Successful WIL in Science

Final report 2019

Lead institution
- Deakin University

Partner institutions
- Curtin University
- Monash University
- University of Newcastle
- Australian Council of Deans of Science

Project leader
- Professor Elizabeth Johnson (Deakin University)

Team members
- Professor John Rice (ACDS)
- Professor Cristina Varsavsky (Monash University)
- Associate Professor John Holdsworth (Newcastle University)
- Professor Jo Ward (Curtin University)
- Dr Deanne Skelly (Griffith University)
- Professor Malcolm Campbell (Deakin University)
- Dr Trina Jorre de St Jorre (Deakin University)
- Dr Jo Elliott (Deakin University)
- Ms Jen Aughterson (Deakin University)

Project Evaluator
- Professor Janice Orrell

Support for the production of this report has been provided by the Australian Government Department of Education and Training. The views expressed in this report do not necessarily reflect the views of the Australian Government Department of Education and Training.

With the exception of the Commonwealth Coat of Arms, and where otherwise noted, all material presented in this document is provided under Creative Commons Attribution-ShareAlike 4.0 International License [creativecommons/4.0/license](creativecommons/4.0/license).

The details of the relevant licence conditions are available on the Creative Commons website (accessible using the links provided) as is the full legal code for the Creative Commons Attribution-ShareAlike 4.0 International License [creativecommons/4.0/legalcode](creativecommons/4.0/legalcode).

Requests and inquiries concerning these rights should be addressed to:
Higher Education Program Management
Governance Quality and Access Branch
Higher Education Group
Australian Government Department of Education and Training
GPO Box 9880
Location code C50MA7
CANBERRA ACT 2601

<learningandteaching@education.gov.au>

2019

ISBN 978-1-76051-691-8 [PDF]

Please cite as:
Acknowledgements

Successful WIL in Science is the product of a vibrant and committed community of leaders, practitioners and scholars. Its successes are the work of the many colleagues who design and teach science and mathematics courses in Australian universities. This community believes in university science and mathematics as a social good to be shared with learners and industry and community partners. They are generous, collaborative and embrace opportunities to share experience and help each other. Above all, this community is passionately committed to offering the best possible learning experience to their students. Our community is a delight to work with and a constant source of inspiration.

Project members would like to especially thank:

- the Australian Council of Deans of Science (ACDS) led by its President, Professor Brian Yates.

  The ACDS placed considerable faith in the team by giving the project unfettered access to its networks. It has demonstrated its commitment to the outcomes of the project by embedding expansion of work-integrated learning (WIL) as a priority in its mission statement. Most importantly, it has shown commitment to the project through supporting the annual WIL in Science Forum and funding an extension project from Successful WIL in Science.

- our project evaluator and critical friend, Professor Jan Orrell.

  We were extremely fortunate to work with Jan who has been extraordinarily generous with her time, wise advice and gentle, but effective, mentoring. From the outset of the project, Jan has been our ‘guide on the side’ and has connected us to the WIL community across Australia, where she is acknowledge as a national, and international, leader.

- our Expert Reference Group who were:

  Ms Anne Younger, General Manager, Education and Training, AiGroup (Chair)
  Mr Tony Quick, Chairman, QuickStep Holdings
  Mr Scott Thompson, Director International Business Development, Lockheed Martin
  Dr Paul Gibbs, Director Pilot Scale Operations, CSL Ltd
  Dr Michael Whelan, Southern Cross University.

  The Expert Reference Group generously donated their time and provided helpful advice that made industry partnership real for the project. Each Expert Reference Group meeting considered a challenging or topical problem associated with WIL partnerships, which ensured that industry views remained integral to the work. In particular, Ms Anne Younger has been a wonderful friend to the project, and has connected us to the national WIL agenda and industry partners.

Successful WIL in Science
• generous collaborators and guides from the broader WIL community particularly Professor Amanda Henderson for inspiration and assistance with our stakeholder contributions framework and Associate Professor Judith Smith, Mr Matthew Campbell and Dr Sonia Ferns for expert leadership in WIL community workshops. Australian Collaborative Education Network community leaders and members have also embraced the emerging WIL in Science networks and connected us with ideas, resources and inspiration.

• and our generous student and staff research participants, who gave their time to help us to learn what it is really like to be involved in WIL in Science.
## List of acronyms used

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEN</td>
<td>Australian Collaborative Education Network</td>
</tr>
<tr>
<td>ACDS</td>
<td>Australian Council of Deans of Science</td>
</tr>
<tr>
<td>TL Centre</td>
<td>Teaching and Learning Centre</td>
</tr>
<tr>
<td>WIL</td>
<td>Work-integrated learning</td>
</tr>
</tbody>
</table>
Executive summary

Successful WIL in Science has been a national project designed to improve the employability of future graduates in science and mathematics by increasing access to and participation in work-integrated learning (WIL). WIL refers to learning and assessments that ‘integrate theory with the practice of work within a purposefully designed curriculum’ (Australian Collaborative Education Network [ACEN], 2015, p1). Successful WIL in Science focused on the provision of WIL within courses where it appears as placements or internships, commissioned industry projects, simulations, contextualised case studies and other industry interactions.

Successful WIL in Science was developed in response to recognition that science graduates have poorer employment outcomes immediately following graduation than graduates in related disciplines (Edwards et al., 2015). It was aligned to the National Strategy for Work Integrated Learning in University Education (ACEN, 2015) which calls for action to increase provision of WIL in Australian universities and is endorsed by peak bodies of business and universities. The project was delivered in collaboration with the Australian Council of Deans of Science (ACDS) and leveraged earlier work to raise awareness of WIL (Johnson & Rice, 2016), and the national reach of the ACDS and its Teaching and Learning Centre.

Successful WIL in Science used three strategies to support increase in WIL delivery: provision of contextualised resources, peer learning and collaboration, and targeted research to inform development of WIL within science degrees. Contextualised resources were curated into the WIL Guide for Science, an online resource that orients users to WIL, describes effective evidence-based practice, links to useful resources and provides advice on effective leadership of WIL. The WIL Guide for Science also offers case studies in WIL design and delivery from science and mathematics courses in Australian universities to prompt ideas and connect users to experienced WIL practitioners. The WIL Guide for Science is published on the ACDS Teaching and Learning Centre website, creating an ongoing channel for communication of new case studies and discussion.

Successful WIL in Science used communities of practice to foster peer learning and create self-driven local nodes. Four communities of practice, in Brisbane, Sydney, Melbourne and Perth connected WIL leaders and practitioners across 24 universities and provided the basis for expert workshops and building capability. Local groups connected members to the national WIL community through the Australian peak body, the Australian Collaborative Education Network (ACEN). These communities fostered new collaborations that have published scholarly papers, presented to science and mathematics colleagues and commissioned background briefing research. The communities of practice may persist through the auspices of the ACDS or may merge with local ACEN groups, providing ongoing productive interactions for members.

Successful WIL in Science conducted primary research into the student experience of WIL among undergraduate science and mathematics students. This research investigated two research questions relevant to increasing science student participation:

What encourages or discourages science students from participating in WIL?
What makes WIL experiences meaningful to science students?
The research project created a significant data resource from interviews with 23 staff (representing 13 Australian universities) involved in the design, delivery and leadership of WIL, and interviews (9) and focus groups (27) with 138 undergraduate science students from four Australian universities.

Findings show that, despite low participation, science and mathematics students value WIL and are very concerned with employment following graduation and employability further into the future. Student participation is affected by:

- **poor communication** to students about WIL opportunities noting the need for repeated and explicit communication regarding options, value, timing and access
- the **cost of participation** including direct costs (e.g. travel) and, of equal significance, opportunity costs (e.g. foregone income from existing employment)
- **pre-existing commitments** such as carer duties, or study that is not flexible enough to accommodate WIL activities
- **confidence and orientation** to WIL, especially for students who have limited personal connections or experience.

Feedback from WIL specialists and students has resulted in six recommendations to guide the design and delivery of WIL to increase student participation:

1. provide more WIL opportunities and make them visible
2. provide more opportunities for learning in the workplace, especially placements
3. develop on-campus WIL opportunities specifically targeted at simulating learning that is equivalent to that of workplace experiences
4. maximise flexibility and provide for credit opportunities to help students prioritise engagement with WIL
5. maximise relevance, especially where WIL is compulsory
6. make use of the full range of WIL activities to build career awareness, confidence and capabilities.

*Successful WIL in Science* has increased the breadth and depth of science faculty engagement with curriculum change for WIL, and driven a step-change in the provision of WIL and student participation. It has a firm base of engaged leaders and commitment from the ACDS, although it is dependent on the continued enthusiasm and participation of leader, academic and industry and student partners. The *Successful WIL in Science* recommends continuing action by the ACDS to support faculties and make WIL a normal part of science and mathematics curriculum.

- **Maintain the WIL in Science network**
  The *Successful WIL in Science* project shows learning from peers has real impact. Local communities of practice should be allowed to change and adapt to local conditions as they are dependent on the local value to participants. Maintenance of an ACDS national forum and network will connect individuals and groups working in WIL irrespective of local variation.
• **Monitor progress**
  Edwards et al. (2015) noted the difficulty of identifying WIL embedded in courses beyond placement and industry project. The recent National Data Collection conducted by Universities Australia (unpublished) has also shown how there is little consensus on definitions of WIL and limited consistency in recording or measuring WIL. Monitoring progress on WIL is crucial for faculties to understand their current practice and future possibilities.

• **Continue to identify and celebrate good practice to provide benchmarks**
  Participants in WIL in Science consistently comment on the value of hearing about WIL implementation in peer universities and from other disciplines. WIL in Science leaders need a space to share and to collaborate.

• **Provide opportunities for research collaboration and dissemination of findings**
  Recommendations from the student experience research in *Successful WIL in Science* are immediately applicable in WIL practice. Further research is needed to inform how science faculties establish sustained industry partnerships and how new ideas for WIL can be adapted to science and mathematics. Effective dissemination of research through the ACDS Teaching and Learning Centre or other organisations (e.g. ACEN) is crucial for application of findings.

• **Describe effective leadership and resourcing for WIL in Science**
  Leadership and resourcing for WIL must be appropriate to the local context, but an absence of leadership will slow progress and undermine universal access and sustainability. Sharing models for WIL leadership and implementation with faculty leaders through the ACDS networks will give faculties options to consider in building their own teams.

• **Engage with national initiatives, peak industry bodies and partner disciplines**
  The National WIL Strategy is a key mechanism to partner with peak bodies from higher education, government and peak industry bodies. Maintaining good relationships with the strategy will ensure the needs of science and mathematics are considered. Working with partner disciplines such as engineering, IT, environmental and agricultural science will leverage application of WIL in shared foundation subjects and accelerate uptake of good practice.
# Table of contents

Acknowledgements ................................................................................................................... iii
List of acronyms used .................................................................................................................. v
Executive summary .................................................................................................................. vi
Tables and figures ....................................................................................................................... x
  Tables ........................................................................................................................................ x
  Figures ...................................................................................................................................... x
Chapter 1: Successful WIL in Science ...................................................................................... 1
  WIL in Australian universities ................................................................................................. 1
  WIL in the curriculum ............................................................................................................. 3
  WIL in Science ....................................................................................................................... 4
  Growing WIL in Science ........................................................................................................ 5
  Sustainable outcomes through national impact ...................................................................... 6
Chapter 2: WIL in Science communities .................................................................................. 8
  Building communities of practice ......................................................................................... 8
  Outcomes from participation ................................................................................................. 12
  Sustainability of communities of practice ............................................................................ 13
Chapter 3: WIL Guide for Science ........................................................................................... 14
  Basics, Good Practice and Leadership .................................................................................. 14
  Case studies of WIL in Science ............................................................................................. 15
  Working with industry partners: roles and responsibilities ................................................... 16
  Feedback on *WIL in Science Guide* .................................................................................. 17
Chapter 4: Student experience research .................................................................................. 18
  Approach ................................................................................................................................. 18
  Findings and recommendations ............................................................................................. 19
Chapter 5: Future WIL in Science ............................................................................................ 25
  Emerging practice .................................................................................................................. 25
  Leadership for WIL ............................................................................................................... 26
  The future of WIL in Science ............................................................................................... 27
References ................................................................................................................................. 29
Appendix A: Certification .......................................................................................................... 32
Appendix B: External Evaluator Report ................................................................................... 33
Appendix C: Project tools and dissemination ......................................................................... 42
Appendix D: Project timeline and deliverables ...................................................................... 50
Tables and figures

Tables
Table 2.1: Comparison of science TLOs (Jones et al., 2011) with most commonly observed institutional graduate attributes (Oliver & Jorre de St Jorre, 2018b) ...........................................7
Table 3.1: Outcomes and outputs from Successful WIL in Science .............................................19
Table 3.2: Comparison of enabling approaches from the National Strategy for Work-integrated Learning (ACEN, 2015) with affordances of the WIL in Science program ...........20
Table 4.1: Participation in WIL in Science network events .................................................................24
Table 4.2 Regional node activities ....................................................................................................27
Table 5.1: Structural elements in the WIL Guide for Science ..............................................................31
Table 5.2: Case studies of Successful WIL presented in the WIL Guide for Science .................32

Figures
Figure 2-1: Expanded authenticity-proximity framework. Reproduced with permission from Kaider et al. (2017) .........................................................................................................................9
Figure 3-1: Science in organisational units in Australian universities. ...........................................15
Figure 3-2: Developmental model for building WIL in Science Faculties, reproduced with permission from Johnson and Rice (2016). ..............................................................................................................16
Figure 4-1: WIL regional node members have a variety of roles and reported varying levels of experience with WIL: ..................................................................................................................25
Figure 4-2: Node members responding to the follow-on survey noted what impact arose from their participation in their regional node on their practice .......................................................28
Figure D1-1: Organisation of the Successful WIL in Science project was delivered in overlapping phases with outputs refined iteratively as each phase informs the other ........50
Chapter 1: Successful WIL in Science

Successful WIL in Science has been a national project designed to improve the employability of future graduates in science and mathematics, by increasing access to and participation in WIL. WIL refers to learning and assessments that ‘integrate theory with the practice of work within a purposefully designed curriculum’ (ACEN, 2015, p1). It includes activities situated in a workplace, such as internships, placements and field trips, as well as on-campus activities that are authentic to work practices, such as simulations and complex laboratories.

