MULTISECTOR PROJECTS

Interdisciplinary Project-Based Work-Integrated Learning:

The Australian Good Practice Guide

Curtin University

University of South Australia

RMIT UNIVERSITY

UTS

AUSTRALIAN TECHNOLOGY NETWORK OF UNIVERSITIES

Authors

Associate Professor Margo Brewer (Curtin University, lead author and project lead)
Associate Professor Sonia Ferns (Curtin University)
Dr Sally Lewis (University of South Australia's lead)
Dr Jeri Childers (University of Technology Sydney's lead)
Leoni Russell (RMIT University's lead)

Project Team

Associate Professor Margo Brewer (Curtin University, lead author and project lead)
Associate Professor Sonia Ferns (Curtin University, project team member)
Ms Michelle Donaldson (Curtin University, project team member)
Dr Sally Lewis (University of South Australia's lead)
Dr Jane Andrew (University of South Australia, project team member)
Ms Leoni Russell (RMIT's lead)
Dr Jeri Childers (University of Technology Sydney's lead)
Ms Alice Hart (Curtin University, project manager)
Mr Matthew Phillips (Curtin University, research assistant)
Ms Fae Heaselgrave (University of South Australia, research assistant)
Dr Julia Alessandrini (RMIT, research assistant)
Ms Louisa Luong (University of Technology Sydney, research assistant)

Acknowledgement

The project team has support from an Expert Reference Group who have advised on project concepts, project evaluation and dissemination strategies. Members include:
Associate Professor Veronika Kelly (University of South Australia)
Ms Judie Kay (RMIT)
Mr Adrian Buck (University of Technology Sydney)
Dr Karsten Zegwaard (University of Waikato)
Ms Anne Younger (Australian Industry Group)

Suggested citation

Brewer, M. L., Ferns, S., Lewis, S., Childers, J., & Russell, L. (2020). Interdisciplinary project-based work-integrated learning: the Australian good practice guide. The Australian Technology Network.

Funded by the Australian Technology Network, 2019

Contents

Purpose of the guide

Universities have made substantial progress with embedding work-integrated learning (WIL) within curricula over recent decades. The International Journal of Work-Integrated Learning (https://www.ijwil.org) defines WIL as "*an educational approach that uses relevant work-based experiences to allow students to integrate theory with the meaningful practice of work as an intentional component of the curriculum*".

This Guide is designed to inform the incorporation of a specific type of WIL–interdisciplinary project-based WIL–into undergraduate or postgraduate programs. Interdisciplinary project-based WIL provides an opportunity for university staff, students, and industry partners to enhance their capabilities through collaborating in real-world problem solving. A key driver for this approach is the development of critical graduate employability skills including collaboration, communication, complex problem solving and project management.

The Guide has grown out of a national leadership project funded in 2019 by the Australian Technology Network (www.multisectorprojects.com). The project, led by the authorship team, aimed to build staff capabilities for the design, implementation and evaluation of project-based learning for students from multiple disciplines as part of their WIL experience. Henceforth, for simplicity interdisciplinary project-based WIL is referred to as interdisciplinary project-based learning throughout much of the guide.

This guide provides an overview of interdisciplinary project-based learning along with examples of this in action across four Australian universities, reflections on lessons learned, and key recommendations for other staff wishing to embed this educational approach within their curriculum. The guide gives an overview of the essential dimensions required to design, implement and evaluate interdisciplinary project-based learning. This includes the views of staff, students and industry, tips for success, suggested readings and several proforma tools (see appendices).

The guide can be used to establish interdisciplinary project-based learning in a range of contexts including the classroom, online and workplace (e.g., placements within industry). The Guide can also be used to benchmark existing interdisciplinary project-based learning for quality review processes.

We trust you find this Guide valuable to facilitate the achievement of educational and employability outcomes for students.

Key messages

Modern, complex problems cut across discipline boundaries, thus to reach more comprehensive explanations of complex, real-life problems, insights from several disciplines need to be reconciled and integrated (de Greef *et al*., 2017).

The driving question in interdisciplinary project-based learning needs to present "real-world problems that students find meaningful, thereby motivating them to take ownership of the questions and to thoughtfully pursue answers to them" (Marx *et al*., 1997, p. 345).

Students are required to self-direct and self-regulate their learning to successfully complete the project (Lim *et al*., 2018).

Interdisciplinary project-based learning changes the educator's role from instructor to facilitator and resource provider. This approach also challenges traditional assessment policies and protocols so staff need to be creative in how they manage student learning and assessment. These cultural shifts require support and guidance for academic staff (Guthrie, 2019).

The production of a concrete artefact is a defining feature of project-based learning and distinguishes it from problem-based learning (Volger *et al*., 2018).

Students should be involved in decisions about the scope of the project and the nature of the problem they will work to address (Svihla & Reeve, 2016).

A clear explanation to students of the *why* of interdisciplinary project-based learning is critical; link the learning experiences to employability in both the prebrief and the debrief to ensure students understand how they can promote their involvement to potential employers.

Given interdisciplinary project-based learning is essentially a student led learning experience, it is important staff guide the students in managing group dynamics and the project (e.g. task allocation) to ensure they are empowered to work as an autonomous group.

About the authors

Associate Professor Margo Brewer is a teaching and research academic in the Faculty of Health Sciences at Curtin University. Margo held a leadership role in work-integrated learning at Curtin since 2002 and a leadership role in interprofessional education from 2010 until 2019. Margo was awarded her PhD in 2017 for her exploration of leadership of interprofessional education within a university context. Margo has won multiple teaching excellence awards in the field of interprofessional education including a national Office of Learning and Teaching award and the International Best Practice award at the World Business Capability Congress in 2012. She has published several papers in the top ranked journal in interprofessional education, received grants totalling over $2.3m, and provided expert advice on interprofessional education to over 40 national and international universities and health services. m.brewer@curtin.edu.au

Dr Sally Lewis is the University of South Australia Program Director for the Bachelor of Marketing and Communication and the Bachelor of Communication. Sally is a former Director of Communication (Government) and Director of Marketing (Industry). Sally has been nationally recognised for her work in interdisciplinary student learning and has received UniSA Creative Industries awards in Teaching and Learning and Innovation. Sally liaises extensively with key industry partners and has research interests in student engagement and public communication. sally.lewis@unisa.edu.au

Associate Professor Sonia Ferns has over 40 years' experience across diverse educational sectors. In addition to teaching cross-disciplinary subjects, a key aspect of Sonia's role involves conducting professional development for teaching and support staff to improve institutional quality through enhancing staff capacity. She also has expertise in curriculum and assessment design, industry engagement, work integrated learning (WIL) and interdisciplinary practice for students. Sonia has also led high profile strategic projects on curriculum renewal, institutional WIL and course optimisation. She has also led many nationally funded research projects. s.ferns@curtin.edu.au

Dr Jeri Childers is the University of Technology Sydney Faculty of Engineering and Information Technology Director of Innovation and Entrepreneurship and the founding Director of the UTS Techcelerator, which enables deep tech prototyping and commercialisation to enable enterprising mindsets and skills development for students who will be leading innovation and technology development. Jeri is internationally recognised for her work in industry- and community-engaged work integrated learning. Jeri has research interests in experiential entrepreneurial work integrated learning, problem-based learning, and employability mindsets and skills development related to innovation and entrepreneurship. jeri.childers@uts.edu.au

Leoni Russell is the Senior Advisor Learning and Teaching in Careers and Employability at RMIT University. She provides academic educational support to build staff capability across a range of educational strategies including WIL, Career Development Learning and the embedding of employability skills into curriculum. Leoni has expertise in WIL curriculum design and has been involved in numerous nationally funded research projects on WIL. leoni.russell@rmit.edu.au

Terminology

For the purpose of the Guide, clarification of common terms is provided below:

Program	Encompasses a structured combination elements of the curriculum including a unit, paper, subject, course
Industry	Organisations involved in off-campus work-integrated learning
Institution	The university, college or academy
Discipline	A broad academic field such as anthropology, economics, health science, communications or engineering.
Profession	An occupational group such as nurses, physiotherapists, mechanical engineers, doctors, teachers, accounting, marketing, etc.

Definitions

The three key elements of the Guide are defined as follows:

Interdisciplinary learning: "a process by which learners integrate information, data, techniques, tools, perspectives, concepts and/or theories from two or more disciplines to craft products, explain phenomenon, or solve problems, in ways that would have been unlikely through single-disciplinary means" (Mansilla, 2010, p. 289).

Project-based learning: "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks" (Markham *et al*., 2003, p. 4).

Work-integrated learning: "an educational approach that uses relevant work-based experiences to allow students to integrate theory with the meaningful practice of work as an intentional component of the curriculum" (International Journal of Work-Integrated Learning, 2020, para. 2).

Acronyms

WIL: Work-integrated learning

Chapter 1
The Case for Interdisciplinary Project-based Learning

The landscape of work has shifted in recent years in response to the rise of technology, super structured organisations and global connectedness (Davies *et al*., 2011). The occupations and specialties most in-demand did not exist a decade ago. For example, in Australia over one million new jobs in knowledge and service industries have emerged over the past 25 years (World Economic Forum, 2016). In their report *Future Work Skills 2020*, Davies *et al*. (2011) identified 10 skills required for the 21st century workforce: transdisciplinarity, novel and adaptive thinking, cross-cultural competency, sensemaking, design mindset, cognitive load management, virtual collaboration, social intelligence, computational thinking, and new media literacy. Similarly, participants at the World Economic Forum (2018) outlined 10 skills employees will need to survive the rise of automation: complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgement and decision-making, and service orientation. Innovation and Science Australia (2017) highlighted the increase in 'interaction' jobs (i.e., jobs involving more complex human interactions and judgements) with employees of the future spending more time on interpersonal, creative, problem solving and entrepreneurial skills. Similarly, the Entrepreneurship Framework, also known as Entrecomp, focuses on critical enterprising mindsets and skills that employers will require in the future (Bacigalupo *et al*., 2016).

