept of WIL more attractive. Our dilemma was that we could not find a better term.

We need to improve the culture of new students to engage more fully in WIL and to prepare better. We also need to improve the culture of workplaces to be more amenable to taking on students in placements. While students complete these activities for credit, to fully engage students need to be paid for the work that they do. Many students need to forgo their part-time paid work to take up short

periods of full-time unpaid work, albeit within their discipline. This needs to change if placement WIL is to be more successful.

The project team believes that we have developed a workable WIL strategy; work still needs to be done with the middle years of a course. We provide career development and WIL introductions for beginning students and placements often occur within the final year of the course. The project has allowed us to recognise that we need to focus more on non-placement WIL opportunities in the middle year(s). This will allow students to obtain a more valuable experience when they do complete an extended placement.

Appendix 5 | Summative evaluation of Lighthouse projects

The purpose of this evaluation was to understand the effects of the *WIL in science: Leadership for WIL* project led by the Australian Council of Deans of Science (ACDS). The evaluation process began with the commencement of the WIL in Science project and concluded with the completion of the lighthouse projects.

Evaluation approach

Project leaders of the six *WIL in Science Lighthouse Projects* were interviewed to explore project focus and implementation, and project approaches, benefits, challenges and outcomes. Specifically, interviews sought to determine how participation in the *WIL in Science Lighthouse Projects* helped to:

- establish visible WIL organisation and leadership in the interviewee's Science faculty;
- raise awareness of the place and importance of WIL in Science related disciplines;
- influence the development and embedding of WIL into course delivery;
- influence personal outcomes and outcomes for the organisation as a result of participation in lighthouse projects; and
- have broader impact/influence beyond the organisation.

Formative evaluation throughout the project was conducted through survey of network members, commentary from the expert advisory group, and survey of workshop participants to establish visible organisation and support for leadership in work-integrated learning. The results of the formative and summative evaluation were triangulated to check for consistency of outcomes reported, and to develop an understanding of the impact of the *WIL in Science: Leadership for WIL* project.

Notes and observations presented in this report are based on interviews conducted with project leaders of these lighthouse projects. These discussions also touched on many broader aspects of their work in teaching and learning. Conversations during the interview were pleasant and friendly and the project leaders were enthusiastic about sharing the outcomes of their team's work.

It is important to note that the project leaders were recognised champions of teaching and learning in their home institution. Their overwhelming enthusiasm, and report of project outcomes themselves are evidence of significant effects of the *WIL in Science: Leadership for WIL* project. The report also captures further areas for work and opportunities identified by the project leaders for improving WIL in science related disciplines.

Interview themes

Common themes emerged from interviewees.

1. **Focus:** interviews revealed that science faculties at the participant universities in the lighthouse projects were at different stages of conception, development and implementation of work-integrated learning.
2. **Benefits:** a very positive picture emerged from project leaders about the immediate benefits of their involvement in the lighthouse project. Benefits attributed include: horizon scanning & collaboration, strengthening understanding of WIL, refining work done so far, meeting and influencing university strategic priorities for WIL, recognition, reward and opportunity for career progression.
3. **Challenges:** interview participants acknowledged a number of challenges while noting the opportunities and time that this project provided to reflect on the challenges. Common challenges included:
 - staff engagement, resource availability, competing priorities and lack of time;
 - cultural challenges such as changing perceptions of employers and academics, and changes to academic work
 - curriculum challenges to include intentional industry-engaged learning, authentic assessment and employability skill outcomes;
 - identifying appropriate industry placements;

- absence of leadership and associated lack of support and advocacy
 - scaling up particular initiatives
 - making WIL a systemic approach
4. **WIL implementation:** interviewees suggested that the challenges for WIL are the same across disciplines and suggested the key to successful WIL implementation is to have clear goals and vision, understand the impetus for WIL, and start with something that you can succeed.
 5. **Improving WIL in Science:** Although not overtly expressed, during discussion it was clear that the biggest challenge that the project leaders faced was changing the perceptions of stakeholders.

Findings

Discussions revealed that the *WIL in Science Lighthouse Projects* were quite different, yet timely and provided the opportunity for review and reflection on current practice. The characteristic differences in the project focus, and the way they were developed and implemented indicated varied levels of work-integrated learning and approaches to work-integrated learning in the host faculties and institutions.

The project leaders reported harnessing renewed discussions around what work-integrated learning is, and how work-integrated learning could be implemented in participant institutions. The obvious focus was on students and what employability skills were important for them to achieve before graduation.

Interview participants reported the benefits and advantages of having the opportunity to promote their work, talk to colleagues about initiatives in other institutions and sharing practice and strategies. In some cases, they reported the real benefit was in challenging their practice to evaluate if current strategies are effective in achieving the vision for WIL.

Some participants are reported personal benefits as a result of their engagement in the WIL in Science lighthouse projects. It appeared that recognition and reward boosted the morale of participants and motivated them to do better. But the most valuable benefits were notable from the influence these individuals have had within their faculty and institution.

However, the most important outcome that surfaced from discussion in the interviews was the shift in thinking or rethinking that the lighthouse projects promoted within participant institutions among various stakeholders, including students.

Without doubt, the WIL in Science project has contributed to the development of leadership and mentoring activities in institutions. Statements of impact from the project teams, their commitment towards WIL outcomes for students and their work in the lighthouse project provide ample considerations for ongoing work. Despite contextual challenges faced by the project teams, participants pointed out the opportunities these challenges provided and the learning they have achieved for the future.

Project leaders also had a common view in terms of the challenges in implementing WIL. They suggested that the challenges for WIL are the same across disciplines. The key to successful WIL implementation is to have clear goals and vision, understand the impetus for WIL, and start with something that you can succeed.

Conclusion

To conclude, the project activities seem very appropriate and timely to build graduate employability outcomes within Science related disciplines for the reasons the project team identify. The lighthouse projects in particular have provided the impetus for building capacity, to design and deliver WIL programs through collaborative discussions and sharing of strategies and practice through the national network of Science WIL leaders and peer-to-peer mentoring activities.

The project leaders acknowledged their institutions as well as thanked the Australian Council of Deans of Science for the support they received to undertake activities in their *WIL in Science Lighthouse Project*. They noted that ACDS provided an important national forum, and provided national recognition for their work through the support for their projects, which in turn led to recognition in their own institutions.

Discussions during the interviews and triangulation of the interview data with the project aims and intentions, and data from participant surveys confirmed the formulation of a renewed community of practice to raise awareness of the place and importance of WIL in Science related disciplines.

The project teams certainly have the potential and leadership to influence change, to develop and embed WIL in core curriculum, to influence work-related outcomes for students and outcomes for the organisation, and have much broader effect to mentoring activities within their organisation. The next steps identified by each of the WIL project teams are quite rightly the most important next steps in moving WIL forward in Science. Of course, these initiatives need funding support and a set of committed leaders. *The WIL in Science: Leadership for WIL* project has established just that.

I thank Professor Liz Johnson for allowing me the opportunity to evaluate this project. The opportunity has been a very satisfying learning experience. Many thanks go to Jen Aughterson for scheduling and organising interviews and interview transcripts. I also thank the interview participants for their time, words of wisdom and enthusiasm that they showed throughout the interview process.

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