Successful WIL in Science was developed in response to recognition that science graduates have poorer employment outcomes immediately following graduation than graduates in related disciplines. WIL is recognised as a mechanism through which orientation to careers and graduate employability can be improved (ACEN, 2015). The project has been delivered in collaboration with ACDS and the project outcomes have been achieved through extensive collaboration with staff and students in faculties of science in Australian universities.

Successful WIL in Science has purposefully built on the large body of work sourced from research in employability and WIL and from the experience of related discipline areas, including projects funded by the Office for Learning and Teaching (OLT) and its predecessors. The focus of the Successful WIL in Science has been on increasing WIL in the curriculum in order to make WIL opportunities an expected part of the science courses, facilitate buy-in from faculty leaders, and maximise the involvement of staff and students.

This report presents the outcomes of the project and insights relevant to future curriculum reform initiatives, with emphasis on the value of working through disciplines and operating collectively across the university sector to create sustainable improvement.

WIL in Australian universities

Sector-wide change in higher education requires alignment of influences and enablers at multiple levels. Curriculum reform is driven by the Higher Education Standards Framework (Threshold Standards) 2015 which explicitly links graduate learning outcomes in every course to future employment (Australian Government, TEQSA Act, 2015, clause 1.4.2)

The importance and challenge of assuring graduate employability and associated work skills (or graduate attributes) has long been recognised in the Australian Higher Education sector (Oliver & Jorre de St Jorre, 2018). The value of employability is neatly captured in the widely accepted definition of employability developed by Mantz Yorke in 2006 (Yorke, 2006, p8):

... a set of achievements—skills, understandings and personal attributes—that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy.

---

1 For this report, faculties of science in Australian universities includes multi-disciplinary faculties that comprise science and other disciplines. Broader faculties occur in over half of Australian universities and may include science in the title of the faculty or represented by schools or departments.
Australian universities have also been exhorted to create closer collaborations between universities, industry partners and students in an effort to close the gap between university and employment (BCA, 2011). WIL is acknowledged in Australia as a crucial pathway for improving graduate employability, and the impetus for widespread adoption is accepted by university and business leaders. This shared concept was formalised through the National Strategy for Work Integrated Learning (ACEN, 2015) developed by Universities Australia, the peak body for all Australian universities; ACEN, the professional body for WIL leaders and researchers; and a range of peak industry bodies. The National Strategy calls for action at national and institutional levels and places responsibility on all stakeholders—government, universities, industry—to enable and grow participation in WIL.

The National Strategy (ACEN, 2015, p. 3) proposes action in eight key areas:

1. Provide national leadership to expand Work Integrated Learning (WIL)
2. Clarify government policy and regulatory settings to enable and support growth in WIL
3. Build support—among students, universities, employers across all sectors and governments—to increase participation in WIL
4. Ensure the investment in WIL is well targeted and enables sustainable, high quality experiences, stakeholder participation and growth
5. Develop university resources, processes and systems to grow WIL and engage business and community partners
6. Build capacity for more employers to participate in WIL
7. Address equity and access issues to enable students to participate in WIL
8. Increase WIL opportunities for international students and for domestic students to study off-shore

These goals demonstrate the complexity of the task and the pressing need for coordinated action. Barriers to the adoption of WIL occur at national, disciplinary, institutional and individual levels, and stakeholders need support to overcome these challenges.

In 2016, the Australian Government prioritised action on graduate employability and WIL by making it a priority in the final round of grant funding for the Office for Learning and Teaching (OLT). This work built on a longstanding focus on graduate learning outcomes and employability, which had created a rich repository of resources and identified leaders in WIL—expert practitioners and researchers—whose advice and mentoring could support others. The OLT had commissioned two Good Practice Guides (Orrell, 2011; Sachs et al., 2016) which summarise key themes from the collected work funded by the OLT/ALTC (currently housed in the Learning and Teaching Repository hosted by Universities Australia). That body of work has provided the foundations for this project and future work. Although the source of future funding is not clear, work on WIL must continue and needs to be collaborative and shared to achieve the widespread adoption called for in the national strategy.

The national focus on WIL shows that the time is ripe to push beyond existing, conventional provision of WIL in professionally accredited degrees (largely focused on external placements) into broad-scale provision through generalist degrees (requiring an increased emphasis on WIL in the classroom).
**WIL in the curriculum**

WIL is a deceptively simple idea. It is the integration of work into learning experiences and implies active collaboration and design to make this happen. In practice, WIL is a large and complex undertaking between three partners: students, employers and universities. Its success is dependent on many factors and influences, including a shared understanding of the goals of partnership, the contribution required and possible from partners, and the complications of local and disciplinary contexts (Jackson, 2015; Patrick et al., 2014).

WIL appears in the taught curriculum as placements or internships, commissioned industry projects, simulations, contextualised case studies and other industry interactions. WIL activities can be usefully envisaged along dimensions of authenticity and proximity to work (Oliver, 2015b; Kaider et al, 2017, diagram reproduced with permission).

Placement, a period where the learner works in industry under the supervision of industry supervisors, is often privileged as the primary activity of WIL, but many authors agree that WIL must include a range of activities tailored to the specific context of the course (Patrick et al., 2009; Yorke & Knight, 2006). Placements make a unique contribution to WIL due to their high proximity and authenticity, but they are difficult to provide for all students and place significant burden of management on employers and universities. In some industries this is recognised by payment to industry partners to offset the cost of supervision, although successful placement must be a shared responsibility (Cooper et al., 2010; Henderson & Trede, 2017). Access to placements and industry partners is often tightly managed by universities and professional bodies as placement experience is required for professional recognition, as seen in registration requirements for professions in health, education, engineering and law.
The wider range of valid activities for WIL may not be readily apparent to students, staff or industry in turn restricting the options considered in curriculum development. Invisible employability learning undermines student and staff perceptions (Jorre de St Jorre & Oliver, 2018), exacerbated in general degrees such as the Bachelor of Arts or Science which do not have a tradition or wealth of experience with placements (Gannaway et al., 2016; Johnson & Rice, 2016). Expansion of WIL to these disciplines necessarily relies on a new approach.

**WIL in Science**

Edwards et al. (2015) compared access to WIL between STEM disciplines and found a large disparity, even where courses share foundational study. In addition to the core placement requirement for all engineering students, the study found:

*The indicative data collected in this study suggest that almost three of every four ICT bachelor students in Australia experience 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. (p. v)*

Edwards et al. (2015) also noted the reliance on individual champions to prosecute WIL activities in science in contrast to well-developed programs in related disciplines.

*Reliance on individual academics to develop and maintain relationships with industry is particularly prominent in the science disciplines, while organisation at the institutional or departmental level for establishing connections is more apparent in ICT and engineering. (p. vi)*

Longstanding traditions of industry connection and professional accreditation and registration have created very different expectations of WIL in professional disciplines. The complexity of implementation means that generalist degrees have considerable ground to make up to achieve the desired step-change in provision.

An alternative to disciplinary drivers for curriculum reform are institutional imperatives. Some universities have made provision of WIL an institutional priority with accompanying investment and reach. University members of the Australian Technology Network of Universities (ATN) have a tradition of close industry collaboration and present industry experience as a widespread feature of their courses. Other institutional models take a broader approach to experiential learning as illustrated by the Professional and Community Engagement (PACE) model at Macquarie University which mandates the inclusion of a ‘PACE’ experience for all graduates (Sachs & Clark, 2017).

Broad-scale and sustained WIL in the Australian universities will only be achieved with the alignment of disciplinary and institutional priorities. The complexity inherent in the development of industry-oriented curriculum requires active support from all levels of governance and leadership in institutions (Patrick et al., 2014). Disciplines can assist institutions by providing tools and resources to contextualise WIL activities and creating communities of practice that can share solutions and grow capability. The *Successful WIL in Science* project was designed to do exactly that.

---

Growing WIL in Science

Successful WIL in Science used provision of contextualised resources, peer learning and collaboration to grow capability for WIL within science degrees in Australian universities. The project was based on the role of faculties as the organisational unit for course design and delivery. Activities of this project and the ongoing WIL in Science program were targeted at faculty leaders and teaching leaders where peer learning could be immediately applied.

Leading change in Science Faculties

Science is a broad collection of sub-disciplines, which see themselves as distinct but sharing an approach to knowledge, thinking and application. The Science TLO statement, achieved through national consensus, describes science as ‘both a body of knowledge and a reliable process of discovery’ pointing to characteristic ways of thinking and acting (Jones et al., 2011, p9). This shared disciplinary view encourages science academics to see discipline colleagues as a credible source of information and ideas for learning and teaching (Burke da Silva et al., 2008; Deslauriers et al., 2011). The importance of strong and effective faculty and discipline leadership in curriculum change for science has been noted in eminent science research journals (Anderson et al., 2011; Bradforth et al., 2015) and is supported by empirical studies of curriculum change (Henderson et al., 2011; Sharma et al., 2017) and university leadership (Mårtensson & Roxå, 2016; Scott et al., 2008).

Patrick et al (2014) present a nuanced multi-factorial model for effective leadership of WIL including shaping the vision, building and maintaining relationships, communicating WIL and building sustainable WIL activity. The authors note that leadership comes from operational and strategic roles. The Successful WIL in Science project sought to leverage the existing leadership context within faculties to maximise impact and increase sustainability.

Variation between Australian science faculties in their experience of and capability for WIL means that faculties have different starting conditions for implementing programs that increase WIL. The initial ACDS WIL project (2015–16), Leadership for WIL, proposed a developmental model to help faculties to find a tailored pathway towards broader use of WIL (Johnson & Rice, 2016). The model proposes three areas of development: intention & planning, build & trial, refine & expand. The project suggested activities and built case studies to illustrate action for each phase. The Successful WIL in Science project used a peer learning model to leverage two contextual factors: preference from learning from disciplinary peers and a spectrum of experience among science faculties. The approach was based on concepts of communities of practice (Wenger et al., 2002) and distributed leadership (Jones et al., 2012) which use collective activity and responsibility to broker adaptive and sustainable learning.

Iterative project development and connectivity

National impact for the Successful WIL in Science project was achieved through the ACDS Teaching and Learning Centre. The centre connects teaching and learning leaders and educators in university science and mathematics through the:

- ACDS Teaching & Learning Centre website housing relevant online resources
- four annual ACDS meetings: the ACDS Annual General Meeting, the ACDS Learning &

Successful WIL in Science was delivered in overlapping phases to allow iterative development of outputs and continuous dissemination (Appendix D: overview, timeline).

- **Phase 1**: creation of concise, tailored advice and resources to support integration of WIL in science degrees, using curated existing resources (output 1), insight from students and graduates (output 2) and case studies from Australian universities (output 3). A roles and responsibilities statement for WIL stakeholders (output 3b) developed collaboratively with the project’s Expert Reference Group, was an additional outcome.

- **Phase 2**: peer-to-peer learning to test and model development of faculty-wide WIL programs was delivered through regional workshops exploring local practice (output 4), development of regional communities of practice (output 5), and national discussion of successful programs and faculty-level strategy (output 6).

The iterative approach adopted for the project allowed activities to be tailored to audiences and local conditions. For example, regional communities of practice based their activities on the interests and priorities of members. This is a crucial feature of successful communities of practice which see learning as a socially constructed and adaptive (Wenger et al., 2002). Similarly, the research design for collection of science student perceptions of WIL allowed space for emergent ideas while maintaining focus on the original research questions.

The original project design proposed institutional peer mentoring as the mechanism to support institutions through change programs (output 5). Early feedback from project members leading regional workshops suggested that a community of practice model would be more sustainable and provide exposure to a wider variety of WIL applications than a single mentor. The change to a self-determining community of practice was successful with members participating consistently and driving their own activities and collaborations.

**Sustainable outcomes through national impact**

*Successful WIL in Science* began with four intended outcomes:

1. an active community of positional and informal learning and teaching leaders
2. an active and growing website, the ACDS Teaching and Learning Centre, linking faculties to good practice, relevant projects, resources and discussion
3. regular national meetings for faculty leaders (ACDS Learning & Teaching Leaders Conference), science and mathematics educators (ACSME) and specialist groups (e.g. WIL Forum)

Teaching Leaders’ Conference, the Australian Conference for Science and Mathematics Education (ACSME), and the WIL in Science forum

- periodic newsletters and blog posts on the website

The ACDS Teaching and Learning Centre membership includes Deans, Associate Deans Teaching and Learning from Faculties of Science or equivalents, recognised teaching and learning leaders and emerging and experienced practitioners. The *WIL in Science* network was formed in 2015 as a network within the larger centre. It is composed of leaders of WIL nominated by faculties of science and, increasingly, those who self-nominate due to informal leadership roles and professional interest.
close links to related sub-discipline education networks in science and mathematics, and other national projects in learning and teaching.

The project has successfully achieved these outcomes and has created a solid foundation for ongoing work on WIL in science courses (Table 3.1). In addition, it has created a significant research database of staff and student perceptions which can be interrogated for future questions in research and application.

**Table 3.1: Outcomes and outputs from Successful WIL in Science**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active community</td>
<td>Participation and activity in WIL in Science network and regional communities</td>
</tr>
<tr>
<td>Active and growing website and resources</td>
<td>Publication of the <em>WIL in Science Guide</em> comprising:</td>
</tr>
<tr>
<td></td>
<td>• advice to practitioners (WIL Basics, Good Practice, Leading WIL)</td>
</tr>
<tr>
<td></td>
<td>• annotated resource directory</td>
</tr>
<tr>
<td></td>
<td>• case studies</td>
</tr>
<tr>
<td></td>
<td>• roles and responsibilities for stakeholders</td>
</tr>
<tr>
<td>National meetings</td>
<td>Dissemination at national meetings: ACDS Annual General Meeting, ACDS Teaching &amp; Learning Leaders, ACSME HERDSA, ACEN</td>
</tr>
<tr>
<td>Links to other networks and projects</td>
<td>Participants were linked to networks (e.g. ACEN) and projects via:</td>
</tr>
<tr>
<td></td>
<td>• WIL in Science Guide</td>
</tr>
<tr>
<td></td>
<td>• regional community activities</td>
</tr>
<tr>
<td>Understanding of barriers &amp; enablers for science student participation in WIL</td>
<td>Student experience research exploring the perceptions of WIL specialists in science faculties and science students</td>
</tr>
<tr>
<td></td>
<td>• Recommendations for WIL practitioners and Faculties</td>
</tr>
<tr>
<td></td>
<td>• Peer-reviewed publications for wider dissemination</td>
</tr>
</tbody>
</table>

*Successful WIL in Science* was also designed to align with the goals of the National Strategy for Work-integrated Learning (ACEN, 2015) (see Appendix D) and has successfully contributed to 17 of the 24 actions recommended for universities, industry and government. Incorporation of the WIL in Science program within the mission statement of the ACDS creates an ongoing impact beyond the *Successful WIL in Science* project. This is particularly important as commitment to long-term goals is crucial for successful curriculum renewal and is embedded within the National Strategy Outcomes.