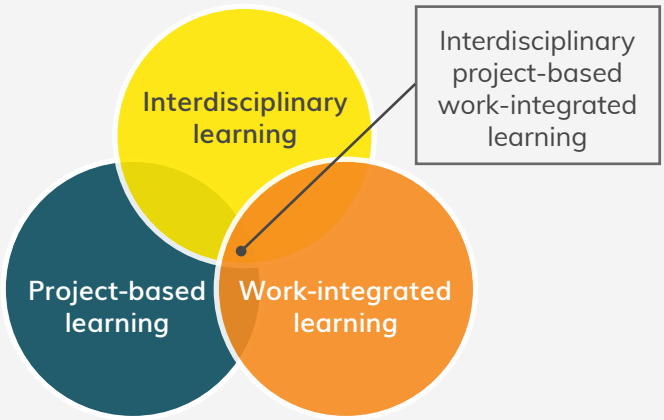
Given this shift in skill demand, it is perhaps not surprising current employers are generally satisfied with graduates' discipline specific knowledge and skills but are concerned about gaps in essential generic skills (Smith & Worsfold, 2014). Employers claim graduates' poor teamwork, communication, literacy and numeracy skills are negatively impacting on their business (Australian Industry Group, 2018).

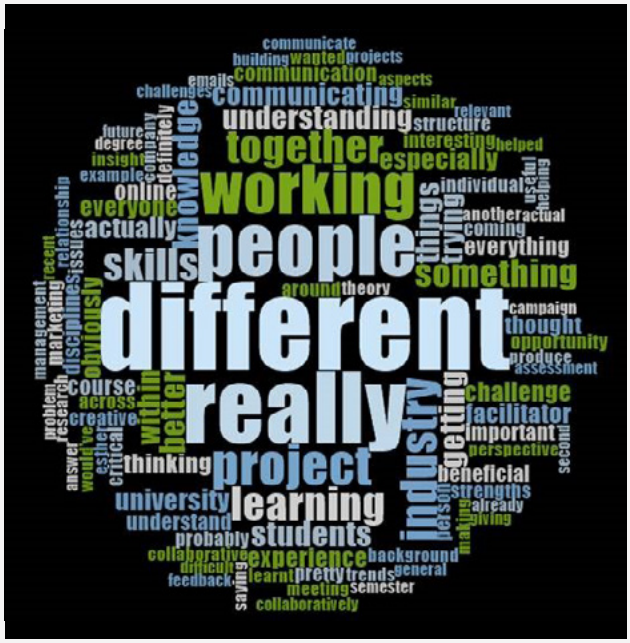
Responding to these issues, higher education institutions are more focused on employability than ever before. Work-integrated learning (WIL) enhances not only disciplinary knowledge but also the development of employability skills including problem-solving, interpersonal communication, teamwork, leadership and negotiation skills, self-esteem and confidence (Lim *et al*., 2018; Smith & Worsfold, 2014). Interdisciplinary project-based WIL has the potential to deliver authentic, sustainable learning experiences at scale (Vega et al., 2014) that bring together three educational approaches: interdisciplinary learning, project-based learning, and WIL, as depicted in Figure 1 overleaf. In addition, both interdisciplinary learning and project-based learning pedagogies "emphasise students' collaboration in providing an authentic application of content and skills, while aiming for a development of twenty-first century skills" (Brassler & Dettmers, 2017, p. 2).

> *Interdisciplinary project-based WIL closely aligns with the contemporary world of work where complex problems demand interdisciplinary solutions and employers focus on the interdisciplinary collaboration skills of graduates.*

Figure 1

Integration of Interdisciplinary Learning, Project-Based Learning and Work-Integrated Learning

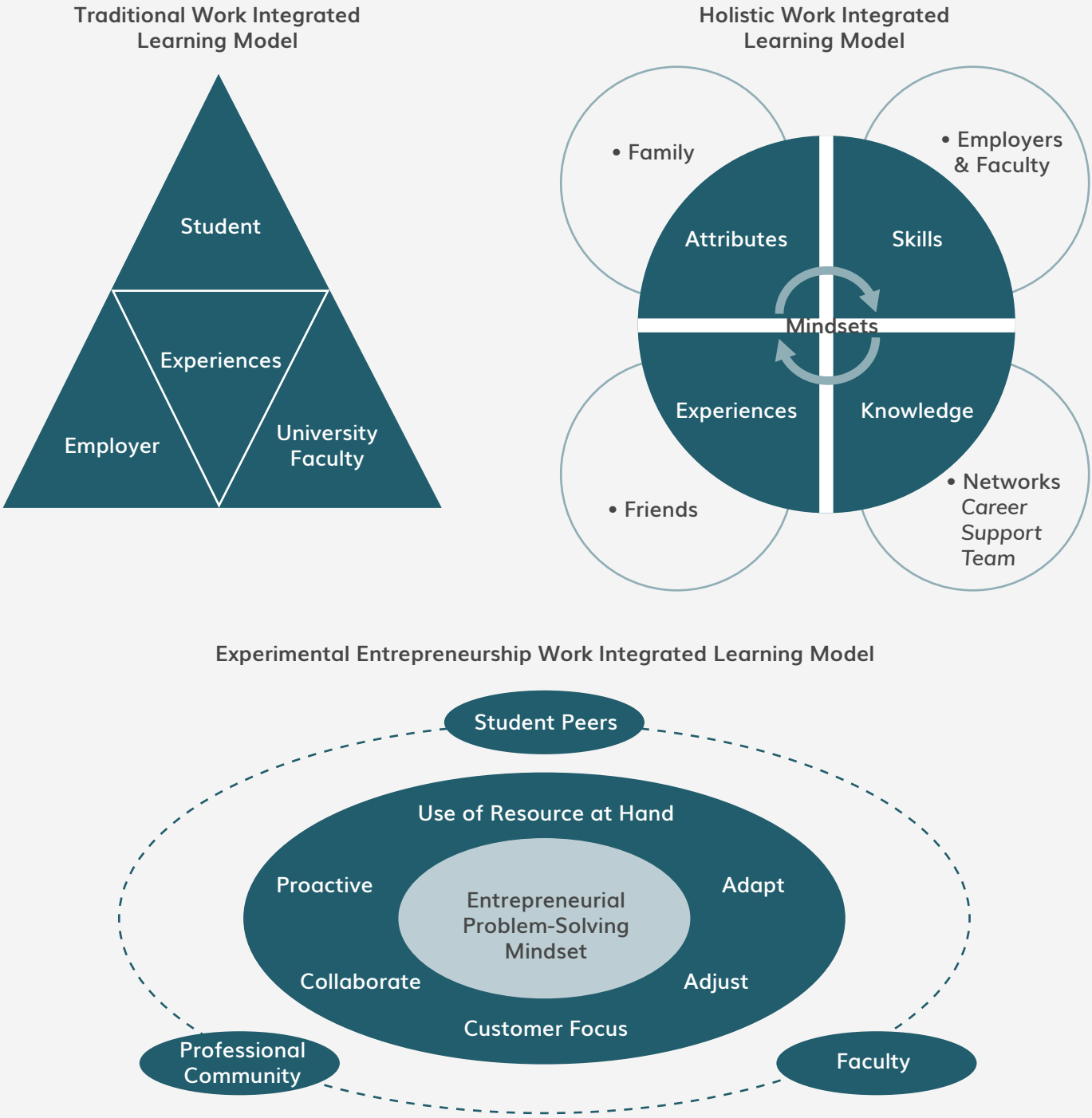




Higher education institutions are also responding to the disruptive nature of the future of work by deploying a variety of WIL models that leverage their local contexts and institutional foci on employability, specific mindset and skill development, pedagogies, stakeholder engagement and local and regional economic development. These models range from traditional models (Cord *et al*., 2011), holistic models (Kinash & Crane, 2015) to include emerging models that enable a focus on development of enterprising mindsets and skills development (de Villiers Scheepers *et al*., 2018). This spectrum of WIL models, adapted from the work of de Villiers Scheepers *et al*. (2018) is presented in Figure 2.

Figure 2

Spectrum of WIL Models



Note: Adapted from "Preparing Future-Ready Graduates through Experiential Entrepreneurial Entrepreneurship" by M. J. de Villiers Scheepers, R. Barnes, M. Clements, & A. J. Stubbs, 2018, Education + Training, 60(4), 303-317 (https://doi:10.1108/ET-11-2017-0167)

Chapter 2

What is Interdisciplinary Project-based Work-integrated Learning?

Project-based learning has been a feature of education for many years. In his review of research on project-based learning, Thomas (2000) identified a number of key elements of projects that are central to this educational approach. The projects must: involve complex tasks based on challenging questions or problems, involve students in design, problem-solving and decision-making or investigative activities, give students the opportunity to work relatively autonomously over an extended period of time, and culminate in an authentic product or presentation. Another key feature of project-based learning is the study of relationships between various disciplines, otherwise known as interdisciplinarity (Habók & Nagy, 2016). Hence, the emergence of interdisciplinary project-based learning.

> *Interdisciplinary project-based work-integrated learning is a systematic educational approach that engages students from two or more disciplines in the integration of information, techniques, concepts and/or theories from their different disciplines as they work collaboratively to solve complex, authentic questions or problems generated in collaboration with industry.*
>
> Project Team

Key characteristics of interdisciplinary project-based learning

To meet the definition of interdisciplinary project-based learning–within the context of WIL–the student learning experience should include the following elements:

- Students from two or more disciplines (or professions)
- Significant interactivity between students from different disciplines to ensure they have opportunities to learn about, and integrate the different perspectives of, their disciplines/ professions
- Students engage in authentic and meaningful work-related projects over an extended period of time
- The focus is on problem solving (rather than problem analysing)
- Students manage their own projects in student-led interdisciplinary groups or teams following broad general steps of project management
- Reflexivity plays a central role during the research stage and the real-world application of knowledge
- While evaluation occurs throughout the student learning journey, the focus of evaluation is on the final outcome of the project
- Must involve three stakeholders; the student, the university, and industry.