*Successful WIL in Science* has contributed to growing momentum towards embedded WIL in Australian university degrees. It has created a focus for science faculties and connected WIL leaders, specialists and practitioners with good practice and emerging solutions. Placement of the *WIL in Science* network under the auspices of the ACDS provides capacity for sustained support of WIL in science and mathematical sciences. Specific outcomes and findings are presented in the next three chapters.
Chapter 2: WIL in Science communities

Successful change in higher education must accommodate local contexts. Australian universities are independent and self-governing, so broadscale improvement to learning and teaching happens through peer influence and interactions, in addition to government intervention. Two key concepts have influenced the peer learning approach used for Successful WIL in Science: communities of practice (Wenger et al., 2002) and distributed leadership (Jones et al., 2012).

Communities of practice use peer interactions to learn and build expertise. Wenger et al. (2002, pp. 4, 5) describe communities of practice as:

Groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. Over time ... [t]hey become a community of practice.

For learning and teaching, a community of practice model offers a more open and exploratory approach that is better suited to peer engagement between institutions where formal work groups are not readily available. McDonald (2014, p6) notes that:

Communities of Practice (CoPs) operate differently from institutionalised higher education work groups, as they are located in the immediate practice field, usually membership is voluntary, and the agenda and outcomes are member driven.

Communities of practice rely on distributed leadership that empowers all participants to be leaders in the community. Distributed leadership creates engagement through shared responsibility and sustainability as it minimises the effect of loss of any one leader and builds momentum for ongoing action (Jones et al., 2012). Distributed leadership and communities of practice foster contribution according to expertise rather than hierarchical position. This is a good fit for WIL where the complementary expertise of university professional and academic staff, and industry partners is required for effective teams.

Disciplinary groups acting as communities of practice can also leverage the tendency of academics to turn to disciplinary peers for advice. The positive influence of peers has been reported for science academics with teaching speciality (Bush et al., 2016) and for sessional or postdoctoral colleagues (Deslauriers et al., 2011; Johnson et al., 2012). Facilitated communities of disciplinary peers have been successfully employed to foster curriculum change in Australian universities (Sharma et al., 2017). Drawing on these concepts, the Successful WIL in Science project established four regional communities of practice to build local capability to support the implementation of WIL in science courses.

Building communities of practice

The Successful WIL in Science communities were initially derived from the national WIL in Science network of the ACDS. Four regional nodes were established in Victoria (Melbourne), Western Australia (Perth) and Queensland (Brisbane) in February–March 2017 and subsequently in NSW (Sydney) in November 2017. Each node formed an independent community of practice, facilitated by a member of the Successful WIL in Science project team.
The regional WIL nodes were initiated with a launch meeting that included an overview of the WIL in Science project by project leaders, and facilitated discussion: to share local practice, interests and concerns; identify one or two areas of focus for each node; and determine how each group would operate. Each node was provided with a modest budget for events or group activities.

The development of the regional WIL nodes was monitored by surveying members after the first meeting, and after the third group activity (Appendix C) to monitor development. Thirty-five members (~40%) responded in the first round with 10 members also responding to the second survey. Node facilitators completed a reflection on the operation of their node in July 2018.

**Participation**
The WIL in Science network was convened in 2015 with 78 participants representing 33 universities (Johnson & Rice, 2016). Participants were invited to register directly with the network through the ACDS Teaching and Learning Centre or to join via the annual WIL in Science Fora held 2015–17. By mid-2018, the network mailing list had grown to 243 members (38 universities) including WIL leaders, practitioners and supporters. Local members from the national network were the initial contacts for local communities of practice (Table 4.1).

*Table 4.1: Participation in WIL in Science network events*

<table>
<thead>
<tr>
<th>Network</th>
<th>Initial meeting</th>
<th>Mailing list 2018</th>
<th>Universities represented</th>
<th>Number of events</th>
<th>Attending events (2017–18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIL in Science</td>
<td>Dec 2015</td>
<td>243</td>
<td>38</td>
<td>3 (annual)</td>
<td>50–60</td>
</tr>
<tr>
<td>Vic node (Melbourne)</td>
<td>Feb 2017</td>
<td>36</td>
<td>6</td>
<td>4</td>
<td>14–21</td>
</tr>
<tr>
<td>WA node (Perth)</td>
<td>Feb 2017</td>
<td>107</td>
<td>4</td>
<td>3</td>
<td>15–36</td>
</tr>
<tr>
<td>Qld node (Brisbane)</td>
<td>March 2017</td>
<td>52</td>
<td>7</td>
<td>3</td>
<td>10–13</td>
</tr>
<tr>
<td>NSW node (Sydney)</td>
<td>Nov 2017</td>
<td>61</td>
<td>7</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

Node facilitators reported participants were enthusiastic and motivated. Around 30 per cent of members of the regional nodes reported operating through a named leadership role, and yet the large majority (over 70 per cent) claimed leadership as integral to their role (Figure 4.1). This is consistent with earlier findings that formal WIL leadership roles in science faculties are not yet well established (Johnson & Rice, 2016). Over 80 per cent of respondents reported composite functions within their own role, claiming a mix of practice (design and delivery) and enabling functions (lead or support).

Regional node facilitators commented that they had seen an increase in the number of named leadership roles among their members during the WIL in Science project. The ACDS has commissioned an extension project (*Progress in WIL in Science*) to *Successful WIL in Science*, which will conduct a snapshot audit of WIL provision in science faculties in late 2018 which will investigate trends in provision of leadership roles.
Figure 4-1: WIL regional node members have a variety of roles and reported varying levels of experience with WIL: a) role; responses to ‘What is your current role in relation to WIL?’ were coded to six categories: Faculty leadership, develop/grow WIL, administer/support WIL, coordinate/teach WIL, other/not defined, industry engagement; b) experience; respondents rated their level of experience from 1 (new to WIL) to 7 (very much).

Survey respondents reported three motivations for joining a community of practice:
- to join a discussion that generates new ideas;
- to build collaborations for future research or action (e.g. national standards); and
- to seek guidance and support for local implementation.

Suggestions for collaboration included research in WIL or development of national standards for practice and language. Some members noted value in building personal capability and maintaining awareness of sectorial progress.

Respondents identified a range of sources for information about WIL and noted the influence of local colleagues and local leaders/experts in WIL. National networks and associations were also recognised as important sources of information, notably ACEN.

Activities
All four nodes opted to schedule face-to-face meetings although some members requested online participation. Online participation in meetings was not achieved due to (a) priority given to group discussion and networking, and (b) lack of experience in setting up combined virtual and located communities, which is a challenging task for non-expert facilitators. Although the original intent was to create broad communities of practice, focus on face-to-face limited the number of universities participating to those close to Melbourne, Perth, Brisbane and Sydney. Some members travelled to attend some meetings but this is not a sustainable model. Successful WIL in Science conducted one webinar in collaboration with ACEN to increase reach, and it is pleasing to note a broader spread of universities continues to attend the annual WIL in Science forum.

Each regional node completed four activities during the Successful WIL in Science project period, gradually building towards an extended activity (Table 4.2). The extended activity for
nodes in Melbourne, Perth and Brisbane were workshops led by external WIL experts that targeted activity to local implementation challenges in assessment (Melbourne, Brisbane) and faculty leadership (Perth). The extended activity for the Sydney node was a roundtable session at the 2018 ACEN Conference. The Brisbane node also co-authored a presentation at the same conference. The process of self-determination is captured in the reflection of one node facilitator.

The first workshop was exploratory, to understand what participants wanted to get out of this network. The workshop consisted of firstly identifying the topics that participants were interested in, and secondly deciding on the activities that should follow to support the group.

Regarding the format of the group, there was unanimous support for workshops. The idea of ‘buddies’ was considered but discarded. In a later workshop the notion of bringing an expert to support academics one-on-one—a so-called expert in residence for a couple of days—emerged. This suggestion came after the realisation that participants were at different stages of considering/introducing/developing their own WIL approaches, and wanted to have a more targeted support from an expert to sound their ideas and receive advice. (Regional node facilitator)

Table 4.2 Regional node activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Melbourne</th>
<th>Perth</th>
<th>Brisbane</th>
<th>Sydney</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10/02/17</td>
<td>01/02/17</td>
<td>31/03/17</td>
<td>17/11/17</td>
</tr>
<tr>
<td></td>
<td>Launch meeting</td>
<td></td>
<td>Launch meeting</td>
<td>Launch meeting</td>
</tr>
<tr>
<td>2</td>
<td>28/04/17</td>
<td>21/07/17</td>
<td>12/07/17</td>
<td>08/12/17</td>
</tr>
<tr>
<td></td>
<td>CoP presentations and discussion</td>
<td>CoP presentations and discussion</td>
<td>Legal issues for placement CoP discussion</td>
<td>CoP discussion at National WIL in Science Forum</td>
</tr>
<tr>
<td>3</td>
<td>22/09/17</td>
<td>23/11/17</td>
<td>6-7/02/18</td>
<td>13/08/18</td>
</tr>
<tr>
<td></td>
<td>Designing WIL assessment with guest presenter: Sonia Ferns (Curtin)</td>
<td>WIL—what does it mean to stakeholders: David Rowbottom (Murdoch), Sonia Ferns (Curtin)</td>
<td>Peer Review of WIL Assessment facilitators Judith Smith, Matthew Campbell (QUT)</td>
<td>WIL Standards and Benchmarking CoP discussion</td>
</tr>
<tr>
<td>4</td>
<td>21/02/18</td>
<td>05/06/18</td>
<td>02/10/18</td>
<td>02/10/18</td>
</tr>
<tr>
<td></td>
<td>Designing WIL assessment II with individual project consultations with Sonia Ferns (Curtin)</td>
<td>What does WIL mean in science and challenges to getting traction: Malcolm Campbell (Deakin)</td>
<td>WIL within undergraduate science degree programs: Case studies in assessment Group paper at ACEN2018</td>
<td>Assuring quality in WIL—is the devil in the detail? Co-presented roundtable session at ACEN2018</td>
</tr>
</tbody>
</table>

**Focus**

- WIL assessment design
- Faculty leadership and organisation of WIL programs
- Building effective WIL assessment through peer review
- Standards and benchmarking for WIL in science
Outcomes from participation

Outcomes from the development of communities of practice were monitored through collection of feedback from participants and the reflections of the four node facilitators. Ten regional node members provided feedback for both the initial survey (post-launch meeting) and the follow-up survey (post-activity 3) with the majority reporting a strong impact of the node on their own practice (Figure 4.2).

Survey respondents noted the high value of connections to and discussion with peers and WIL experts.

*Has opened me up to ideas of others that seem interesting and likely of more value to students.* (WIL communities survey respondent)

*It has helped me meet pioneers in the field and helped me become familiar with many new activities that I didn't previously know about.* (WIL communities survey respondent)

This value of practical assistance was echoed by the reflections of the regional node facilitators who felt a combination of open sharing and practical assistance was most appreciated.

The nodes also contributed to broader awareness. In their reflections, regional node facilitators reported an increase in the prominence of WIL in Science during the project, and awareness of the barriers faced. All four facilitators felt the nodes had contributed to awareness and action.

*Anecdotally, I see higher levels of activity in this space. Not all is due to the node activities—universities have also stepped up here—but some can definitely be attributed to it. The distinguished characteristic of the node to focus on WIL in Science should not be under-estimated. Science curricula present different challenges and opportunities.* (Regional node facilitator)
Sustainability of communities of practice

Communities of practice may wax and wane as the needs of their members change. Initially, the Successful WIL in Science communities were supported through the efforts of local facilitators and through project funding for specific activities, including workshops with external experts for three of the nodes and a small scoping study on existing standards for WIL in Science for the fourth node. The next question is whether or not the regional nodes should be maintained and, if so, whether they should remain in their current form or transform into alternative channels for building capability for WIL.

WIL regional nodes were driven by a core of champions, including node leaders. Several node leaders will not continue in influential faculty roles so succession planning is essential. This issue will be considered by the ACDS through its national WIL in Science network.

In survey responses, experienced members commented on the importance of shared understanding and that there is always something useful to learn from peers.

*I feel I need to be involved at a grass-roots level and get a feel for what is happening. (WIL communities survey respondent: self-rated highly experienced)*

*A greater shared understanding of the complexities of good WIL, in particular the importance of strong relationships with industry. (WIL communities survey respondent: self-rated highly experienced)*

Regional node facilitators had varying views on whether or not their nodes would continue in the current format. Some facilitators suggested consolidating networks with ACEN.

*We will link via ACEN. [The node] has helped to establish new connections. (Regional node facilitator)*

*Perhaps—under a different umbrella. The WA node has had several discussions about the possibility of morphing into an ACEN special interest group in WIL. This idea is supported by node members, but requires further discussion with ACEN connections. (Regional node facilitator)*

Facilitators felt the regional nodes had been a significant step in building momentum around WIL in Science. Regional node members rated collaboration with peers from other institutions highly and it is likely that WIL in Science practitioners and leaders will seek opportunities for networking across a range of channels. The two conferences of the ACDS, the ACDS Teaching & Learning Leaders Conference and ACSME have each included themes on graduate employability and WIL in the last two meetings, which have attracted participation. The regional node facilitators noted the importance of maintaining the momentum built up through Successful WIL in Science.

*The ACDS L&T leadership conference should keep this issue on the radar—for the practitioners, and the ACDS AGM for faculty leaders. Why: for the first group—to show that it is important and their contributions are valued, and for the latter group—because they must support their doers (else it will ultimately impact on their faculty financially and reputationally). (Regional node facilitator)*
Chapter 3: WIL Guide for Science

Successful WIL in Science sought to raise awareness of WIL and to link science and mathematics educators to good practice in WIL. The project created a substantial online resource site to support science faculties as they work with WIL for the first time or progress their development. The online resources were collected as the WIL Guide for Science and made available as open educational resource on the ACDS Teaching and Learning Centre website; an established reference point for news and resources about teaching university-level science (www.acds-tlcc.edu.au).