Benefits of interdisciplinary project-based learning

Project-based learning provides students with the opportunity to gain a deep understanding of concepts and potentially allows them to solve societal problems (Moalosi *et al*., 2012). The same problem is analysed from different perspectives, developing a broader understanding of the issue, also known as meta-disciplinary knowledge (Biasutti & El-Deghaidy, 2015). Furthermore, the level of student engagement in their learning process during project-based learning aligns with the rise in students wishing to have greater control as proactive producers and managers of their learning (Flynn & Vredovoog, 2010).

Martinez *et al*. (2010) reported several advantages of project-based learning over traditional teaching approaches:

- Active engagement of students in the learning process
- Student self-awareness
- Independent learning
- Teamwork skills
- Integration of knowledge and skills from several disciplines
- Student autonomy
- Critical thinking
- Student satisfaction with the learning experience.

In a recent review of the literature on project-based learning, Condliffe (2017) identified three domains of competence relevant to 21st century employability that students develop:

- Cognitive domain: academic content, critical thinking, digital literacy, active listening, problem-solving and creativity
- Intrapersonal/affective domain: self-regulation, metacognition, grit and flexibility
- Interpersonal domain: communication, collaboration, conflict resolution and leadership.

Benefits of interdisciplinary project-based WIL from our project

Students from our university pilots articulated the benefits of the experience as *"Great for preparing me for the workplace"*, *"Very beneficial for life after Uni"*, and *"The real-world exposure made the work meaningful and different'*. These positive student experiences resound with earlier research undertaken in Europe and the United States (Heikkinen & Isomöttönen, 2015; Kruck & Teer, 2009). Students recognise interdisciplinary project-based WIL enhances their graduate employability: "The main finding with respect to learning gain was that students had first-hand experience with the diversity of working teams and expanded their knowledge beyond their own discipline" (Lim *et al*., 2018, p. 11).

"So working collaboratively within the team, facing the challenges together, overcoming the challenges and everything like that was really cool. It was good to have different skill sets and work within one project."

(2nd Year Student)

"Having a group and having to deal with problems that is presented by a company, like a real life company, gave us a good insight into the details on what we would expect when we are facing a problem in real life. Especially like transformation issues within the company."

(3rd Year Student)

The opportunity to redesign curriculum to embed real-world learning and authentic assessment activities is a key benefit of interdisciplinary project-based WIL. Interviews with our project pilot participants indicated increased engagement with industry and community partners motivated students and facilitated their skill development. A further benefit university staff gained from the projects was enhanced collaboration with colleagues from other disciplines.

"We can find ourselves in a little bit of an academic bubble sometimes ... So, I think it's really important to actually take that step back and look at what others actually need. That's where industry comes in...to say these are the kinds of problems that we face every day that we need you guys to help us solve. These are the kinds of skills that we're looking for. These are the kinds of tools that we would like people coming out of universities to have."

(University Staff Participant)

The benefits for industry include access to new thinking, creative input from students, new processes and technologies and potential identification of future talent. Involvement with projects of this nature enable industry partners to develop links that may lead to further collaborations in the areas of education and research. Industry partners involved in our project pilots valued the opportunity to influence the education of the future workface including the enhancement of graduate employability skills (e.g., complex problem solving, project management, self-management, communication and teamwork skills), all of which have been shown to emerge from interdisciplinary project-based learning.

"And it was such a good project to see how the different groups would work together because that's how it is when we work in an operational environment."

(Industry representative)

Chapter 3
Leading Interdisciplinary Project-Based Learning

Implementing interdisciplinary project-based learning requires significant investment in supporting staff to rethink approaches to the design of learning experiences across at least two disciplines. As a result, this chapter begins with a focus on the leadership required to promote innovation and creativity in program design. Advice on potential theoretical frameworks to inform the learning experience is provided including the key steps in the design process.

Leadership

The three key stakeholder groups in interdisciplinary project-based learning are the student, the university and industry. We recommend the establishment of a collaborative leadership team with representation of staff from each program participating students are studying, plus students and relevant industry partners. While the level of involvement of students and industry may vary, we encourage staff to consider the model of participation set out in the participation principles developed by the International Association for Public Participation (2014) outlined in Figure 3 below.

Figure 3

International Public Participation Principles Spectrum

Note: Adapted from "International Public Participation Principles" by the International Association for Public Participation, 2014 (https://www.iap2.org.au/Resources/IAP2-Published-Resources).

The International Association for Public Participation (2014) provides further detail on the participation expected at each level and the commitment this would involve between university staff and students/industry (see Table 1 overleaf). While engaging with students and industry at the empowerment level may be challenging, in most instances it is recommended staff aim to collaborate (level 3 participation) with representatives from both of these stakeholder groups in leading any initiative. Note: The level of participation of students should shift to empower in the implementation phase.

Table 1

Stakeholder Participation Process

Participation Goal	Description of Participation	Commitment by Staff
1. Inform	Provide students and industry with information to assist them to understand the alternatives and/or decisions.	Ensure stakeholders are kept informed.
2. Consult	Obtain feedback from students and industry on alternatives and/or decisions.	Listen to and acknowledge concerns and aspirations and respond to feedback .
3. Involve	Work with students and industry to ensure their concerns and aspirations are understood and considered.	Ensure concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how stakeholder input has influenced decisions.
4. Collaborate	Partner with students and industry in all key decisions	Seek advice and innovation in formulating solutions and incorporate this advice and recommendations into decisions.
5. Empower	Place final decisions in the hands of students and industry.	Implement stakeholders' final decisions.

An alternative model of engagement is the Higher Education Academy's Student Partnership Model (Healey *et al*., 2014). This partnership model exemplifies the integration of learning and teaching approaches around delivery, assessment, curriculum design, discipline-based activities and scholarly work, ensuring a holistic and cohesive learning experience for students. The importance of co-design and co-inquiry is fundamental to sustaining partnerships where students are empowered to influence the learning journey.

The Higher Education Academy's student partnership model encompasses key elements that are useful for establishing interdisciplinary project-based learning and negotiating processes, outcomes and evaluation strategies with students. Through this partnership, students can create an experiential pathway that meets their learning needs while addressing the requirements of the other stakeholders– academic staff and industry.

Incorporated in this partnership model are the Higher Education Academy's partnership principles and behaviours which form the basis for working with students and industry as members of a collaborative leadership team. These principles and behaviours are outlined in Table 2 overleaf.

Table 2

Partnership Principles and Behaviours when Co-creating with Students and Industry

Principle	Behaviour
Authenticity	All members of the leadership team – comprised of staff, student and industry representation - are provided with a meaningful rationale for investing in the partnership, and are honest about what they can contribute and the boundaries of the partnership.
Inclusivity	The leadership team embraces and draws upon the different talents, perspectives and experiences that all team members bring.
Reciprocity	All leadership team members have an interest in, and stand to benefit from, working and/or learning in the partnership.
Empowerment	Power is distributed appropriately and all leadership team members are encouraged to constructively challenge ways of working and learning that reinforce existing barriers and/or inequalities.
Trust	All leadership team members take time to get to know each other, engage in open and honest dialogue and are confident they will be treated with respect and fairness.
Challenge	All leadership team members are encouraged to constructively critique and challenge practices, structures and approaches that undermine the interdisciplinary nature of the project, the staff-student partnership, and the staff-student-industry partnership, and are enabled to take risks to develop new ways of working and learning.
Community	All leadership team members feel a sense of belonging and are valued for the unique contribution they make.
Responsibility	All leadership team members share collective responsibility for the aims of the partnership (and the project), and individual responsibility for the contribution they make.

Note: Adapted from "Engagement Through Partnership: Students as Partners in Learning and Teaching in Higher Education," by M. Healey, A. Flint, & K. Harrington, 2014, *Higher Education Academy*, p. 14 (https://www.advance-he.ac.uk/knowledge-hub/engagement-through-partnership-students-partners-learning-and-teaching-higher)

Chapter 4
Designing Interdisciplinary Project-Based Learning

Several important decisions are required in the design of interdisciplinary project-based learning. This chapter begins with advice on potential theoretical frameworks to inform the learning experience followed by the key steps in the design process.

Theoretical Framework

The theory that is arguably most relevant to interdisciplinary project-based learning is social constructivism (Li & Lam, 2013). The constructivist view of learning considers the student as an active agent in the process of knowledge acquisition (Bada & Olusegun, 2015). Students actively construct knowledge in their own minds through a process of discovery and transformation of information, comparing new information to old, and revising 'rules' that no longer apply. Constructivists believe the context has a significant impact on learning as people construct knowledge and meaning through experiences and reflecting on those experiences (Bada & Olusegun, 2015). Social constructivism assumes understanding, significance and meaning are developed in collaboration with other people (Amineh & Asl, 2015).

Learning Pedagogies

Three pedagogies that are useful for the design of interdisciplinary project-based learning are: (1) cooperative learning, (2) inquiry-based learning and (3) experiential learning, all of which are underpinned by social interaction.

Cooperative learning: Cooperative learning is defined by a set of processes that help people interact together in order to accomplish a specific goal or develop a product that is usually content specific. Five essential elements should be considered in the design of the learning experiences that promote cooperation: positive interdependence, individual and group accountability, promotive interaction, appropriate use of social skills, and group processing (Johnson & Johnson, 1989, 2005).

1. Positive interdependence exists when group members perceive they are linked with each other in a way that they cannot succeed unless everyone succeeds
2. Individual and group accountability refers to the group being accountable for achieving its goals, but also each member is accountable for their contribution and for learning the material
3. Promotive interaction occurs when members share resources, support, encourage and praise each other's efforts
4. Interpersonal and small group skills (e.g., communication, constructive feedback and problem solving skills) are taught along with academic content
5. Group processing exists when group members reflect on how well they are achieving their goals and maintaining effective working relationships and make adjustments accordingly.

For more information, visit the Cooperative Learning Institute http://www.co-operation.org/what-is-cooperative-learning.

Inquiry-based learning: Inquiry-based learning is an umbrella term covering a range of pedagogical approaches that require students to undertake investigative work such as addressing questions or solving problems (Aditomo *et al*., 2013). Project-based learning is an example of this pedagogy. While there are multiple definitions of inquiry-based learning they share one common element; the learning is question- or problem-driven (Aditomo *et al*., 2013). Emphasis is placed on posing questions, gathering and analysing data, and constructing evidence-based arguments (Hmelo-Silver *et al*., 2007). Inquiry-based learning has students follow methods and practices similar to those of professional scientists in order to construct knowledge. Students set out to discover new causal relations through formulating hypotheses and testing them (experimenting and/or observing) (Pedaste *et al*., 2015). Active participation and student responsibility are core elements of inquiry-based learning.

For more information, visit the Inquiry-Based Learning Institute http://www.iblinstitute.com.

Experiential learning: Experiential learning is a philosophy of education based on a theory of experience (Kolb & Kolb, 2005. This pedagogy is built on six propositions (Healey, 2005):

1. Learning is a process, not an outcome; the focus is on engaging students in a process that best enhances their learning
2. All learning is relearning; learning draws out students' beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas
3. Learning requires the resolution of conflicts; conflict, differences, and disagreement drive the learning process
4. Learning is a holistic process of adaptation; learning involves the total person (thinking, feeling, perceiving and behaving)
5. Learning results from transactions between the person and the environment
6. Learning is the process of creating knowledge.

For more information, visit the Institute of Experiential Learning https://www.experientiallearninginstitute.org.

When adapting these learning pedagogies to new models of entrepreneurial WIL, it is important to use the principles that guide good practice (de Villers Scheepers & Barnes, 2019) outlined in Figure 4 and to scaffold learning to enable the stages of experiential entrepreneurial WIL (de Villers Scheepers *et al*., 2018) outlined in Figure 5.

Figure 4

Principles of Effectual Entrepreneurship Pedagogy

- Individuals reflecting on their own resources available
- Adapt and adjust in problem solving and embrace opportunity
- Use experiments and prototypes; be curious and discovery driven
- Be customer-focused, solve problems for the beneficiary
- Collaborate and co-create with stakeholders
- Be proactive, limit risk by using resources available to solve problems for 'pain points' and 'gain points'

Note: Adapted from "Experiential Entrepreneurial Work Integrated Learning Model" by M. J. de Villiers Scheepers & R. Barnes, 2019, Australasian Collaborative Education Network.

Figure 5

Stages of Experiential Entrepreneurial WIL

Preparation

Self-assessment of entrepreneurial mindset and skills, theory of problem-solving and opportunity development.

Creation

Participation in an experience focusing on building enterprising mindsets and skills, prototyping and peer and industry support.

Reflection

Critical reflection on mindsets, skills, goals, customers, problem-solving and feasibility analysis.

Data & Insight Collection & Curation

Note: Adapted from "Preparing Future-Ready Graduates through Experiential Entrepreneurial Entrepreneurship" by M. J. de Villiers Scheepers, R. Barnes, M. Clements, & A. J. Stubbs, 2018, Education + Training, 60(4), 303-317 (https://doi.org/10.1108/ET-11-2017-0167).

Design process: Constructive alignment

An important consideration with interdisciplinary project-based learning is where and how to begin the design process. Biggs (1996) constructive alignment outcomes based approach provides a useful framework for this design process. This three phase model begins with the learning outcomes and then moves though learning opportunities and assessment. When beginning the design process you need to keep three constructivist principles of project-based learning in mind (1) learning is context specific, (2) learners are involved actively in the learning process, and (3) learners achieve their goals through social interactions and the sharing of knowledge and understanding. In other words, students have "opportunities to construct knowledge by solving real problems through asking and refining questions, designing and conducting investigations, gathering, analysing, and interpreting information and data, drawing conclusions and reporting findings" (Blumenfeld., 2000 p. 150).

Step 1. Learning outcomes

Agreement on learning outcomes for the interdisciplinary project-based learning experience needs to be negotiated. Learning outcomes will incorporate a combination of discipline specific knowledge and skills as well as employability skills (generic graduate capabilities). Alignment of project learning outcomes with the overarching outcomes for the program is essential to ensure students are addressing the mandated requirements for their studies. As outlined above, involvement of students in deciding key learning outcomes is encouraged but not essential. What is essential in good practice in WIL (Smith, 2014) is the involvement of industry in shaping the learning outcomes.

Oliver and Jorre de St Jorre (2018) describe capabilities future employers will be seeking in graduates as outlined in Table 3. These capabilities provide one example to inform the development of specific learning outcomes.

Table 3

Example Capabilities to Inform Learning Outcomes

Oliver and Jorre de St Jorre's (2018) capabilities	
Domain	**Example capabilities**
Foundation capabilities	Oral and written communication, numeracy, relevant knowledge and skills.
Collaborative capabilities	Teamwork, working collaboratively with colleagues to complete tasks, understanding different points of view, ability to interact with co-workers from different or multicultural backgrounds.
Employability capabilities	Work under pressure, be flexible in the workplace, meet deadlines, understand business/organisation, leadership, management skills, take responsibility for personal professional development, demonstrate initiative.
Adaptive capabilities	Broad background knowledge, develop innovative ideas, identify new opportunities, adapt knowledge and apply skills in different contexts, solve problems, integrate knowledge, work independently).

Note: Adapted from "Graduate Attributes for 2020 and Beyond: Recommendations for Australian Higher Education Providers" by B. Oliver & T. Jorre de St Jorre, 2018, *Higher Education Research & Development, 37*(4), 821-836 (https://doi.org/10.1080/07294360.2018.1446415)

Albert (2019), in her commentary on successful project-based learning, suggested the learning outcomes that should be included (and assessed) include:

- Communication: interpersonal, listening, giving and receiving feedback, group problem solving, managing conflict and negotiation
- Client (industry partner) relationship management skills: setting clear expectations, creating clear deliverables, building rapport and showing value
- Presentation skills: oral, visual and written
- Project management: effectiveness of meetings, work distribution and the ability to meet deadlines.

Once targeted capabilities are defined, Bloom's taxonomy, as revised by Anderson and Krathwohl (2001), can inform the articulation of specific learning outcomes. The nature of interdisciplinary project-based learning lends itself to the higher stages of Bloom's Taxonomy (i.e., analysing, evaluating and creating, reflecting the inherent complexity and abstract concepts). In particular, a unique aspect of this educational approach is the creation of a project product in the form of a concrete artefact by the student group. This artefact may include a video, photographs, a sketch, model, report or poster (Kokatsaki *et al*., 2016).

Step 2. Assessment

Assessment is one of the biggest challenges in designing WIL (Ferns & Zegwaard, 2014). Lasen *et al*. (2018) describe the challenge of balancing the expectation of the different stakeholders and the intended learning outcomes. Zegwaard (2015) highlights the need for the development of authentic, robust, reliable and defensible assessments. Bosco and Ferns (2014) Authentic Assessment Framework provides a useful lens through which to design the student assessment. This framework consists of four criteria:

1. The student is actively engaged in a workplace setting or with an authentic audience
2. The student is required to demonstrate high quality intellectual engagement i.e., analysing, evaluating, creating, performance enactment
3. The student reflexively evaluates their performance
4. The industry partner contributes to the assessment e.g., establishment of marking criteria, direct marking.

Given these criteria and the key output of project-based learning is a realistic product or presentation (Thomas, 2000) we suggest the following recommendations for assessment:

- Both individual and group assessment are undertaken
- The focus is mostly on assessing the 'product' or artefact
- Assessment incorporates scaffolded, developmental tasks
- Feedback from peers, industry and university stakeholders are incorporated
- The assessment artefact is relevant for students and evidences skill development and discipline expertise
- Self-reflection is a key component of the assessment.

Portfolios are effective for assessing outcomes in project-based learning (Taylor *et al*., 2015) as they allow students to (1) provide multiple sources of evidence of learning, (2) reflect on, and modify, learning processes and products over time, and (3) self-assess their own competence based on the evidence they provide. However, for many students this assessment format will be unfamiliar. Students will require support not only to understand the learning approach, but also to comprehend and fulfil portfolio assessment expectations. Similarly, learning journals may be used (Volger *et al*., 2018) but may be challenging in the interdisciplinary learning context where both individual and group assessment is required. Volger et al. (2018) provides an example of journal prompts. Zwick (2018) provides a useful overview of an undergraduate neurobiology course using a project-based approach that includes description of the learning experiences along with project report rubrics and a poster rubric.

Step 3. Learning Activities

An authentic question or problem–typically generated by industry or in collaboration with industry–that is relevant to two or more disciplines/professions is at the centre of interdisciplinary project-based learning. Furthermore, the central activities of the project must involve the construction of new knowledge and/or new skills by students. In his comprehensive review of project-based learning, Thomas (2000) highlighted the need for the project to be designed in such a way that students make a connection between the project activities and the underlying concepts that you wish to foster. This is achieved via a compelling question or an ill-defined problem. The project must also involve students in a constructive investigation as an interdisciplinary group that is goal-directed and involves inquiry, knowledge building, and resolution (Thomas, 2000). The investigation could be focused on design, decision making, problem finding, discovery or model building. Another factor to keep in mind when designing the learning activities is that the project does not have a predetermined outcome or take a predetermined path. Students have a significant degree of autonomy, choice, responsibility and unsupervised time to work on their project (Thomas, 2000). Ideally, project-based learning incorporates real-life challenges–rather than simulated questions or problems–where the solutions students generate have the potential for implementation. As the focus of this guide is on WIL, the opportunity for achieving this ideal is elevated by the involvement of industry in the leadership team.