An early finding from the initial work of the ACDS was that many science staff had little experience of WIL, either teaching or participating as a student—both important influences on teaching practice (Bearman et al., 2017; Burke da Silva et al., 2008). Calls for more WIL might provide the impetus to implement WIL, but staff also need information and guides to design and deliver meaningful WIL opportunities. The WIL Guide for Science web resources were designed to meet that need. The guide is a multifaceted web resource designed to support science faculty staff by collating, curating and contextualising existing WIL literature and resources to science.

Creation of the WIL Guide for Science was based on three core ideas.

1. **Reframing the literature**: To achieve widespread WIL in Science courses, teaching and learning leaders need principles, examples of effective practice and the means to translate ideas into their own context (Patrick et al., 2014). Few teaching staff, however, refer to academic literature for new teaching practices and ideas (Bearman et al., 2017), so this literature must be reframed to highlight practical messages and actions to be immediately useful (Burke da Silva et al., 2008). Contextualised examples and a focus on ‘real-world’ challenges can also help teaching staff identify how they might implement these practices in their own classrooms (Burke da Silva et al., 2008; Scott et al., 2008).

2. **Learning from other disciplines**: The guide collates and curates existing WIL literature and resources, drawing upon lessons and expertise from disciplines in which WIL is more commonplace and linking these ideas back to the science context. Where appropriate, the guide refers directly to resources from other disciplines to encourage science and maths educators to explore beyond discipline boundaries.

3. **Seeing WIL in action**: The guide includes commissioned case studies from Australian science faculties that illustrate different approaches to WIL. Contemporary case studies also offer the option of contacting the authors directly, prompting collaboration and conversation about the challenges and opportunities of implementation.

**Basics, Good Practice and Leadership**

The WIL Guide steps science faculty staff through the process of designing, implementing and refining a WIL program for science. The content is divided into three sections to enable easy navigation: WIL Basics, Good Practice in WIL and Leading WIL. Earlier work had established that science faculties were at different stages of readiness to implement or expand WIL (Johnson & Rice, 2016), so the guide is set out so that users can step in at any
point and receive support appropriate to them. The WIL Basics section was constructed as a general resource so it could be used by WIL champions within an institution to work with and engage their colleagues, students or industry partners.

To create the *WIL Guide*, the project conducted a review of the academic and grey literature from Australia and internationally, and created an annotated bibliography to highlight key themes and challenges. This list of key themes was then used as the basis for the structure of the guide (Table 5.1) and the annotated bibliography formed the basis for the guide’s resource section. A detailed site map is provided in Appendix C.

**Table 5.1: Structural elements in the WIL Guide for Science**

<table>
<thead>
<tr>
<th>Section</th>
<th>Topic pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIL Basics</td>
<td>State of WIL in Science, Defining WIL, Motivation for WIL, Common Challenges, Vision for WIL in Science</td>
</tr>
<tr>
<td>Good Practice</td>
<td>Learning outcomes, Learning activities, Assessing WIL, Preparing students, Supporting students, Engaging students, Engaging industry, Engaging colleagues, Evaluating WIL</td>
</tr>
<tr>
<td>Leading WIL</td>
<td>What is WIL leadership? Who are WIL leaders? Investing in relationships, Connecting with others, Adapting to your context, Learning from others</td>
</tr>
<tr>
<td>Resources</td>
<td>Annotated bibliography, Case studies, About our projects, Networks, News and events</td>
</tr>
</tbody>
</table>

**Case studies of WIL in Science**

The diversity in experience with WIL among science faculties offered case studies as another channel for peer learning. Case studies describing aspects of WIL development and delivery were commissioned from WIL leaders identified through the WIL in Science network and by peer and self-referral. To help staff identify lessons for their own practice, the project worked with case study providers to emphasise the approach taken to design and implement the initiatives, with reference to enabling factors and challenges. Case studies were integrated throughout the website and include examples of workplace and campus-based WIL, and faculty-wide approaches (Table 5.2).

**Table 5.2: Case studies of Successful WIL presented in the WIL Guide for Science**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author/s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WIL in the classroom</strong></td>
<td></td>
</tr>
<tr>
<td>Authentic assessment in chemistry labs</td>
<td>Dr Angela Ziebell, Monash University</td>
</tr>
<tr>
<td>Bio-business management in a postgraduate biotechnology course</td>
<td>Dr Jeff Yeoman and Dr Damian Spencer, La Trobe University</td>
</tr>
<tr>
<td>Transforming Laboratory Learning</td>
<td>Professor Tina Overton, Monash University</td>
</tr>
<tr>
<td><strong>Workplace WIL</strong></td>
<td></td>
</tr>
<tr>
<td>Unifying WIL in Science*</td>
<td>Associate Professor Tina Acuña (Project Leader), The University of Tasmania</td>
</tr>
<tr>
<td>Providing WIL across complex interconnected science degrees*</td>
<td>Dr Jo-Anne Chuck (Project Leader), Western Sydney University</td>
</tr>
</tbody>
</table>
Exploring alternate models for WIL in Science: Linking Work with Learning*

Associate Professor Susan Rowland and Professor Peter Adams (Project Leaders), The University of Queensland

Academic WIL

Dr Michael Whelan, Southern Cross University

Agribusiness Industry Experience Program

Dr Susan Low and Dr Sarita Bennett, Curtin University

Industry projects

Development of professional skills in science students through a work-integrated learning honours stream*

Dr Rowan Brookes (Project Leader), Monash University

WIL at scale

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

Professor Peter C Meier (Project Leader), University of Technology, Sydney,

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

Professor Malcolm Campbell (Project Leader), Deakin University,

*These case studies were initiated by the Lighthouse Projects, sponsored by the ACDS WIL in Science project (2016) and funded by the Office of the Chief Scientist.

Publication of case studies on the ACDS Teaching and Learning Centre website provides an ongoing mechanism to update the WIL in Science community and to celebrate innovative work.

**Working with industry partners: roles and responsibilities**

The third resource developed for the WIL in Science Guide is a guide to stakeholder roles and responsibilities: the WIL Stakeholder Contributions Framework. Shared understanding of the roles and responsibilities of respective stakeholders in WIL is key to successful partnerships. In their model for collaborative governance for WIL, Henderson and Trede (2017) note that WIL activities, especially placement or industry-commissioned projects, operate outside conventional academic settings and rely on a shared understanding of goals, context and success measures as students move between environments managed by the university and industry partners.

This view was reinforced by the Expert Reference Group of the Successful WIL in Science project. Industry reference group members noted that many potential industry partners did not understand how they could be involved with WIL and might be hesitant to approach universities without some understanding of what involvement may entail. In parallel, science faculties with limited experience of brokering and maintaining relationships with industry may struggle to articulate the roles of academics and industry partners. The Stakeholder Contributions Framework4 was designed to provide a starting point for

---

conversations between universities and industry partners about what each group, and students, may be able to contribute.

To develop the framework, the project drew on the collaborative governance framework developed by Henderson and Trede (2017) and the key stages and aspects of WIL identified through development of the *WIL Guide for Science*. Project members identified the roles and responsibilities of each group of stakeholders (university, industry, students) related to each stage or aspect, including leadership, design and co-development, logistics and support, delivery, assessment and feedback, and evaluation. The framework was reviewed by the Expert Reference Group before publication in the *WIL Guide for Science*. Further testing of the framework with WIL specialists, students and industry partners is planned as an extension activity of the project.

**Feedback on *WIL in Science Guide***

Feedback regarding the content, layout and usability of the website has been positive and web analytics indicate that, as of late October 2018, the website had 1,221 views. A series of blog posts was used to increase traffic to the site by announcing the publication of new sections and resources, sharing research findings and showcasing case studies (Table 5.3).

**Table 5.1: WIL blog posts and page views on the ACDS Teaching and Learning Centre website**

<table>
<thead>
<tr>
<th>Post Title</th>
<th>Publication date</th>
<th>Views (at 25/10/18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIL Guide for Science</td>
<td>5 April, 2018</td>
<td>1221</td>
</tr>
<tr>
<td>Case Studies of Successful WIL</td>
<td>7 March 2017</td>
<td>397</td>
</tr>
<tr>
<td>WIL Basics</td>
<td>23 November, 2016</td>
<td>310</td>
</tr>
<tr>
<td>WIL Resources</td>
<td>31 August, 2016</td>
<td>198</td>
</tr>
<tr>
<td>WIL Networks</td>
<td>5 April, 2017</td>
<td>184</td>
</tr>
<tr>
<td>2016 WIL in Science Forum presentations</td>
<td>November 3, 2016</td>
<td>128</td>
</tr>
<tr>
<td>Publication of the WIL in Science: Leadership for WIL Final project report</td>
<td>May 12, 2017</td>
<td>76</td>
</tr>
<tr>
<td>Webinar: Creating sustainable WIL programs with WIL in Science</td>
<td>August 7, 2017</td>
<td>29</td>
</tr>
<tr>
<td>Communicate to engage in WIL</td>
<td>September 6, 2017</td>
<td>47</td>
</tr>
<tr>
<td>ACDS 2017 WIL in Science National Forum—Presentations</td>
<td>December 12, 2017</td>
<td>170</td>
</tr>
<tr>
<td>What would you give up? For students WIL comes at a cost</td>
<td>January 30, 2018</td>
<td>89</td>
</tr>
<tr>
<td>Newly published WIL Guide for Science</td>
<td>February 15, 2018</td>
<td>84</td>
</tr>
<tr>
<td>Context is everything: Bringing authenticity to laboratory learning</td>
<td>May 10, 2018</td>
<td>46</td>
</tr>
<tr>
<td>Leading WIL: a new resource for science faculties</td>
<td>August 14, 2018</td>
<td>136</td>
</tr>
</tbody>
</table>
Chapter 4: Student experience research

Successful WIL in Science undertook a primary research study to explore issues specific to science and mathematics. One perceived barrier that is not well understood is the lower engagement of science students with WIL in comparison to students in other disciplines. Staff and student perceptions of student engagement with WIL was investigated, with emphasis on the following research questions:

1. What encourages or discourages science students from participating in WIL?
2. What makes WIL experiences meaningful to science students?

As noted earlier, Edwards et al. (2015) observed that students studying in a Bachelor of Science were much less likely to complete a work placement than students in other more professionally orientated STEM disciplines. Science students’ participation in WIL is likely to be at least partially limited by the number and type of opportunities available. However, there is also a perception, that science students might not engage with WIL opportunities as readily as students in other disciplines. A survey of the WIL in Science network found that managing science student perceptions, expectations and experiences of WIL was perceived as a common challenge (Johnson & Rice, 2016). More specifically, network members were interested in increasing science students’ engagement with WIL, including increasing participation and making WIL experiences more meaningful through reflection and integration with other learning (Johnson & Rice, 2016).

Approach

In the first stage of the project, 23 staff (representing 13 Australian universities) involved in the design, delivery and leadership of WIL were interviewed. Collectively, these staff are referred to as ‘WIL specialists’ because they were all engaged in a range of roles related to WIL, including:

- coordinating or teaching a WIL unit or program
- developing or growing WIL in their faculty or university, by providing knowledge and guidance to other staff
- providing administrative support for WIL, including placing, advising, and monitoring students
- engaging with industry and developing partnerships for WIL
- championing WIL from a leadership position within their faculty.

WIL specialists were asked about their perceptions of student interest, participation and engagement with WIL and opportunities and challenges associated with increasing student engagement. The outcomes of that research were then used to inform an in-depth investigation into science students’ perceptions and experience of WIL. In total, 138 undergraduate science students from four Australian universities participated in 27 focus groups and nine individual interviews. These included:

- 80 students enrolled in a Bachelor of Science
- 12 students enrolled in an advanced (four-year) Bachelor of Science
- 17 students enrolled in a double degree combining a Bachelor of Science with another course (including engineering, psychology, commerce, education, journalism, and international studies)
• 29 students enrolled in a discipline-specific science course, such as biomedical science, environmental science or forensic science.

Participants ranged in age from 18 to 43, with a median age of 21. Female (65%), international (12%) and domestic students (88%) were represented.

Staff and student responses were recorded and subjected to qualitative analysis to identify commonly recurring themes (Miles et al., 2014). Research instruments and links to publications are included in Appendix C. Peer-reviewed journal articles will be published to disseminate detailed outcomes of that research. This chapter provides a summary of key findings with emphasis on recommendations for science faculties.

Findings and recommendations

Students value WIL but participation is low. WIL specialists and students agreed that most science students were interested in WIL opportunities, but understood that interest does not always translate into participation. Many of the WIL specialists interviewed were involved in the delivery of non-compulsory WIL, including elective units and extracurricular opportunities, reflecting the way in which WIL is commonly offered in science programs (Edwards et al. 2015). Student participation in those optional WIL opportunities was often as low as 10 per cent. Fortunately, the project analysis of staff (WIL specialists) and student perceptions, suggests that there is plenty of scope to increase participation rates. There was considerable consistency between students’ and WIL specialists’ understanding of the factors that contribute to student engagement with WIL. The project has made six recommendations to faculties to help students to prioritise WIL in science.

1. **Provide more WIL opportunities and make them visible**

Analysis of both staff and student perceptions suggests that the greatest barrier to science students’ participation in WIL is the availability and visibility of opportunities. WIL specialists emphasised the importance of communicating both the relevance and availability of WIL opportunities to students. However, the opportunities available were often insufficient to accommodate the entire student cohort, so WIL specialists were rarely in a position to prioritise communication targeted at increasing student engagement.

   *We’ve only got 150 places, which is enough for 15 per cent of our students, we’ve got 20 per cent who are motivated so we’re not scrounging around to find enough students to fill those positions. (WIL specialist)*

Likewise, students were aware that WIL opportunities, especially placements, were limited, hard to find, and difficult to gain.

   *Trying to find an internship is really hard ... someone you can talk to that can direct you to the right place to apply for an internship or where to look or how exactly to go about doing an internship. (Student)*

Many students had been unable to find placements that aligned with their interests, discipline or career direction and, where opportunities were available, they were in short supply and therefore competitive. Requirements such as minimum weighted average mark (WAM), relevant experience or residency status excluded some applicants. Other students had not participated in WIL because they were not aware of the opportunities or
placements that were available, how to find and gain opportunities, what would be involved, or what value they would gain.