As outlined previously, project-based instruction follows a constructivist approach to learning. Self-directed learning is supported by a variety of different 'scaffolds'. Scaffolds take many forms including procedural guidelines, student-teacher interactions, learning materials, and use of online collaborative platforms and multimedia resources such as articles, videos, text documents and podcasts (Guthrie, 2019). Information resources are particularly important to help students construct mental models, formulate hypotheses and work within the problem space (Guthrie, 2019). For example, Svihla and Reeve (2016) required students to design a temporary shelter that met the needs of a specific client allocated to their group, using waste and found materials. Table 4 overleaf provides an extract from their article to illustrate the learning experience.

Table 4

Interdisciplinary Project-based Learning Exemplar

Design Stage	Activities intended to:	Example Activities
Problem framing	Provide an initial framing, orient students to the problem framing, or support students to frame the problem.	Project launch positioned the project as being about designing temporary shelters for homeless people; students assessed needs of homeless people in their city.
Gather information	Build student knowledge and understanding of the problem.	Students completed crossword puzzles connected to newspaper articles about laws affecting homeless people; they researched solutions to homelessness.
Ideation	Help students consider different points of view and ways to meet identified needs.	Students created worst-solution sketches as part of a wrong theory activity.
Develop solutions	Support students to develop tentative and improved solutions to identified needs.	Students created models of temporary shelters; they wrote letters to representatives about solutions to homelessness.
Evaluation	Provide students with feedback on how well their solutions responded to identified needs.	Students gave each other feedback on their models; they presented their solutions to community members at exhibitions.

Note: Adapted from "Facilitating Problem Framing in Project-Based Learning" by V. Svihla & R. Reeve, 2016, Interdisciplinary Journal of Problem-Based Learning, 10(2) (https://doi.org/10.7771/1541-5015.1603).

The Buck Institute of Education (2019) provides a framework for 'gold standard' project-based learning. This gold standard outlines the seven teaching practices of effective project-based learning that can be used for the successful development, implementation and quality outcomes for interdisciplinary project-based learning (https://www.pblworks.org/what-is-pbl/gold-standard-teaching-practices). A brief description of the teaching practices against each standard is summarised in Table 5.

Table 5

Project-Based Learning Teaching Practices

Element	Teaching practice
Design and plan	Teachers create or adapt a project for their context and students, and plan its implementation from launch to culmination while allowing for student voice and choice.
Align to standards	Teachers use standards to plan the project and make sure it addresses key knowledge and understanding from the discipline areas to be included.
Build the culture	Teachers explicitly and implicitly promote student independence and growth, open-ended inquiry, team spirit, and attention to quality.
Manage activities	Teachers work with students to organise tasks and schedules, set checkpoints and deadlines, find and use resources, create products and share them publicly.
Scaffold student learning	Teachers employ a variety of lessons, tools, and instructional strategies to support all students in reaching project goals.
Assess student learning	Teachers use formative and summative assessments of knowledge, understanding, and success skills, and include self and peer assessment of team and individual work.
Engage and coach	Teachers engage in learning and creating alongside students, and identify when they need skill development, redirection, encouragement, and celebration.

Note: Adapted from "Gold Standards of Teaching Practices" by the Buck Institute for Education, 2019 (https://www.pblworks.org/what-is-pbl/gold-standard-teaching-practices).

Many of these gold standard practices align with the outcomes of Kokotaski and colleagues' (2016) literature review on project-based learning which yielded six key recommendations viewed as essential for the successful adoption of project-based learning in an educational setting:

1. Student support: Students must be effectively facilitated and supported; emphasis should be placed on effective time management and students' self-management including making productive use of technological resources
2. Teacher support: Regular support needs to be provided to teachers through networking and professional development opportunities. Support from senior management is also crucial.
3. Effective group work: High-quality group work will help ensure the students share agency and participation in the project
4. Balancing didactics instruction with independent inquiry: Ensure students develop a certain level of required knowledge and skills before they can comfortably engage in independent project work
5. Assessment emphasis on reflection, self and peer evaluation: Evidence of progress needs to be regularly monitored and recorded
6. Student choice and autonomy: An element of choice and autonomy throughout the project process will assist students develop a sense of ownership and control over their learning.

Another example to guide the design of interdisciplinary project-based WIL is the Edge on Innovation Project (Smith *et al*., 2018). Funded by the Australian Technology Network and led by researchers at QUT, Curtin, RMIT, UTS and USA and representatives from the Australian Industries Group this project provides learning resources for practitioners in experiential entrepreneurial WIL, including evidencing strategies that can be used in assessment (http://acen.edu.au/wil-edge/)

Appendix E provides a step-by-step to guide to planning and implementing interdisciplinary project-based learning while Appendix F provides a template you can use for the design process. The reflective prompts listed below provide another useful guide to the development of interdisciplinary project-based learning.

Reflective Prompts

These questions will assist you in creating an interdisciplinary project-based learning that aligns learning outcomes, activities and assessment underpinned by a theoretical framework.

1. Why would it be valuable for my students to do a project that is interdisciplinary?
2. What other disciplines are my students likely to collaborate with when they enter the workforce? Do I know any staff from those disciplines that I might collaborate with in the creation of interdisciplinary project-based learning, or do I need to make a plan for finding suitable staff?
3. What industry organisations might be interested in offering, or have previously raised, project ideas?

4. What industry organisations might be interested in offering mentors or project coaches?
5. How would I approach these industry organisations to get them interested and engaged in the creation of interdisciplinary project-based learning? Do I have a good ‘pitch’ ready for a first meeting/conversation?
6. How will I get support from my colleagues and the institution for interdisciplinary project-based learning?
7. How would I include students as partners in interdisciplinary project-based learning? How will I recruit or entice students to be partners?
8. What steps will I take to enable students and industry to collaboratively explore and define the problem/question that the project will address?
9. What do I want students to learn? What are the learning objectives? How will I assess outcomes?
10. What resources, including training and equipment, are needed?
11. How will I encourage staff (academic and industry) to allow the students to struggle and explore the project with a high level of independence in an atmosphere of learning and growth?
12. How will I encourage and enable students and academics to work with the barriers, goals and realities of industry projects?

Chapter 5

Challenges and Enablers of Interdisciplinary Project-Based Learning

While there are many benefits of interdisciplinary project-based learning, challenges that impact on the design, development and outcomes of a project potentially impede implementation and success. The six key challenges that emerged though our pilot projects are outlined below with solutions both trialled and recommended. We also provide the four key enablers to emerge from our pilot projects.

Challenges of Interdisciplinary Project-Based Learning

Workload and resources: Successful implementation of interdisciplinary project-based learning relies on input and dedicated time from both industry partners and university staff. Furthermore, due to the collaborative nature of this type of learning experience, students often need to devote additional time and accommodate peer's availability for collaboration. Dedicated academic champions of interdisciplinary project-based learning who are willing to commit time and support during design, development and delivery, and liaise with industry partners, are essential to success.

Staff capacity: Implementing interdisciplinary project-based learning challenges traditional approaches to learning and teaching in a university context. Staff require continual support and targeted professional development to enable successful enactment of these learning experiences. Empowering staff to work with teaching staff outside their discipline is important for gaining support of interdisciplinary project-based learning among staff. Interviews with our project pilot staff revealed that silo working and a lack of cooperation and collegiality are roadblocks to engaging staff in these teaching practices. Staff workshops, meet and greet sessions with other disciplinary leads, and opportunities for collaborative teaching and/or research projects may help improve interdisciplinary working relations that form the foundation for interdisciplinary project-based learning.

Student capability: Complex problem-solving skills, well-developed communication and collaboration capabilities and high levels of motivation are just some of the student capabilities that are pivotal to successful outcomes and realising the benefits of interdisciplinary project-based learning. Therefore, consideration needs to be given to the foundational skills students acquire throughout their studies that are essential for interdisciplinary project-based learning. Consideration also needs to be given to the provision of just-in-time technical skills required for projects. For experiential entrepreneurial WIL additional preparation will be required in relation to the theory and practice of enterprising mindsets, skills, problem-framing, problem-solving, customer validation, prototyping and market testing. We recommend that students in the latter stages of their degree program–with extensive discipline knowledge and other essential capabilities–are most suited to successful interdisciplinary project-based learning. Furthermore, University staff need to frame the project and its outcomes in such a way that students understand what they are trying to achieve and how the learning experience links to the requirements for their program.

University policy environment: University policies, protocols and procedures may prohibit innovation and flexibility in program design and industry engagement (Ferns *et al*., 2019). These authors attest that university policies, especially associated with assessment regimes, are barriers to improving the student experience. The move in higher education towards more authentic assessment provides an ideal opportunity for champions of interdisciplinary project-based learning.

Reshaping assessment and evidencing student outcomes: Accommodating the needs of diverse disciplines in validating student outcomes is intensified when working with multiple staff with varying capacity to engage with interdisciplinary project-based learning. Care must be taken not to draw from any one discipline area in the design process; instead, relevance to all participating disciplines must be assured. A review of prior learning across the multiple disciplines is needed to ensure this relevance and maintain high levels of student engagement.

Industry participation: Collaboration with industry is crucial to successful outcomes of interdisciplinary project-based learning. The industry partner needs to articulate the problem to be solved and the deliverables being sought. University staff are required to 'translate' this for the university context and link these to learning outcomes specific to each discipline. The relationship between university staff and industry partners must be predicated on effective communication and appreciation of different perspectives, which are modelled for the students involved.

Scheduling: Timetabling learning across multiple disciplines is a key challenge of all interdisciplinary learning. Online delivery provides an important solution to these scheduling issues. To ensure success of this delivery mode we recommend you consider:

- How you will support students to build rapport within the teams and manage the group dynamics to ensure effective collaboration
- The use of online tutors/facilitators to support student usage of online tools such as Google Docs which is a creative development space where teams can collaborate and bring their ideas together. Student feedback from our pilots indicated they liked the prompting and scaffolding so they could then work in their groups in a self-directed manner
- Establishment of individual team discussion forums to connect students and address operational or project task related activities. The use of 'chat prompts' can assist students in considering resources, timelines and progress. For example, by stimulating action through a task requirement (for example "Can you please post your concept/ideas/progress by midday tomorrow?"), the students can assign elements of the task to each other without, in their view, being perceived as autocratic by the other team members.