WIL specialists had sometimes found communicating with students about WIL difficult, especially where they were not working with them directly. They reported that students were not always aware that they were participating in WIL or developing capabilities of importance to their employability. This is consistent with other research emphasising the importance of explicit communication to help students to recognise, articulate and evidence their capabilities (Jorre de St Jorre & Oliver, 2018). One method of increasing visibility and accessibility is to build and publicise WIL throughout courses. Embedding WIL in courses also helps to ensure that students obtain maximum benefit from their WIL experiences, as it allows for appropriate contextualisation, scaffolding and assessment (Jackson, 2015; Patrick et al., 2009; Smith et al., 2014).

Students themselves suggested that some compulsory WIL should be embedded in their courses and that embedding WIL early in the course would raise students’ awareness and prompt further participation.

Even if they can’t give us two, give us one, and the person who’s really passionate about it will go and find the next one, or the other one. Then [employers would] know, okay, if I have five different experiences to show you, then I am passionate about it … But if they give at least one so that everyone has a chance. (Student)

WIL specialists sometimes found persuading their colleagues to communicate about WIL difficult. It was not clear whether this was because those staff did not perceive WIL as valuable, were not aware of the opportunities available, or did not know how to communicate about WIL. This illustrates the importance of faculty support and leadership to cohesively scaffolding WIL throughout degree programs.

2. Provide more opportunities for learning in the workplace, especially placements

Students recognised the importance of on-campus WIL to provide knowledge, skills and confidence; however, most students thought that WIL was most valuable where it was situated in an actual workplace. When students were asked about the types of WIL that had most value, placements (also referred to as internships) was the most common answer.

[I] feel the most valuable form would be a literal placement in the workplace though, because it shows accurately what you would be doing in the real world. (Student)

Students more highly valued WIL in the workplace for several reasons, but most appreciated that workplace WIL provides opportunities to gain additional skills and understanding through being part of a workplace environment and learning directly from professionals.

My laboratory was an environmental laboratory. It had a specific role of doing environmental analyses and that was distinct from the role of the environmental consulting companies who would then try to infer some kind of meaning from their analyses … and just understanding how the workplace works which you can’t get unless you’re actually there interacting with people who work in that area. (Student)
They also valued learning through exposure to new people and perspectives.

... working more with customers, working with people who might be older and might be younger and might not have the same mentality as I have and just understanding different perspectives. (Student)

Students appreciated the opportunity to learn first-hand what roles in the workplace entail, to learn about different roles and to ‘test drive’ potential career paths. The opportunity to discover and test different career options is especially important in generalist degrees, because these do not have a clear vocational focus, and students are less likely to understand the careers that they can or want to pursue (Kinash et al., 2017).

Students also saw workplace WIL as an opportunity to gain work experience that would be valued by employers, grow networks and develop a reputation for their work ethic.

... if you are volunteering in these sorts of situations, they’ll see how you work. They understand you as a person, and that makes you more attractive in the long run if a position becomes available within their organisation. (Student)

Student views were consistent with those of employers, who often think that placements help to prepare students for the workplace (Coll et al., 2009), and research showing that students that participated in WIL tend to gain employment more quickly after graduation (Ferns et al., 2014).

Some students appreciated that WIL in the workplace had helped them to better understand and contextualise other learning in their degree and on campus. These students spoke about WIL in the workplace being motivating and changing their approach to learning on campus. Students associated WIL in the workplace with ‘real experience’, being ‘under a lot more pressure’, considered the work to be more ‘serious’, and spoke about the need to act ‘more professionally’ than in a classroom environment.

Providing placement opportunities for all students is a challenge, and few science faculties provide these for all students. Many science faculties expect or encourage students to self-source placements and this can be an effective way of providing scalable opportunities. However, where placements are sourced by students, it is crucial that support is provided. Some students had been discouraged by what they perceived as inadequate support in self-sourcing a placement. Challenges included insufficient personal networks and not knowing who to approach or how to approach them. Where support was provided, some students also reported that lack of discipline-specific assistance was a problem.

3. Develop on-campus WIL opportunities specifically targeted at simulating learning that is equivalent of workplace experiences

Science faculties might develop on-campus experiences that are specifically targeted at providing students with opportunities to learn from and network with industry or employers in ways that simulate the learning gained through workplace experiences. For example, projects developed with, and for, industry can provide unique learning experiences that help graduates to differentiate themselves from their peers, while also providing networking opportunities and exposure to new people and perspectives (described in case studies of WIL see Chapter 3).
Universities are themselves employers of science graduates and some students were interested in understanding these roles and career paths:

... maybe having researchers come and talk to us about their experiences and possibly doing a work placement, but even if we were teamed up with a researcher and got to see what they were doing and see the struggles that they’re going through, and see how they tackle the issues that they’re facing, or if you can possibly have some input into that. (Student)

Many science faculties already offer authentic research experiences in their own research laboratories. They might also consider how they could provide students with internship or project experiences that help them to understand the realities and skills required for academic or professional roles in higher education, research enterprise or related activities.

4. Maximise flexibility and provide for credit opportunities to help students prioritise engagement with WIL

Fitting WIL around other commitments was difficult for some students. Students were often prepared to participate in placements, regardless of whether they would gain credit or payment, because they so highly valued the exposure to experience and networks. However, they also emphasised things that they would have to give up to accommodate those opportunities, including paid work or other study. Other students were not able to enrol in a WIL unit because of timetabling (especially where other classes were not recorded) or because there was insufficient space in their degree:

For me it’s also electives. I have run out of electives and that’s the reasons I cannot take a lot of industry-based units, and I feel like if my course was structured in a way where even if there were second-year units, but I did my core units in the first year, I would have not have wasted my first-year electives, even though for science you don’t really have electives. (Student)

Ease of accessing or prioritising WIL opportunities was not equal for all students and some found it difficult or impossible because of work or carer commitments.

I don’t have a lot of time because I have to work quite a lot to help our finances at home, so at the moment I’m part-time uni and I’m working more than I’m at class. I do want to do things like join the chem club and that, but I always have scheduling conflicts. (Student)

Jackson (2018) warns of the dangers of relying on extracurricular WIL to provide work experiences for students. The author notes that extracurricular WIL is less likely to be actively supervised and that learning opportunities are likely to be more limited than a purposefully designed experience, may put students at greater risk of exploitation, and make access to WIL less equitable.

All students should have access to WIL opportunities and be encouraged to participate, but it is important that expectations are reasonable, and alternatives and flexibility are provided where possible. Science faculties might improve the flexibility of WIL by:
a) Offering credit: ensure all students have space in their degree for a placement or equivalent project (designed with and for industry) that is ‘for credit’.

b) Providing alternatives: help students to fit WIL around their other commitments. For example; adjust for work or study commitments, negotiate hours that accommodate carer roles, find local opportunities that require less travel, and provide WIL on campus or online when students are unable to engage in off-campus learning.

c) Providing financial support for students in need, via grants or paid internships

5. Maximise relevance, especially where WIL is compulsory

Given that students must forgo work, study and other opportunities to participate in WIL, it is imperative that the experiences they have are worthwhile. WIL should provide students with engaging learning opportunities that relate to their interests or developmental needs. Most students recognised that even loosely related or seemingly unrelated experiences provided opportunities to develop transferable skills. However, they most valued experiences that were closely related to their career interests because they perceived these as better opportunities to develop industry-specific skills and networks, and ‘test drive’ career options. Likewise, WIL specialists emphasised the importance of authenticity. WIL specialists also emphasised the importance of assessment and reflection for supporting students to make meaning from their WIL experiences.

6. Make use of the full range of WIL activities to build career awareness, confidence and capabilities

Although students valued placements and WIL in the workplace most, they recognised the importance of other WIL (e.g. on-campus WIL activities) to build knowledge, skills and confidence. Students’ confidence in their own knowledge, abilities and capacity to contribute to an organisation can be a barrier to participation in placements or work-based WIL, especially early in their degree. Many were worried that they would not fit in or have anything to contribute.

"I don’t know if I have the skills or the knowledge or the ability to do this, and this is kind of going to reinforce whether I can do it or not. So it’s quite scary for quite a few people, you know, picking a supervisor or picking a company, and doing interviews for companies ..." (Student)

Some students had not applied for opportunities because they did think they were are as capable as their peers. Some expressed concerns about being judged on their academic record or knowledge, were nervous of rejection, or thought that people in industry would not want or have time for them. Some students were nervous of the professional environment and new experiences, were not comfortable contacting people for opportunities, or were unsure about the jobs and career pathways they might pursue.

WIL opportunities matched to students’ level of knowledge and activities of increasing complexity should be embedded across courses to build confidence, awareness, skills and understanding. This was highlighted by students themselves:

"In first year, we probably wouldn’t have the skills to go straight in and do a work experience in an industry environment, but at least having the exposure, just going and seeing, and just being there, and site visits, and those kinds of things. (Student)"
Ideally, science faculties might consider how they contextualise all learning to the real world, workplace and careers and incorporate multiple touch points in degree programs. This strategy is emerging in some Australian science degrees that have embedded compulsory WIL activities. Recent efforts to create scaffolded curriculum design tools could make this concrete for course coordinators (Kaider & Bussey, 2018). Scaffolded development of WIL could comprise:

- **early in the degree.** Low stakes WIL (e.g. on-campus experiences that utilise industry or alumni, field trips or short placements) might be utilised to help students understand and explore their career options, provide a motivational context for learning and ensure that all students are aware of the value and relevance of WIL and how to find opportunities.
- **throughout the degree.** A full range of WIL activities might be used to contextualise and scaffold learning and build students’ confidence in their own knowledge and skills. Students might also be provided with, or encouraged to seek, extracurricular opportunities that develop their capabilities and differentiate them to employers.
- **at the end of the degree.** A capstone experience, such as a placement or project, might be offered as an opportunity for students to integrate, extend and evidence their learning in ways that are relevant to employers.
Chapter 5: Future WIL in Science

The *Successful WIL in Science* project has successfully pushed faculties to take action, by taking advantage of growing momentum from national and institutional priorities to engage faculty leaders and staff with WIL. It has:

- **established independent, local communities of practice.** While the local WIL nodes are likely to change over time, they have brought together WIL leaders who will continue to collaborate and share ideas.
- **built a hub for WIL resources through the ACDS TL Centre.** The longevity of this resource will depend on continued interest from the science teaching and learning community, but its placement within a national instrument is promising.
- **created a significant research resource** in the data from the student experience research. This deep dataset will be further interrogated by project members with findings shared with the community through conferences and academic publication.

Anecdotal feedback suggests many faculties of science are now building WIL into their science courses as elective subjects or for-credit curriculum, highlighting the links between study and future work. Challenges of working at scale with industry partners and across a range of courses remain. Continued national focus is required to make WIL available to all science and mathematics students.

Emerging practice

**Action in science and mathematics**

Growing action to embed and research WIL practice is evident in recent national meetings including ACSME\(^5\) and the biennial ACEN\(^6\) conference. Activity has focused on:

- research to understand employability for science and mathematics graduates
- diagnosis of challenges and mapping of current state
- development of new WIL subjects for science degrees
- refinement of existing subjects with more authentic experiences and assessment
- whole-of-course learning design that directly addresses employability.

The work of the School of Chemistry at Monash University to develop WIL is an instructive example of transformation at discipline level. The school uses an integrated approach with educational research driving innovative teaching practice. It includes:

- research into the expectations and perceptions of students, academic staff and employers. (Ogunde et al., 2017; Sarkar et al., 2016). This research program develops understanding of WIL in the discipline, identifies targets for curriculum development and evaluates interventions
- creating industry-relevant activities in the undergraduate chemistry laboratory program (George-Williams et al., 2019). New undergraduate chemistry laboratory activities were built on authentic industry challenges with industry partners. Students are asked to investigate a real-world solution and to construct reporting for an industry audience
- embedding specific development of employability (transferable) skills as a separate subject in the chemistry major (Overton et al., 2018).

---


This approach is facilitated by explicit leadership from a professor in the discipline, the Associate Dean, Teaching & Learning, and local communities of practice in the scholarship of learning & teaching. It leverages disciplinary tools such as the accreditation standards of the Royal Australian Chemical Institute (RACI) which are based on the Australian Science TLOs.

Not all faculties will have the immediate resources to launch a similar comprehensive program, but many faculties have made headway or are building on long-standing efforts. This example demonstrates there is fertile ground for action by science faculties.

**Emerging models of WIL**
Recent work funded through the ATN network has described emerging models of WIL (Ferns et al., 2018). This exciting work points to alternative implementations of WIL that could make access for all students possible. The project has identified five categories of ‘new’ WIL that could be adopted by Science Faculties.

1. **Micro-placements**: short periods in the workplace where students work independently or collaboratively on projects

2. **Online projects**: involve students and industry working online communicating via digital platforms

3. **Hackathons, events and competitions**: involve students working in teams on one-off intensive activities where universities partner with organisers of external events

4. **Incubators/start-ups**: is a workspace that provides mentoring, information, networks, office space and resources for the early-stage development of new business ventures

5. **Consulting**: involves students (individually or in teams) providing consultancy services and information to fellow students, industry partners and/or community organisations.

This project has identified enablers and challenges for innovative approaches. The analysis points to the need to find entrepreneurial partners, both industry and students, who are willing to trial new ideas, and to invest in the partnership. Successful implementation requires support for staff workload and investment in good management, however, the excitement and value to industry and students is obvious in the examples. New models of WIL can orient universities to the changing face of work, a clear gain for future graduate employability.

**Leadership for WIL**
New leadership roles for WIL are also appearing. Recent appointments of senior leaders at The University of Sydney (Associate Dean Work Integrated Learning), The University of Queensland (Deputy Associate Dean Academic (Future Students and Employability), and the University of Newcastle (Assistant Dean, Work Integrated Learning) point to increased emphasis on WIL in more faculties. As noted in earlier work, some universities have longstanding leadership and commitment to WIL in Science (Johnson & Rice, 2016). However, this is not yet systematic, with WIL in Science communities still reporting ad hoc leadership responsibility and under-resourcing (Chapter 2). The importance of institutional

---

7 Snapshots of case studies available from https://acen.edu.au/innovative-models/
Successful WIL in Science

leadership has been well demonstrated in the general case of WIL (Patrick et al., 2014) and in the specific case of science and mathematics (Johnson & Rice, 2016).

Resourcing remains a significant barrier to implementation of WIL at scale. In particular, industry partnerships are time consuming and need investment. Experience from other disciplines and advice from the project Expert Reference Group reinforces the importance of listening to industry partners and making their experience of partnership positive, as noted elsewhere (PhillipsKPA, 2014). This requires dedicated workload but also has value for other aspects of industry relationships, such as research and community engagement.