Enablers of Interdisciplinary Project-Based Learning

Expectations: Establishing clear, realistic and explicit expectations of what is to be delivered and by whom will facilitate the implementation of interdisciplinary project-based learning. A critical element of this expectation setting process is establishing clarity over the roles and responsibilities of all stakeholders. A partnership agreement may be useful in this process. This agreement might set out the shared vision and goals, the commitment from each organisation in the way of personnel, financial and other resources (e.g., access to technology), and the key roles and responsibilities of university staff, students and industry representatives.

Leadership support: Innovation in teaching, particularly innovation involving cross-disciplinary collaboration, requires support from leadership to allow flexibility in curriculum and the allocation of resources. This leadership support will enable staff to embed new ideas into their teaching, spend time developing working relationships with staff from other disciplines and with industry, etc. While time is a key resource needed for interdisciplinary project-based learning to be successful, additional funding may be needed especially while piloting new projects and developing evidence of the outcomes achieved.

Motivated partners: Selection of the industry partner(s) is essential to success. Partners must be highly motivated and willing to collaborate with the University and with other partner institutions in various ways. Once again, establishing clear expectations through a formal partnership agreement is encouraged.

Motivated students: Proactive and engaged students who are prepared to try something new and challenge themselves are also essential to success. This can be difficult when interdisciplinary project-based learning is compulsory. Based on our experience, we recommend starting with a pilot with selected, highly motivated students to test out the design, implementation and evaluation process. Once these processes have been refined, the experience can be embedded for all students (if this is deemed desirable).

Chapter 6
Evaluating Interdisciplinary Project-Based Learning

Evaluation of any new educational initiative is critical to demonstrating the innovation warrants inclusion in the curriculum. Evaluation not only allows us to understand whether the interdisciplinary project-based learning was successful in achieving the desired outcomes but also unpacking the what, where, how and why of the initiative. This chapter provides a brief overview of three evaluation models for your consideration along with advice on the data collection process.

Evaluation models

Multiple program evaluation models exist. We have chosen to focus on three: Stufflebeam's (1971) CIPP model, Biggs' (1993) 3 P Model and the Kirkpatrick and Kirkpatrick's (2006) typology of education outcomes.

CIPP model: The Context, Input, Process, and Product (CIPP) evaluation model was created as a decision-making for education improvement by Stufflebeam (1971). This model focuses on program improvement rather than on proving something about the program. Context evaluation is the evaluation of the need, problem and opportunity. Input evaluation assists in decision-making by examining how resources (people, facilities and budget) are utilised to achieve the educational outcome. Process evaluation is the continuous examination of the implementation of the program. Product evaluation involves measuring and analysing not only the results during and after the education program but also examining the overall efficacy of the program. The first three elements of the model are useful for formative, quality improvement evaluation, while the final element is most appropriate for summative research. An example of questions asked in each phase of the CIPP model are outlined in Table 6. For further information we recommend the latest textbook on the CIPP model by Stufflebeam and Zhang (2017).

Table 6

Example Questions from the CIPP Evaluation Model

Context	Input	Process	Product
What are the educational needs? What are the potential challenges to meeting these needs?	What are the potential approaches to meeting the identified educational need? How feasible is each approach given the educational context? How cost-effective is each approach given the educational context?	How was the program actually implemented compared to the plan? Are/were the program activities on schedule? If not, why? What implementation problems have been/were encountered?	Were the intended program outcomes achieved? Were there any unintended outcomes (positive or negative)? How sustainable is the program?

Note: Adapted from "Program Evaluation Models and Related Theories: AMEE Guide No. 67" by A. W. Frye & P. A. Hemmer, 2012, *Medical Teacher*, 34(5), e288-e299 (https://doi.org/10.3109/0142159X.2012.668637)

3 P model: Biggs' (1993) 3 P Model focuses on the presage, process and product of student learning as well as the educators' journey in planning, implementing and assessing outcomes. This model views education as an integrated system were the eventual outcomes (product) of student learning depend on the interaction between the presage factors (e.g., educational context, characteristics of the educators and the students) and the process factors (e.g., approach to learning and teaching). These factors are unpacked in more detail in Table 7.

Table 7

Example Questions from the CIPP Evaluation Model

Presage	Process	Product
Context: Accreditation requirements, student numbers, funding, space & time constraints, competing curricula demands Educator characteristics: Teacher expertise & motivation, educational approach Student characteristics: Prior learning, preferred approach to learning, expectations & motivation, competing learning needs	Learning & teaching approach: Theoretical framework, interdisciplinary, project-based, compulsory or optional, duration of experience, assessment	Capabilities: Attitudes, perceptions, knowledge, skills, behaviours

Note: Adapted from "Learning to Work Together: Using the Presage, Process, Product (3P) Model to Highlight Decisions and Possibilities" by D. Freeth & S. Reeves, 2004, *Journal of Interprofessional Care*, 18(1), 43-56 (https://doi.org/10.1080/13561820310001608221)

Kirkpatrick model: The Kirkpatrick and Kirkpatrick (2006) typology of education outcomes is comprised of four levels: reaction, learning, behaviour and results. The reaction and learning elements focus on what occurs within the education program while the behaviour and results elements focus on changes that occur after the program. Reaction focuses on the students' perceptions of the learning experience. Praslova (2010) suggested data on both students' enjoyment (affective reactions) and how much they believe they learned (utility judgments) is gathered. Learning focuses on measures of the learning outcomes often assessed through knowledge tests, measures of performance or skill and, in the context of interdisciplinary project-based learning, includes the students' project artefact and the presentation of this to their peers, university and industry staff. Behaviour focuses on measuring the effects of the program on 'work' performance. This can include the evidence of students using the knowledge and skills gained in subsequent learning experiences. Results are the most difficult to evaluate in all contexts but particularly in higher education as they focus on benefits for the organisation(s) involved in the training and the broader community. Potential outcomes at this level and the previous three levels are provided in Table 8.

Table 8

Components of the Kirkpatrick Evaluation Model within the Higher Education Context

Level	Outcome	Example measures
Reaction	Students' affective reactions and judgments of usefulness of the learning.	Surveys, interviews.
Learning	Direct measures of changes in learning.	Knowledge tests, performance tasks (e.g. project presentation & artefact) or other assessed work.
Behaviour	Measures of transfer of learning to subsequent performance and/or outputs.	Research projects, creative productions, application of learning during WIL placements/internship, professional portfolio or resume.
Results	Organisation and community benefits.	Career success, admission to higher degree programs, community service engagement.

Note: Adapted from "Adaptation of Kirkpatrick's Four Level Model of Training Criteria to Assessment of Learning Outcomes and Program Evaluation in Higher Education" by L. Praslova, 2010, *Educational Assessment, Evaluation and Accountability*, 22(3), 215-225 (https://doi.org/10.1007/s11092-010-9098-7)

Stakeholders and their perspectives

While not explicitly stated in the evaluation model presented above, it is important to capture outcomes from the perspective of all key stakeholders groups. Internal stakeholders include the students, university staff, heads of discipline and/or heads of school and relevant senior executive including deans. External stakeholders include the industry partners involved in the program, employers of graduates, funding bodies, accreditation bodies and journal editors. When planning evaluation it is optimal to include student, university and industry staff representatives in the design process.

Data collection

Both quantitative and qualitative data can be used to address the program evaluation questions in whichever evaluation model you chose to use. Our project used the Kirkpatrick and Kirkpatrick (2006) model to evaluate outcomes for students, university and industry staff (see Table 9) using a mixed-methods approach to answer several research questions including:

1. What impact did the project have on university and industry staff attitude towards, and confidence with, interdisciplinary project-based learning?
2. What impact did participation in the interdisciplinary project-based WIL pilot have on students' attitude towards interdisciplinary learning?, and
3. What impact did the project have on industry staff attitudes towards collaboration with the university?

Table 9

Project Evaluation Plan Utilising Kirkpatrick's Model

Level	Outcome		Measure
Level 1	Reaction	Students' views on the learning experience (pilot project)	Post project survey
Level 2	Learning: Acquisition of knowledge/skills	Increase in staff knowledge of & confidence to facilitate interdisciplinary project-based learning	Post-project interviews
		Increase in students' employability skills	Post project focus groups with students
Level 3	Behaviour change	Students transfer learning to practice	*Not within scope (timeframe) of our project*
Level 4	Results	Increase in project-based interdisciplinary WIL	End of project interviews with university and industry staff
		Student/graduate employability, networks with industry Employer satisfaction with graduate's employability	*Not within scope (timeframe) of our project*

Note: Adapted from "Evaluating Training Programs: The Four Levels" by D. Kirkpatrick & J. Kirkpatrick, 2006, Berrett-Koehler Publishers.

Sample interview questions used with our industry partners are outlined below:

1. What does the term interdisciplinary project-based learning mean to you?
2. Tell me about your recent experience with interdisciplinary project-based learning?
3. As a result of the experience, has there been any change in your understanding of, or attitude towards, interdisciplinary project-based learning?
4. Did your involvement in this project impact on you or your organisation in any way?
5. What do you see as the key benefits of project-based learning for:
   a) Students/graduates?
   b) Industry?
   c) Employers?
   d) Universities?
6. Do you foresee any challenges with interdisciplinary project-based learning in your work context? If yes, what solutions do you think might be possible to overcome these challenges

Appendix G provides a template for planning the evaluation of your interdisciplinary project-based learning initiative.

References

Aditomo, A., Goodyear, P., Bliuc, A. M., & Ellis, R. A. (2013). Inquiry-based learning in higher education: Principal forms, educational objectives, and disciplinary variations. *Studies in Higher Education*, *38*(9), 1239-1258. https://doi.org/10.1080/03075079.2011.616584

Albert, T. C. (2019). *Successful project-based learning: 5 best practices to enhance student outcome in experiential courses*. Harvard Business Publishing. https://hbsp.harvard.edu/inspiring-minds/successful-project-based-learning

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing, Abridged edition*. Allyn and Bacon

Amineh, R. J., & Asl, H. D. (2015). Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages*, 1(1), 9-16. pdfs.semanticscholar.org

Australian Industry Group. (2018). *Skilling: A national imperative*. Workforce development needs survey report. https://www.aigroup.com.au/policy-and-research/mediacentre/releases/Skilling-WFD-Survey-12Sept/

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande. (2016). EntreComp: *the entrepreneurship competence framework*. Joint Research Centre European Commission. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/entrecomp-entrepreneurship-competence-framework

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: a paradigm for teaching and learning. *Journal of Research & Method in Education*, 5(6), 66-70. http://www.iosrjournals.org/

Blumenfeld, P., Fishman, B., Krajcik, J., Marx, R., & Soloway, E. (2000). Creating usable innovations in systematic reform: scaling up technology-embedded project-based science in urban schools. *Educational Psychologist*, 35(3), 149-164. https://doi.org/10.1207/S15326985EP3503_2

Biasutti, M., & EL-Deghaidy, H. (2015). Interdisciplinary project-based learning: an online wiki experience in teacher education. *Technology, Pedagogy and Education, 24*(3), 339-355. https://doi.org/10.1080/1475939X.2014.899510

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32*(3), 347-364. https://doi.org/10.1007/BF00138871

Biggs, J. B. (1993). From theory to practice: A cognitive systems approach. *Higher Education Research and Development, 12*(1), 73-85. https://doi.org/10.1080/0729436930120107

Bosco, A., & Ferns, S. (2014). Embedding of authentic assessment in work integrated learning curriclum. *Asia-Pacific Journal of Cooperative Education, 15*(4), 281-290. https://www.ijwil.org/files/APJCE_15_4_281_290.pdf

Brassler, M., & Dettmers, J. (2017). How to enhance interdisciplinary competence—interdisciplinary problem-based learning versus interdisciplinary project-based learning. *Interdisciplinary Journal of Problem-Based Learning, 11*(2), 12. https://doi.org/10.7771/1541-5015.1686

Brewer, M. L., & Flavell, H. (2020). *Embedding interprofessional education in the curriculum*. Higher Education Research and Development Society of Australasia. https://www.herdsa.org.au/publications/guides

Buck Institute of Education. (2019). *Gold standard project based learning*. Buck Institute of Education. https://www.pblworks.org/what-is-pbl/gold-standard-project-design

Condliffe, B. (2017). *Project-based learning: a literature review*. Working Paper. MDRC. https://eric.ed.gov/?id=ED578933

Cord, B., Bowrey, G., & Clements, M. (2011). A regional WIL model: Sharing a new approach, *Asia-Pacific Journal of Education, 12*(3), 163-174. https://www.ijwil.org/files/APJCE_12_3_163_174.pdf

Davies, A., Fidler, D., & Gorbis, M. (2011). *Future work skills 2020*. Institute for the Future for the University of Phoenix Research Institute. http://hdl.voced.edu.au/10707/194830

de Greef, L., Post, G., Vink, C., & Wenting, L. (2017). *Designing interdisciplinary education: A practical handbook for university teachers*. Amsterdam University Press. https://www.aup.nl/en/book/9789462984769/designing-interdisciplinary-education

de Villiers Scheepers, M. J., & Barnes, R. (2019). *Experiential entrepreneurship work integrated learning model*. ACEN.

de Villiers Scheepers, M. J., Barnes, R., Clements, M., & Stubbs, A. J. (2018). Preparing future-ready graduates through experiential entrepreneurial entrepreneurship, *Education + Training, 60*(4), 303-317. https://doi.org/10.1108/ET-11-2017-0167

Ferns, S., Dawson, V., & Howitt, C. (2019). A collaborative framework for enhancing graduate employability. *International Journal of Work-Integrated Learning, 20*(2), 99-111. https://www.ijwil.org/files/IJWIL_20_2_99_111.pdf

Ferns, S., & Zegwaard, K. (2014). Critical assessment issues in work integrated learning. *Asia-Pacific Journal of Cooperative Education* [Special Issue], 15(3), 179-188. http://www.apjce.org/files/APJCE_15_3_179_188.pdf

Flynn, W. J., & Vredevoogd, J. (2010). The future of learning: 12 views on emerging trends in higher education. *Planning for Higher Education, 38*(2), 5. https://search.proquest.com/docview/212564903?accountid=10382

Freeth, D., & Reeves, S. (2004). Learning to work together: Using the presage, process, product (3P) model to highlight decisions and possibilities. *Journal of Interprofessional Care, 18*(1), 43-56. https://doi.org/10.1080/13561820310001608221

Frye, A. W., & Hemmer, P. A. (2012). Program evaluation models and related theories: AMEE guide no. 67. *Medical Teacher, 34*(5), e288-e299. https://doi.org/10.3109/0142159X.2012.668637

Guthrie, C. (2019). Towards greater learner control: Web supported project-based learning. *Journal of Information Systems Education, 21*(1), 11. http://jise.org/Volume21/n1/JISEv21n1p121.html

Habók, A., & Nagy, J. (2016). In-service teachers' perceptions of project-based learning. *Springer Plus, 5*(1), 83. https://doi.org/10.1186/s40064-016-1725-4

Healey, M., Flint, A. & Harrington, K. (2014). *Students as partners guide: Student engagement through partnership*. Higher Education Academy https://www.advance-he.ac.uk/knowledge-hub/engagement-through-partnership-students-partners-learning-and-teaching-higher

Healey, M. (2005). Linking research and teaching to benefit student learning. *Journal of Geography in Higher Education, 29*(2), 183-201. https://doi.org/10.1080/03098260500130387

Heikkinen, J., & Isomöttönen, V. (2015). Learning mechanisms in multidisciplinary teamwork with real customers and open-ended problems. *European Journal of Engineering Education, 40*(6), 653-670. https://doi.org/10.1080/03043797.2014.1001818

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*(2), 99–107. https://doi.org/10.1080/00461520701263368

Innovation and Science *Australia. (2017). Australia 2030: Prosperity through innovation* https://www.industry.gov.au/data-and-publications/australia-2030-prosperity-through-innovation

International Association for Public Participation. (2014). *International Public Participation Principles*. https://www.iap2.org.au/resources/iap2-published-resources/

Kokotsaki, D., Menzies,V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools, 19*(3), 267–277. https://doi.org/10.1177/1365480216659733

Kinash, S., & Crane, L. (2015). *Supporting graduate employability from generalist disciplines through employer and private institution collaboration*. Office of Learning and Teaching. https://eprints.usq.edu.au/32983/1/Kinash_Report_2015.pdf

Kirkpatrick, D., & Kirkpatrick, J. (2006). *Evaluating training programs: The four levels*. Berrett-Koehler Publishers. https://www.worldcat.org/title/evaluating-training-programs-the-four-levels/oclc/318612381

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*(2), 193-212. https://doi.org/10.5465/amle.2005.17268566

Kruck, S. E., & Teer, F. P. (2009). Interdisciplinary student teams projects: A case study. *Journal of Information Systems Education, 20*(3), 325-330. https://aisel.aisnet.org/jise/vol20/iss3/7

Johnson, D.W., & Johnson, F. (2009). *Joining together: Group theory and group skills* (10th ed.). Allyn & Bacon. https://www.worldcat.org/title/joining-together-group-theory-and-group-skills/oclc/798982044

Johnson D. W., & Johnson, R. (1989). *Cooperation and competition: Theory and research*. Interaction Book Company.

Lasen, M., Evans, S., Tsey, K., Campbell, C., & Kinchin, I. (2018). Quality of WIL assessment design in higher education: A systematic literature review. *Higher Education Research and Development, 37*(4), 788-804. https://doi.org/10.1080/07294360.2018.1450359

Li, M. P. & Lam, B. H. (2013). *Cooperative learning*. The Hong Kong Institute of Education. https://www.csuchico.edu/ourdemocracy/_assets/documents/pedagogy/li,-m.-p.-_-lam,-b.-h.-2013-cooperative-learning.pdf

Lim, L., Andrew, J., Lewis, S. & Gao, J. (2018). *Interdisciplinary teamwork in an authentic project-based learning environment*. Refereed paper HERDSA (Re)Valuing Higher Education Conference, Adelaide July 2018. https://www.herdsa.org.au/publications/conference-proceedings/research-and-development-higher-education-re-valuing-higher

Markham, T., Larmer, J., & Ravitz, J. (2003). *Project based learning handbook: A guide to standards-focused project based learning for middle and high school teachers* (2nd ed.). Buck Institute for Education.

Mansilla, V. B. (2010). Learning to synthesize: The development of interdisciplinary understanding. In R. Frodeman, J. T. Klein, & R. C. S. Pacheco (Eds.). *The Oxford handbook of interdisciplinarity* (pp. 288-306). Oxford University Press.