Successful WIL in Science has contributed to raising awareness of graduate employability and WIL. Faculties of science are engaging with WIL. The challenge is to maintain the momentum to grow science students’ access to WIL.

The future of WIL in Science

WIL in Science is now recognised nationally. It has a firm base of engaged leaders and commitment from the ACDS, although it is dependent on the continued enthusiasm and participation of leader, academic and industry and student partners. Based on the findings of the project, the Successful WIL in Science makes six recommendations for continuing action by the ACDS to support faculties to make WIL a normal part of science and mathematics curriculum:

- **Maintain the WIL in Science network**
  The Successful WIL in Science project shows learning from peers has real impact. Local communities of practice should be allowed to change and adapt to local conditions as they are dependent on the local value to participants. Maintenance of an ACDS national forum and network will connect individuals and groups working in WIL irrespective of local variation.

- **Monitor progress**
  Edwards et al. (2015) noted the difficulty of identifying WIL embedded in courses beyond placement and industry projects. The recent Work Integrated Learning in Universities Report8 from Universities Australia has also shown how there is little consensus on definitions of WIL and limited consistency in recording or measuring WIL. Monitoring progress on WIL is crucial for faculties to understand their current practice and future possibilities.

- **Continue to identify and celebrate good practice to provide benchmarks**
  Participants in WIL in Science consistently comment on the value of hearing about WIL implementation in peer universities and from other disciplines. WIL leaders in Science need a space to share and to collaborate.

---

• **Provide opportunities for research collaboration and dissemination of findings**
  Recommendations from the student experience research in *Successful WIL in Science* are immediately applicable in WIL practice. Further research is needed to inform how science faculties establish sustained industry partnerships and how new ideas for WIL can be adapted to science and mathematics. Effective dissemination of research through the ACDS TL Centre or other organisations (e.g. ACEN) is crucial for application of findings.

• **Describe effective leadership and resourcing for WIL in Science**
  Leadership and resourcing for WIL must be appropriate to the local context, but an absence of leadership will slow progress and undermine universal access and sustainability. Sharing models for WIL leadership and implementation with faculty leaders through the ACDS networks, will give faculties options to consider in building their own teams.

• **Engage with national initiatives, peak industry bodies and partner disciplines**
  The National WIL Strategy is a key mechanism to partner with peak bodies from higher education, government and peak industry bodies. Maintaining good relationships with the strategy will ensure the needs of science and mathematics are considered. Working with partner disciplines such as engineering, IT, environmental and agricultural science, will leverage application of WIL in shared foundation subjects and accelerate uptake of good practice.
References


Appendix A: Certification

Certification by Deputy Vice-Chancellor

I certify that all parts of the final report for this OLT grant provide an accurate representation of the implementation, impact and findings of the project, and that the report is of publishable quality.

Alfred Deakin Professor Beverley Oliver
Deputy Vice-Chancellor Education
Deakin University
31 October 2018
Appendix B: External Evaluator Report

Conducted by Janice Orrell PhD
Project External Evaluator
Professor, Higher Education and Assessment, Flinders University
October 2018

This project has been built on a prior project that was sponsored by the Chief Scientist and that sought to establish lighthouse practices that were indications of what might be possible in relation to successful approaches to embedding Work Integrated Learning (WIL) in science and mathematics programs. Importantly, both the prior program and this current one are endorsed by the Australian Council of Deans of Science (ACDS) which is essential if the project is to achieve its aim of developing a climate for curriculum change in relation to the uptake of WIL into science and mathematics. Leadership at all levels of this project has been an important factor of its success.

This Successful WIL in Science project has been established to promote, support and enhance the participation of STEM students in WIL experiences during their university studies. This project was founded on evidence that students studying science in universities are least likely to be offered opportunities for WIL participation within their program of studies and are also least likely to elect to take up opportunities to participate in WIL. The goal of this project, therefore, was to consider ways to enable and support increased participation in WIL by students in STEM studies. To achieve this goal, strategies were adopted to provide resources and activities that will engage, encourage and inform leaders of science and mathematics studies in Australian universities about the challenges of providing WIL in their curriculum.

The provision of WIL involves an interplay between quite diverse stakeholders and quite diverse domains of activities and interests. The introduction of WIL into curriculum is never an easy matter as it requires the space in the curriculum for it to occur. This is always a contested space. Critical consideration in the first instance is for those who lead science programs within the universities to achieve a significant shift in understanding about the role of their curriculum in preparing students to transition into the workforce upon graduation. The outwards-facing character of WIL requires consideration not only of the strategic opportunity for students, but also their safety and the protection of the university and course reputation. This latter concern requires consideration of duty of care, including legal and industrial risk, which involves adequate preparation of students, supervisors and host organisations.

University science leaders need to ensure that the curriculum and academic capabilities of those who teach science are able to develop, deliver and embed effective Work Integrated Learning (WIL). This requires thinking beyond developing graduates who are knowledgeable within a discipline to developing students who are also able to reflect on how the knowledge and capabilities that they have gained during their studies can be of value beyond the university. Many academics and academic leaders have not experienced this
focus in their own studies and struggle to engage with the need to do so as teachers. Furthermore, many have not been supported in making this conceptual shift that significantly impacts on their own ways of working within the university and the contestation the introduction of WIL imposes on curriculum reform.

This project therefore has a complex agenda that can only be a preliminary but very important step in engaging science education in addressing student employability and as well as workforce needs for graduates of science.

The Nature and Scope of the Project
Project Design and Deliverables
This project has been designed around two phases. Phase 1 focused on the generation of WIL based resources for science and mathematics educators to drive curriculum change. This involved three key deliverables:

Output 1: Curation of existing resources: The project team established that while there are extensive resources that have been developed in the Australian WIL context, most require significant adaptation to be appropriate for science or mathematics curriculum. This has involved the identification and curation of available WIL focused curriculum resources, their adaptation to science and mathematics programs and then promotion of their utilization through peer sharing and evaluation.

Output 2: Collection of the student voice: This element of the project is focused on the identification of the kinds of WIL resources and practice that students and graduates perceive to be relevant and useful in preparing them for decision making and transition from their undergraduate program into a future career.

Output 3: Case studies of successful WIL: This element of the project sought to expand on the earlier outputs of the Chief Scientists’ Lighthouse project. Detailed case studies provide evidence of what is possible to achieve in STEM programs as well as detailed useful guides for designing and implementing curriculum change and further innovation.

Phase 1
As in any worthwhile project, the first phase of this project sought to identify existing WIL resources in other disciplines that would be of value to this project and to identify ways that they could be adapted to align more productively with STEM education. Phase 1 also included in depth research studies regarding student perceptions of the value of engagement in WIL (The Student Voice project) and the meaningful elements in WIL experiences for science graduates. Another element of phase 1 was to begin to build on the prior Chief Scientist’s Lighthouse Project to identify further cases of successful practices of WIL in science and to use these as a basis of discussion in state-based Nodes meetings. The practice-focus of these early node meetings contributed to their eventual evolution into peer supportive communities of practices.

Early in the project development, the project team realised that its key task was to generate a climate of readiness for change. An essential understanding for the change process was a shared acceptance that the study of science in universities was no longer limited to a
stepping stone to a career in science research, which had long been the case. With widened participation in university studies, including the sciences, graduates needed to exit the university with capabilities that enabled them to participate in quite diverse workplaces. Graduates now need to possess self-understanding and confidence about their capacity to engage effectively in the workforce. This is now called graduate employability in the general discourse of university education, but it is a construct that many academics fail to perceive as a legitimate goal for their science-based curriculum.

The goal of this project, therefore, was to create an awareness of the potential value of STEM education for preparing science graduates for quite diverse non-STEM careers. Four strategies were used to engage in this dialogue within the science education community. One was regular reporting to the Australian Council of Deans of Science (ACDS). A second was regional meetings as well as the incremental development of the state-based Successful WIL in Science Nodes. A third was the highly successful WIL in Science national forums and a fourth was attendance and presentations at higher education and science conferences to disseminate project outcomes.

Central to the project goal was demonstration to academic leaders in science that Work Integrated Learning (WIL) was a viable and effective tool with which to accomplish graduate employability development. Educational change to incorporate WIL into very traditional STEM curricula required engagement with quite diverse stakeholders, namely, science education leaders, academics who teach STEM topics, employers of university graduates and students themselves. This was achieved through the systematic building of peer networks and communities of collaborative practice supported by focused national WIL forums and conferences.

Phase 2
Phase 2 of this project has produced the critical work of promoting conceptual and practice changes in university Science and Mathematics programs. The deliverables for Phase 2 of the project were to make visible and accessible WIL in science resources on the ACDS website and to establish sustainable communities of practice and peer support networks that would lead to a measurable improvement and growth in WIL programs in science and mathematics in Australian Universities. Phase 2 also focused on identifying strategies that will assist science leaders in the formation of mature relationships with related industries who were willing and able to contribute as partners to student employability and career literacy.

Evaluation Processes
Purposes and Process of the Evaluation
The first task for the external evaluation was to establish an understanding of the key purposes of the project and to come to an agreement with the project team regarding the evaluation purposes and processes. As a result of this negotiation, the evaluation was designed to maintain a formative focus, particularly for the initial stages, in which the evaluator became a member of the project team. This approach included the evaluator being a participant in project team meetings and an observer of the project leaders’ consultations with the advisory committee. The evaluator role also included providing
advice and feedback on strategic planning, resource identification, interactions with employers, engagement with academics in forming communities of practice and development of an ongoing research and evaluation agenda amongst the project team. The final stage of the evaluation process focused attention on reviews of what had been achieved and on identification of the challenges and enablers.

The role of the evaluator, therefore, was that of a critical friend to the project team to ask questions, challenge thinking, observe progress and provide regular formative feedback to the project team. This role involved attending project meetings and major project events such as national forums and regional Nodes meetings and workshops. It also involved participating in special meetings to conceptualise a research agenda and to review their evaluation processes as well as conducting an interim evaluation for the project team in 2017.

**Key Stakeholders and Audiences**
The key stakeholders in this project are the formal and informal leaders in university STEM programs that have a concern for the comparatively low participation of their students in WIL related experiences as outlined in the project report. In particular their concern is related to the employability of graduates and for providing programs that are attractive to prospective students in terms of return on their investment in higher education studies. The intended audience for the project report is the formal leaders of STEM in universities, namely, the Australian Council of Deans of Science as well as the informal leaders within university programs of students who currently offer WIL or who would offer WIL if they had sufficient resources, curriculum space and support to do so. Another audience for resources derived from the project activities is students in terms of assisting them to understand the importance of being proactive in engaging in WIL opportunities. There are other WIL stakeholders, such as employer groups and policy makers, but they are largely out of scope in this project.

**Key Sources of Data**
The key sources of data for this evaluation are:

- Field notes and observation data from attendance at meetings, team meetings, a sample regional meeting and a sample Node meeting.
- Review of resources added to the Web resource.
- Observations at the National Forum
- Review of publications and documentation that are the result of the research on the student voice and project progress reports that were presented at national conferences.

**Core Values of the Project**
The core values of this project were:

- Science (STEM) matters and the study of science is an important role of higher education
- University programs should not only provide for building student disciplinary knowledge and skills but also attend to general capabilities that enhance graduate employability.
- All students should have access to experiences that will enhance their employability
Leadership, both formal and informal, are critical in achieving curriculum change.

Students provide an important voice in shaping curriculum change.

Adapting proven resources and strategies, learning from other disciplines that have more experienced in WIL lends efficiency to the project.

Key Evaluation Questions
The following questions have been adapted from the OLT guide to the project evaluation and have guided this evaluation report.

1. Which processes were planned and which were actually put in place in the project?
2. Were there any variations from the processes initially proposed and, if so, why?
3. What were the observable outcomes?
4. To what extent have the intended outcomes been achieved?
5. Were there any unintended outcomes?
6. What factors helped achieve the outcomes of the project?
7. What measures, if any, have been put in place to promote the sustainability of the project’s focus and outcomes?
8. What factors helped and hindered in the achievement of the outcomes?

Project Processes & Outcomes

Context of the Project
This project has focused on developing, resources and awareness and capabilities to support a more robust and extensive practice of WIL in Science which has involved engagement with diverse groups, namely students, faculty leadership, academic staff and their own institutional leadership to contribute to a shared understanding of Work Integrated Education (WIE) as a university enterprise. It is important to note from the outset that this was a very ambitious project. This project has set out not only to generate a repository of WIL resources that have been adapted for science and mathematics programs, but also to be a catalyst in generating a climate for change in university programs. However, inflexible institutional infrastructure and processes often mitigate against change and frustrate and demotivate potential change agents. In addition, curriculum are contested and overloaded and there is resistance to external interference and strategic initiatives however sound they may be.

Project Interventions
The planned interventions for this project have been systematically conducted, based on reliable evidence. The outcomes and enabling resources are well established and located in systems that will sustain them beyond the life of the project. Adaptations and changes to the project plans were minimal and were implemented based on formative reviews and supported by evidence.

Monitoring and Communication of Progress
Monitoring of progress through regular meetings of the project team as a whole has been systematically established and subgroup activity reports were a regular feature of the team meetings. This attention to communication and planning also kept the project leader and team well informed of any progress and challenges in regions, Nodes and universities.
Resource development
Identification of existing resources and the translation of those resources into tailored tools for science has produced extensive case-based exemplars, science framed guides and tools to support the introduction and development of effective WIE and WIL practices and curriculum change. The repository of these within the ACDS Teaching & Learning website has ensured its long-term security beyond the project.

State and Regional Nodes and Networks
State based Nodes in most states have been well established with the exception of South Australia and Tasmania. These Nodes will be a vehicle for on-going communication, professional development and provide a vehicle for peer learning and support. While this outcome was described in the proposal as a mentoring strategy, there has been a conceptual change. Nodes have been reframed as a site of peer collaboration in order to reflect more accurately what has occurred within the Nodes over the life of this project. The sustainability of these networks is dependent on the commitment of local staff to maintain them beyond the project.

WIL in Science Leadership
Establishing informal WIL Leadership in universities and at regional levels in the state-based Nodes has been a critical focus to ensure engagement with the project’s intention to foster curriculum change that will support the increase and enhancement of WIL experiences for science students. Formal WIL leadership that is informed has been accomplished by regular reporting to the ACDS. The sustainability of WIL leadership in science education will be dependent on continued support of the ACDS, but also supported by the links that have been established by the project leadership with organisations such as ACEN.

Establishing Links between Science and Employers
Establishing stronger links between science in Universities and graduate employers has been a significant challenge for the project that has been supported and informed by members of the Advisory Committee. This aspect of the project has been recognised and initiated, but is still in early stages of development. It is notable that Universities Australia (UA) has recognised the importance of this challenge generally and has established a project to foster and mature, reciprocal relationships between universities industries in Australia. This issue really constitutes a need for a focused systematic national project in itself that is be sponsored and supported by the ACDS because it requires a shift in orientation for STEM disciplines, faculties and industry alike. Historically, however, research and WIL partnerships have remained separate agendas that now need to be systematically brought together. Achieving some level of consolidation of these two collaborations should not be limited to a process for individual universities alone, but should be an enterprise for the higher education science sector.

Student Voice
Sustained research processes and activities were conducted by the project team to systematically expose and critically examine students’ voices regarding their perceptions of the value of the inclusion of WIL in their education for preparing for their future beyond university as well as their estimation of the value of their experiences of WIL. A notable value of this particular element of the project is that it went beyond an exploration of
students within a single discipline and a single program or institution. For too long research on students’ educational experiences including WIL has been limited in the scope, largely focused on single program and single institution studies. What is needed to provide guidance into the future of WIL is big data, that extends to multi-institutional studies that go beyond the singular foci just outlined. The research conducted in this project has provided a valuable model for big data research. It has included multiple institutions sustained over time and included both student and staff perceptions. It has already been systematically reported in higher education forums beyond the project and the evidence generated has been used to support developments in the project itself.

**Enablers of Project Success**

There are a number of important factors that have enabled the success of this project. They are:

- There was high level sponsorship for the project. The project was grounded in a prior project initiated by the former Chief Scientist, Professor Ian Chubb AC, and had ongoing support from the Australian Council of Deans of Science.
- There was consultative, capable project leadership.
- It was committed to regular structured meetings of the project team to review progress.
- There was sufficient funding to support the employment of competent and experienced project officers to undertake systematic reviews of current practices and generative research.
- There was a commitment to the utilisation and adaptation of existing resources and organisational infrastructures such as ACDS Teaching & Learning Centre and ACEN.

The success of this project is due in no small part to the fact that there has been strong and consultative leadership and a united and highly capable project team that undertook distributive leadership responsibilities to achieve the broad remit. The team met regularly with clear agendas and maintained their focus on processes to achieve the intended outcomes. A significant strength of the team was a prevailing milieu of the team that demonstrated respect for the diverse roles and a commitment to communication and cooperation. Regular reviews of their established approaches were conducted and together with a willingness to modify them when there was sufficient evidence to indicate a need to do so. A constant concern was how to ascertain what would be the most efficient and generative means of communication to ensure and sustain exposure to WIL in science to the sector.

**Project Challenges**

Challenges confronted by the project team included:

- Identifying what would make WIL meaningful in science where academics are largely focused on research and in the current HE climate on survival and do not recognise the legitimacy of their role in fostering student employability.
- Addressing students’ failure to perceive the relevance of WIL for their future. Questions remain regarding how the project can help to reduce the invisibility of existing WIL practices to make them explicit and accessible for students so that they graduate with a better appreciation of their own employability capabilities?
• It was not difficult for the project processes to capture those who already are open to the integration of WIL into the curriculum. Innovative strategies were needed, however, to ensure that those unfamiliar or not supportive of WIL in the science curriculum are encouraged to participate in the Nodes and networks to support curriculum change.
• There is an enduring construction of WIL as industry placements. There are, however, many features of authentic activities already embedded within STEM curriculum that can achieve the intentions of WIL and the increasing interest in supporting student’s employability development.
• Engagement with relevant industry partners and establishing committed mature partnerships rather than episodic, tentative relationships remains an ongoing challenge to the future of increased and high-quality WIL in STEM subjects.

Conclusion
This project team is commended for the depth and quality of their attention to intended goals and for achieving them within budget and within the time frame. While some matters for further attention were raised from an evaluator’s point of view, they have been a focus of the project leader’s and team members’ considerations. All the noted challenges were exposed and explored during the life of the program. Some have been extensively addressed, whereas some remain long-term challenges to higher education generally, that cannot be resolved in a single, time-restricted project. That said, this project team has not avoided them and has generated agendas that might focus on these issues, particularly establishing more productive partnerships into the future with related industries.

As a result of the project activities these matters are now better understood by the team, the advisory group and science education leaders. Thus, these issues stand a far better chance of being carried forward into the future and to become the focus of further action. I am confident that the aspired project outcomes have been achieved. Resources and new knowledge that were developed over the course of the project have been carefully curated to ensure that they will be sustained for the foreseeable future. Important networks to foster, support and sustain further engagement in WIL and sector wide focus on student employability are robust and potentially self-sustaining.

It is important to note that this project has been conducted in a period of considerable flux and uncertainty in the sector that has been triggered by impending budgetary constraints and institutional restructures that have been the basis of significant university staff turnover. This state of flux and uncertainty has very real implications for WIL as any loss of staff impacts on the capacity to maintain existing engagement in WIL and to respond to a call for curriculum innovation and change. There are no identifiable education and training programs to develop the capabilities and knowledge required for WIL work. As a result, effective WIL programs are heavily reliant on the accumulated expertise of university staff. In addition, WIL programs are outwards-facing activities that are dependent on established external networks and partnerships with external organisations. These networks and partnerships are core features of high-quality WIL and are grounded in trust and reciprocal partnerships that have been negotiated between university staff and organisations that employ graduates. Thus, this evaluation considers that the considerable achievements of
this project, that has been carried out in the current higher education contextual milieu, are highly commendable.

The leadership and the team should be commended for their achievements in this project. Furthermore, their conclusions and recommendations for further development deserve serious, thoughtful consideration as they have seriously engaged with what is in the national interest as reflected in the National Strategy for graduate employability in terms of the value and potential contribution of science informed graduates.
Appendix C: Project tools and dissemination

a) WIL Guide for Science site map

Overview and Welcome
Outlines purpose and general structure of Guide

WIL Basics
Here we define WIL, describe the spectrum of activities that constitute WIL, and discuss the benefits of WIL, and the perspectives of key stakeholders.

State of WIL in Science
Statistics on science students' access to, and participation in, WIL.

Defining WIL
Summary of definitions and WIL activities (WIL, matrix and spectrum), what WIL is not

Motivation for WIL
Graduate employability context and what different stakeholders value

Common challenges
Barriers and costs for stakeholders, equity and access

Vision for WIL in Science
What we would consider success, and view as ideal practice for WIL

Learning outcomes
Setting learning outcomes that balance specificity and flexibility

Assessing WIL
Involving industry in assessment, assessment for learning

Supporting students
Mentoring and induction of students, legalities

Engaging industry
Working with employers and industry bodies to plan your WIL program

Evaluating WIL
Ensuring your WIL activity or unit meets stakeholder needs

Good Practice
Here we provide tools and describe the processes needed to successfully deliver meaningful WIL.

Good practice
Good practice

Learning activities
How to decide what type of WIL best suits your purpose

Preparing students
Preparation for and scaffolding of WIL experiences

Engaging students
Making WIL meaningful, communication, access and equity considerations

Engaging colleagues
Getting buy-in, sharing resources, experiences and knowledge.

Leading WIL
Here we share ideas about WIL leadership, resources and examples of different approaches.

What is WIL leadership?
Frameworks and domains of leadership

Who are WIL leaders?
Formal and informal leadership roles

Investing in relationships

Connecting with others
Suggestions for involving employers, alumni and other university teams

Adapting to your context
Case studies and examples of different stages of WIL program maturity

Learning from others
Suggestions for connecting with other WIL leaders and practitioners

Resources
This section contains an annotated bibliography of the resources, tools and case studies referred to throughout the Guide.

Case studies
This section showcases a series of case studies of WIL in Science

About our projects
This section contains further information about the WIL in Science projects, and a contact list.

Networks
This section links readers to the regional WIL networks.

News and events
This section houses blog posts about WIL events, publications and research findings.

Successful WIL in Science
b) WIL communities survey

Communities Initial Survey
As a member of a work-integrated learning (WIL) community, you are invited to share your experience of participating in that community. The aim of this research is to investigate how membership in a community of practice impacts professional learning and practice. The outcomes of this research will be used to identify strategies for sharing teaching and learning practice and facilitating broad-scale curriculum reform.

We invite you to share your experience through completion of this short survey, which should take no more than 10 minutes to complete.

Participation is voluntary and you may decline to participate with no adverse consequences. Your consent to participate will be implied by submission of the completed questionnaire.

For more information about this research, please read the Plain Language Statement.

If you consent to participation in this research and are ready to start the survey, please click the ‘Next’ button below.

1. What is your current role in relation to work-integrated learning?
2. Which of the following describe your current role/s? Please tick all that apply
   a. I design work-integrated learning.
   b. I deliver work-integrated learning.
   c. I support others in the design or delivery of work-integrated learning.
   d. I provide leadership in work-integrated learning.
   e. Other (please specify)
3. How do you work with or support other staff to provide work-integrated learning?
4. If you provide leadership in work-integrated learning, in what context do you provide leadership?
5. How extensive is your previous experience with work-integrated learning?
6. Please rate the following with regards to designing and delivering work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
   c. How supported do you feel?
7. Please rate the following with regards to advising and supporting others to provide work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
   c. How supported do you feel?
8. Please rate the following with regards to leading work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
Successful WIL in Science

Communities Follow-up Survey
As a member of a work-integrated learning (WIL) community, you are invited to share your experience of participating in that community. You responded to an earlier survey, following your first meeting with the WIL community. We invite you to share your subsequent experience with the group, to help us understand how membership in a community of practice impacts professional learning and practice.

We anticipate that this survey should take no more than 10 minutes to complete. Participation is voluntary and you may decline to participate with no adverse consequences. Your consent to participate will be implied by submission of the completed questionnaire.

For more information about this research, please read the Plain Language Statement.

If you consent to participation in this research and are ready to start the survey, please click the ‘Next’ button below.

1. Which meetings or workshops did you attend? Please tick all that apply.
2. In the first survey, we asked what you hope to achieve through participation in the group. Have your objectives changed? If so, how and why?
3. How has your participation in the group helped you work towards your objectives?
4. Have there been any other outcomes, impacts or changes as a result of your participation in the group?
5. What aspects of the group have been most useful, and why?
6. Please rate the following with regards to designing and delivering work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
   c. How supported do you feel?
7. How has participation in the group impacted your practice with regards to the design and delivery of work-integrated learning? If applicable, please describe how participation in the group has impacted your practice.
8. Please rate the following with regards to advising and supporting others in your team or work area to provide work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
   c. How supported do you feel?
9. How has participation in the group impacted your practice with regards to advising and supporting others in your team or work area to provide work-integrated
learning? If applicable, please describe how participation in the group has impacted your practice.

10. Please rate the following with regards to leading work-integrated learning:
   a. How knowledgeable do you feel?
   b. How confident do you feel?
   c. How supported do you feel?

11. How has participation in the group impacted your practice with regards to leading work-integrated learning? If applicable, please describe any changes.

12. Has the design, delivery or leadership of work-integrated learning in your team or work area changed as a result of participation in the group? If applicable, please describe how participation in the group has impacted your practice.

13. Has participation in the group influenced who you talk to about work-integrated learning? If applicable, please describe any changes.

14. Have you shared information or ideas gained through involvement in the group with other people who have not participated in the group? If applicable, please describe any changes.

c) Semi-structured interview questions – Stage 1

Research aims
This research will investigate WIL leader perceptions and experience of:
   a. How and why science students do or do not engage with WIL opportunities
   b. The strategies used to communicate and motivate science students to engage with WIL
   c. Strategies for making WIL experiences meaningful to science students

Interview questions
1. What is your role? – relative to work-integrated learning in Science
2. Do students understand the term work-integrated learning? (If no or not really, do you think it matters?)
   a. What terms are most appropriate for talking to students about WIL?
   b. What about employability? Is that a term students understand?
3. How do you (or others) communicate with science students about WIL? (Who, how and what do you communicate?)
   a. Do you think this is effective? Is anything missing?
4. How interested are science students in WIL? How do they compare to students in other disciplines? Why do you think this is?
5. What challenges are associated with engaging Science students in WIL?
6. How do you (or others) motivate science students to engage with WIL?
7. Is there anything else that you think would encourage science students to prioritise WIL?
8. Is there anything that discourages science students from engaging with WIL?
9. How do you make WIL experiences meaningful to science students?
10. Is there anything else that you think would make WIL experiences more meaningful to science students?
11. Is there anything you would like to ask science students – related to WIL?

d) Semi-structured interview questions – Student Focus Group

1. Let’s start by talking about you. What do you want to do with your science degree and how confident are you that you will get that opportunity?

2. What do you do to make yourself more employable and how will you differentiate yourself from other science graduates?

3. What does the term ‘work-integrated learning’ mean to you?

4. A simple definition of work-integrated learning is learning activities that incorporate work, employment and careers and help students develop the capabilities required for the workplace. If we use this definition, what kinds of activities can you think of that would count as work-integrated learning? Let’s take a minute to write down as many as you can think of.

What different kinds of WIL did you come up with? Ask to share list and collect lists. Give list of activities

5. Have you had the opportunity to do any of these activities? Were they positive or negative learning experiences, and why?
   If prompt is necessary: What understanding or skills did you develop? How could you have got more out of the experience?

6. What kind of preparation was important? Was there anything you didn’t know beforehand that would have saved you a lot of bother?

7. What types of work-integrated learning do you think are most valuable and why?

8. How important is it to actually go into a workplace for work-integrated learning? If you are working on a project or a task developed by or with industry, but doing it at uni, is that still valuable work-integrated learning?

9. Are there any situations in which you think industry-involvement in training might not be the best way to learn something?

10. Part of the definition we talked about before is that work-integrated learning helps you develop the capabilities you need for the workplace – these are the type of skills that are transferable across workplaces and important in every workplace, like teamwork and communication, not just science theory and procedures (if they have mentioned specific capabilities already, refer back to those examples instead). What opportunities have you had in your course to develop these skills?

11. Sometimes the things you’re learning and the skills you’re developing aren’t obvious to you at the time, so when it comes to applying for a job and demonstrating what
you can do, it’s hard to come up with examples. How helpful is it to reflect on what you have learned and things you need to improve on as you go along?

12. Can you think of any examples of how someone or something has helped you reflect on this?

13. What encourages you, or other science students like you, to participate in work-integrated learning?

14. Have you declined any work-integrated learning opportunities? What discourages you from participating, or makes it challenging to participate?

15. How much work-integrated learning do you think should happen in your course and how much of your own time are you willing to invest?

16. How have you heard about work-integrated learning opportunities?

17. Do you think opportunities are communicated effectively or are there better ways of communicating that you would prefer? Who do you think science students would be most likely to listen to?

18. Is there anything else anyone would like to say and make sure we include in the research?

Work-integrated learning examples (list given to focus group participants)
- Industry-based projects
- Simulations
- Problem-based learning with industry partners
- Work placements, including internships, practicums and industry-based learning
- Observations and job shadowing
- Case studies and scenarios
- Career development learning
- Workplace audits
- Field trips
- Industry-inspired projects
- Online workplace tests
- Complex labs
- Role plays
### Presentations and publications – as at July 2018

<table>
<thead>
<tr>
<th>Event/Media</th>
<th>Format</th>
<th>Lead/ presenter</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>HERDSA 2017: Investigating science students’ perceptions of work-integrated learning to achieve curriculum reform</td>
<td>Presentation</td>
<td>Jo Elliott</td>
<td>Trina Jorre de St Jorre, Liz Johnson</td>
</tr>
<tr>
<td>ACEN National Webinar: Creating Sustainable WIL in Science</td>
<td>Webinar</td>
<td></td>
<td>Project team</td>
</tr>
<tr>
<td>ACDS TL conference 2017: Successful WIL in Science</td>
<td>Presentation</td>
<td>Liz Johnson</td>
<td>Project team</td>
</tr>
<tr>
<td>ACSME 2017</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do we engage science students with WIL</td>
<td>Presentation</td>
<td>Jo Elliott</td>
<td>Trina Jorre de St Jorre, Liz Johnson</td>
</tr>
<tr>
<td>Successful WIL in Science</td>
<td>Poster</td>
<td>Liz Johnson</td>
<td>Project team</td>
</tr>
<tr>
<td>HERDSA 2018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing local communities of practice for the integration of work-integrated learning across science curricula</td>
<td>Presentation</td>
<td>Cristina Varsavsky</td>
<td></td>
</tr>
<tr>
<td>Actioning the worry: Supporting science students’ participation in work-integrated learning</td>
<td>Presentation</td>
<td>Trina Jorre de St Jorre, Jo Elliott, Liz Johnson</td>
<td></td>
</tr>
<tr>
<td>STEAMing towards WIL</td>
<td>Presentation</td>
<td>Liz Johnson</td>
<td></td>
</tr>
<tr>
<td>What actually works? Practical, learner-centred principles for engaging students with employability</td>
<td>Presentation</td>
<td>Trina Jorre de St Jorre, Jo Elliott</td>
<td>Liz Johnson</td>
</tr>
<tr>
<td>ACDS TL conference 2017: Successful WIL in Science update</td>
<td>Presentation</td>
<td>Liz Johnson</td>
<td>Project Team</td>
</tr>
<tr>
<td>ACEN 2018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-integrated learning within undergraduate science degree programs: Case studies in assessment (full paper)</td>
<td>Full paper</td>
<td>Deanne H Hryciw (Deanne Skelly)</td>
<td>Judith Wake, Ursula Kennedy, Angela Howard, Yetta Gurtner, Michael Whelan, Susan Rowland</td>
</tr>
<tr>
<td>Science students want more and earlier access to WIL (full paper)</td>
<td>Full paper</td>
<td>Jo Elliott</td>
<td>Trina Jorre de St Jorre, Liz Johnson</td>
</tr>
<tr>
<td>Graduate outcomes &amp; employability in generalist degrees</td>
<td>Abstract</td>
<td>Liz Johnson</td>
<td>Deanne Gannaway</td>
</tr>
<tr>
<td>Assuring quality in WIL – is the devil in the detail?</td>
<td>Roundtable (60 min)</td>
<td>John Holdsworth</td>
<td>Anne-Louise Semple, Jo-Anne</td>
</tr>
<tr>
<td>ACSME 2018</td>
<td>Chuck, Peter Meier, Erica Smith</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WIL-ing participants: Supporting science students’ participation in work-integrated learning</td>
<td>Abstract</td>
<td>Joanne Elliott, Trina Jorre de St Jorre, Elizabeth Johnson</td>
<td></td>
</tr>
<tr>
<td>Are science academics on the same page as society for a new future of work?</td>
<td>Abstract</td>
<td>Jo-Anne Chuck, Felicity Blackstock, Thomas Millar, Christopher Jones</td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: Project timeline and deliverables

D.1. Project Overview

The Successful WIL in Science project was delivered in two phases with outputs refined iteratively and cross-referenced (Fig 3.3). Key milestones in the project include:

- launch of regional nodes: Vic (10 February 2017), WA (1 February 2017), Qld (31 March 2017), NSW (17 November 2017)
- publication of WIL Guide for Science: WIL Basics (7 April 2017), Good Practice (1 February 2018), Leadership for WIL (6 July 2018)
- national meetings: WIL in Science Forum (2 December 2016, 8 December 2017, 7 December 2018)

Figure D1-1: Organisation of the Successful WIL in Science project was delivered in overlapping phases with outputs refined iteratively as each phase informs the other.
## D.2: Detailed timeline

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Completion date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Deliverables</strong></td>
<td>Fri 27/07/18</td>
</tr>
<tr>
<td>a) <em>WIL Guide for Science</em></td>
<td>Fri 13/07/18</td>
</tr>
<tr>
<td>1. Develop website plan (wireframe, consultation, etc)</td>
<td>Mon 14/11/16</td>
</tr>
<tr>
<td>2. Design website / create pages</td>
<td>Fri 13/01/17</td>
</tr>
<tr>
<td>3. Create resource list (annotated bibliography)</td>
<td>Fri 6/07/18</td>
</tr>
<tr>
<td>Section 1: WIL Basics</td>
<td>Fri 7/04/17</td>
</tr>
<tr>
<td>Section 2: Good Practice</td>
<td>Fri 9/02/18</td>
</tr>
<tr>
<td>Section 3: Leading WIL</td>
<td>Fri 6/07/18</td>
</tr>
<tr>
<td>4. Review and maintain</td>
<td>Fri 13/07/18</td>
</tr>
<tr>
<td>b) Resources</td>
<td>Fri 10/03/17</td>
</tr>
<tr>
<td>1. Identify major existing resources (peer review papers, grey literature, institutional tools, case studies and reports, websites)</td>
<td>Fri 10/03/17</td>
</tr>
<tr>
<td>c) Student Voice Research</td>
<td>Fri 27/07/18</td>
</tr>
<tr>
<td>1. Develop research plan</td>
<td>Mon 1/05/17</td>
</tr>
<tr>
<td>2. Stage 1. WIL specialist perceptions of student engagement</td>
<td>Fri 25/08/17</td>
</tr>
<tr>
<td>2. Stage 2. Student experience and perceptions of WIL at Deakin</td>
<td>Fri 27/07/18</td>
</tr>
<tr>
<td>2. Stage 3. Extension - Student experience and perceptions of WIL in other contexts</td>
<td>Fri 27/07/18</td>
</tr>
<tr>
<td>3. Thematic analysis</td>
<td>Fri 13/07/18</td>
</tr>
<tr>
<td>d) Case Studies of Successful WIL</td>
<td>Fri 22/06/18</td>
</tr>
<tr>
<td>e) Local Networks &amp; Workshops</td>
<td>Fri 15/06/18</td>
</tr>
<tr>
<td>f) Engaged dissemination</td>
<td>Mon 2/10/17</td>
</tr>
<tr>
<td>g) WIL stakeholder engagement framework</td>
<td>Fri 29/06/18</td>
</tr>
</tbody>
</table>
Successful WIL in Science

### Project Deliverables

- **a) WIL Guide for Science**
  - 100%

- **b) Resources**
  - 100%

- **c) Student Voice Research**
  - 100%

- **d) Case Studies of Successful WIL**
  - 100%

- **e) Local Networks & Workshops**
  - 100%

- **f) Engaged dissemination**
  - 100%

- **g) WIL stakeholder engagement framework**
  - 100%

### 2017-2019

- **2017**
  - **Project Deliverables**
    - Develop website plan (wireframe, consultation, etc)
    - Design website / create pages
    - Create resource list (annotated bibliography)

- **2018**
  - **Section 1: WIL Basics**
    - 100%
  - **Section 2: Good Practice**
    - 100%
  - **Section 3: Leading WIL**
    - 100%

- **2019**
  - **Review and maintain**
  - **Thematic analysis**
D.3: Benchmarking with National Strategy for Work-Integrated Learning (ACEN 205)

Comparison of enabling approaches from the National Strategy for Work-integrated Learning (ACEN, 2015) with affordances of the WIL in Science program

<table>
<thead>
<tr>
<th>National Strategy enabling approaches</th>
<th>WIL in Science affordances</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Provide national leadership to expand work integrated learning (WIL)</td>
<td>WIL in Science is a sector-wide collaboration promoting engagement, shared language and resources in a broad discipline area</td>
</tr>
<tr>
<td>1.1 Collaborate in driving an expansion in WIL opportunities</td>
<td>WIL in Science is a channel for collective national action</td>
</tr>
<tr>
<td>1.2 Ensure mechanisms are in place to enable collaboration, implement the strategy and strengthen the partnership</td>
<td>WIL in Science Network identifies WIL leaders for science and mathematics, and sought to engage the leadership of science faculties</td>
</tr>
<tr>
<td>1.3 Engage the support of political leaders and policymakers</td>
<td>WIL in Science Network has a direct connection with the ACDS and also creates local contacts to monitor growth in WIL</td>
</tr>
<tr>
<td>1.4 Establish a national profile of current WIL activity to inform next steps and future growth opportunities</td>
<td>WIL in Science Guide promotes evidence-based practice connecting leaders and practitioners to peer-reviewed literature WIL in Science has conducted primary research on barriers and enablers to student participation in WIL</td>
</tr>
<tr>
<td>2 Clarify government policy and regulatory settings to enable and support growth in WIL</td>
<td>Increased awareness and engagement by Deans of Science, as key university leaders, will facilitate this objective</td>
</tr>
<tr>
<td>2.1 Align government policy and regulation to support growth in WIL</td>
<td>WIL in Science engages university leaders and practitioners through peer interactions</td>
</tr>
<tr>
<td>2.2 Ensure reliable information is available to students and employers to support the integrity of interactions involving third-party providers arranging internships</td>
<td>WIL in Science Guide promulgates good practice</td>
</tr>
<tr>
<td>3 Build support—among students, universities, employers across all sectors and governments—to increase participation in WIL</td>
<td>WIL in Science promotes evidence-based practice connecting leaders and practitioners to peer-reviewed literature WIL in Science has conducted primary research on barriers and enablers to student participation in WIL</td>
</tr>
<tr>
<td>3.1 Ensure clear, concise and accessible information about WIL is available</td>
<td>WIL in Science Guide promulgates good practice</td>
</tr>
<tr>
<td>3.2 Promote the benefits of WIL</td>
<td>WIL in Science engages university leaders and practitioners through peer interactions</td>
</tr>
<tr>
<td>3.3 Improve the capacity of students and employers to prepare for and engage in WIL</td>
<td>WIL in Science Guide promulgates good practice</td>
</tr>
<tr>
<td>3.4 Draw on available research to improve the quality of WIL experiences and the levels of participation in WIL</td>
<td>WIL in Science promotes evidence-based practice connecting leaders and practitioners to peer-reviewed literature WIL in Science has conducted primary research on barriers and enablers to student participation in WIL</td>
</tr>
<tr>
<td>4 Ensure the investment in WIL is well targeted and enables sustainable, high-quality experiences, stakeholder participation and growth</td>
<td>WIL in Science has engaged with faculty leaders who control local resourcing, and regional nodes have shared resourcing challenges and responses</td>
</tr>
<tr>
<td>National Strategy enabling approaches</td>
<td>WIL in Science affordances</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>5 Develop university resources, processes and systems to grow WIL and engage business and community partners</td>
<td></td>
</tr>
<tr>
<td>5.1 Strengthen WIL capacity and practice in universities</td>
<td>WIL in Science Network is a channel for leadership development and capacity-building</td>
</tr>
<tr>
<td>5.2 Promote employer engagement and improve access and support</td>
<td></td>
</tr>
<tr>
<td>5.3 Increase accredited WIL content in course curricula</td>
<td>WIL in Science networks supports leaders and educators to enact WIL</td>
</tr>
<tr>
<td>5.4 Strengthen university collaboration around WIL</td>
<td>WIL in Science is a channel for peer collaboration</td>
</tr>
<tr>
<td>5.5 Strengthen capacity through increased professional development available to the sector</td>
<td>WIL in Science is a channel for professional development</td>
</tr>
<tr>
<td>6 Build capacity for more employers to participate in WIL</td>
<td></td>
</tr>
<tr>
<td>6.1 Increase employer participation in WIL</td>
<td>WIL in Science has initiated resources to support faculties to work with industry partners</td>
</tr>
<tr>
<td>6.2 Increase small and medium enterprise (SME) participation in WIL</td>
<td></td>
</tr>
<tr>
<td>6.3 Develop WIL in specific and priority sectors</td>
<td>WIL in Science promotes WIL in STEM disciplines</td>
</tr>
<tr>
<td>6.4 Build and track employer engagement</td>
<td></td>
</tr>
<tr>
<td>7 Address equity and access issues to enable students to participate in WIL</td>
<td></td>
</tr>
<tr>
<td>7.1 Improve access and equity for students to take up WIL opportunities</td>
<td>WIL in Science creates resources for faculties to enable diverse implementation of WIL</td>
</tr>
<tr>
<td>8 Increase WIL opportunities for international students and for domestic students to study offshore</td>
<td></td>
</tr>
<tr>
<td>8.1 Increase opportunities for international students to participate in WIL</td>
<td></td>
</tr>
<tr>
<td>8.2 Improve the capacity for international students to participate in WIL opportunities</td>
<td></td>
</tr>
<tr>
<td>8.3 Support access to credit-bearing offshore placements for Australian students</td>
<td></td>
</tr>
</tbody>
</table>