Martinez, F., Herrero, L. C., & De Pablo, S. (2010). Project-based learning and rubrics in the teaching of power supplies and photovoltaic electricity. *IEEE Transactions on Education, 54*(1), 87-96. https://ieeexplore.ieee.org/abstract/document/5438911

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., & Soloway, E. (1997). Enacting project-based science. *Elementary School Journal, 97*(4), 341–358. https://www.journals.uchicago.edu/doi/abs/10.1086/461870

Moalosi, R., Oladiran, M. T., & Uziak, J. (2012). Students' perspective on the attainment of graduate attributes through a design project. *Global Journal of Engineering Education, 14*(1), 40-46. http://www.wiete.com.au/journals/GJEE/Publish/vol14no1/06-Uziak-J.pdf

Oliver, B., & Jorre de St Jorre, T. (2018). Graduate attributes for 2020 and beyond: Recommendations for Australian higher education providers. *Higher Education Research & Development, 37*(4), 821-836. https://doi.org/10.1080/07294360.2018.1446415

Pedaste, M., Mäeots, M., Siiman, L. A., Jong, T. D., Van Riesen, S. V. A., Kamp, E. T., Manoli, C. C., Zacharia, Z. C., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review, 14*, 47-61. https://doi.org/10.1016/j.edurev.2015.02.003

Praslova, L. (2010). Adaptation of Kirkpatrick's four level model of training criteria to assessment of learning outcomes and program evaluation in higher education. *Educational Assessment, Evaluation and Accountability, 22*(3), 215-225. https://doi.org/10.1007/s11092-010-9098-7

Smith, C., Ferns, S., & Russell, L. (2014). *The impact of work integrated learning on student work-readiness*. Office for Learning and Teaching. https://ltr.edu.au/resources/SI11_2139_Smith_Report_2014.pdf

Smith, C. D., & Worsfold, K. (2014). WIL curriculum design and student learning: A structural model of their effects on student satisfaction. *Studies in Higher Education, 39*(6), 1070–1084. https://doi.org/10.1080/03075079.2013.777407

Smith, J., Ferns, S., Russell, L., Marcus, M., Kay, J. & Wache, D. (2018). *The edge on innovation project*. http://acen.edu.au/wil-edge/

Svihla, V., & Reeve, R. (2016). Facilitating problem framing in project-based learning. *Interdisciplinary Journal of Problem-Based Learning, 10*(2). doi.org/10.7771/1541-5015.1603

Stufflebeam, D. L. (1971). The use of experimental design in educational evaluation. *Journal of Educational Measurement, 8*(4), 267-274. https://doi.org/10.1111/j.1745-3984.1971.tb00936.x

Stufflebeam, D. L., & Zhang, G. (2017). *The CIPP evaluation model: how to evaluate for improvement and accountability*. Guilford Publications. https://www.guilford.com/books/The-CIPP-Evaluation-Model/Stufflebeam-Zhang/9781462529230

Taylor, B., Harris, L. R., & Dargusch, J. (2015). Student perspectives about how to best support portfolio assessment in project-based learning environments. *The Australasian Association for Engineering Education Annual Conference*. https://www.researchgate.net/publication/309035702_Student_perspectives_about_how_to_best_support_portfolio_assessment_in_project-based_learning_environments

Thomas, J. W. (2000). *A review of research on project-based learning*. Autodesk Foundation. https://www.pblworks.org/research/research-review-research-project-based-learning

Vega, C., Jiménez, C., & Villalobos, J. (2013). A scalable and incremental project-based learning approach for CS1/CS2 courses. *Education and Information Technologies, 18*(2), 309-329. https://doi.org/10.1007/s10639-012-9242-8

Vogler, J. S., Thompson, P., Davis, D. W., Mayfield, B. E., Finley, P. M., & Yasseri, D. (2018). The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork. *Instructional Science, 46*(3), 457-488. https://doi.org/10.1007/s11251-017-9438-9

World Economic Forum. (2018). *The future of jobs report 2018*. *World Economic Forum*. https://www.weforum.org/reports/the-future-of-jobs-report-2018

World Economic Forum. (2016). *The future of jobs*. https://www.weforum.org/reports/the-future-of-jobs

Zegwaard, K. E. (2015). Building an excellent foundation for research: Challenges and current research needs. *Asia-Pacific Journal of Cooperative Education, 16*(2), 89-99. https://www.ijwil.org/files/APJCE_16_2_89_99.pdf

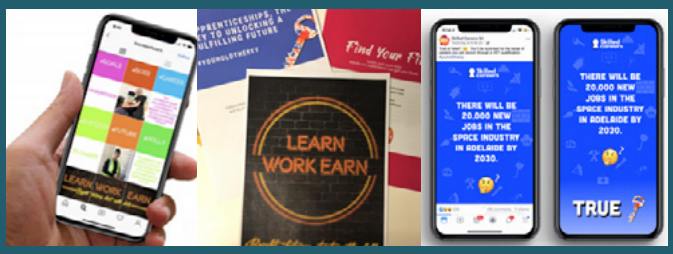
Zwick, M. (2018). The design, implementation, and assessment of an undergraduate neurobiology course using a project-based approach. *Journal of Undergraduate Neuroscience Education, 16*(2), A131. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6057755/pdf/june-16-131.pdf

Appendix A.
University of South Australia (UniSA) Exemplar

The UniSA pilot brought together students from communication, marketing and digital media to develop a social media campaign for an industry client. Over a 10 week study period the students co-designed and developed an industry standard communication plan complete with campaign prototypes. The South Australian Department for Innovation and Skills supported the pilot and provided the campaign challenge to increase Apprentice and Trainee participation. The Department provided the students with market research and campaign feedback.

UniSA Match Studio's design thinking methodology was employed to support student's interdisciplinary learning and project-based approach. This enabled students to not only focus on applying their disciplinary knowledge and skills in developing solutions to the client challenge, but also to develop transferable skills that will be critical in workplaces of the future. The pilot was delivered fully online and was supported by inbuilt pedagogical tools, such as GoogleDocs and discussion forums that enhanced opportunities for collaborative learning, and an online tutor who provided oversight and individualised feedback on developing campaigns.

A key element of this course, directly linked to the successful online delivery, was the focus on a clear and tangible outcome. Examples of student work can be seen in the images below:



Students could see there was both a clear end point in terms of what they needed to produce while also appreciating they were developing a document–a communication plan–that would assist with their graduate employment opportunities. Students felt focused and invested in the course in order to produce this outcome.

Similar to an experience within the workforce, online engagement and individual contribution within each team were discussed. Supporting this, clear rules of online engagement and professional communication standards were embedded early in the course. As the course progressed students could see their professional skills developing.

The students were tasked with extending an existing, multi-faceted marketing and communication campaign using social media channels. This approach enabled two key aspects of the course:

- Students had access to existing market research and campaign tactics
- Students were able to produce the required course outcome, at the required standard, within a 10-week timeframe.

Alignment of the student cohort to the target audience was important. This is the first time students had been asked to undertake a complex task of this nature and they were dealing with interdisciplinary team building in an online environment as well as meeting the course learning objectives. Loosely aligning the student age profile with the campaign audience enabled a degree of expedience in understanding some of the audience behaviours–in this case specifically in regard to social media usage.

Feedback points were embedded during the course with the industry partner enabling students to collate their team questions and ask for specific feedback on their developing concepts. A video with the course co-coordinator 'interviewing' the industry partner was also provided early in the course. This strengthened the course in terms of adding an industry voice to support the discipline specific narrative.

Appendix B.
RMIT Exemplar

The RMIT University pilot brought together students from the College of Business human resources, marketing and accounting disciplines in the final year 'Future of Work' unit, to research and develop project reports and recommendations for three different industry and community partners. A Partnered Project Planning Workshop initiated the collaborative process to:

- Identify overarching learning goals
- Identify stakeholder benefits of being involved in the project
- Consider potential problems or opportunities that could inform and scope the project
- Negotiate expected project outcomes and draft the project briefs, and
- Establish a shared understanding of the roles and responsibilities of all stakeholders.

The workshop included students who had recently completed the unit, the industry/community partners and the academic staff involved in teaching the Future of Work unit. The industry/community partners included:

- The **National Tertiary Education Union** (NTEU), Victoria. This project looked at fostering promotion opportunities for groups of under-represented academics in successful career pathway outcomes.
- **JobCo.** This not-for-profit, community-based disability service focuses on assisting people with mental health issues on their recovery journey. The project considered how JobCo can maintain a great culture and ensure staff are equipped to provide great service, when staff spend minimal time in the office with other colleagues.
- **Specialisterne.** This global organisation specialises in working with employers who are seeking to diversify their workforce and assisting them to recruit talented autistic individuals with suitable skills. This project considered a range of ideas on how to influence and encourage companies to embrace neurodiversity in the workplace on a large scale.

Over a 6 week period the students completing this capstone elective, worked in interdisciplinary teams to investigate future work trends and prepare a report and comprehensive recommendations around a real industry problem or opportunity. The 'Predicting the future of work – industry challenge' included a hackathon group pitch strategy where students unpacked and refined their industry research project and presented their approach back to the industry partners. The resulting research project reports provided viable solutions and potential pathways to address the industry and community partners' challenges.

Appendix C.
Curtin University Exemplar

Curtin University, Lab Tests Online Australia (LTOAU) and WA Health Consumer Council worked collaboratively to provide an inter-disciplinary, industry-focused learning experience for students. The overarching aim was to establish LTOAU as a premier resource for information about pathology testing and laboratory-based diagnostics for health consumers. The goal was to investigate the current use of the website, improve website effectiveness and accessibility of content, and increase the use of LTOAU. The project primary sponsors was the LTOAU management group and the WA Health Consumer Council. Central to the work was the perspective of the health consumer and consideration of the diversity in literacy levels and disabilities. The other stakeholders considered were groups who may use the site (health care workers, education providers and students) as well as those professional groups likely to promote LTOAU to health consumers (pathology practices, general practitioners, hospitals and health clinics).

The project involved Curtin students from the disciplines of marketing, media and graphic design, and data analytics. Deliverables of the project included an analysis of Google Analytics to understand the publics' demand and patterns of use of educational material on pathology. Evaluation of the LTOAU web design, consumer surveys and analysis of Google Analytics provided an evidence-base to re-design the website to improve performance for the user and optimise search engine capability. A media strategy, including the use of social media, was developed which has appeal for a diverse audience. Visual design of the existing website was reviewed and renewed to increase impact and address literacy issues. The re- designed website will incorporate icons, animation, and graphics that create an engaging and easy to navigate interface. The new website is informed by the findings emerging from the collaborative project with Curtin students and LTOAU.

Thank you to Zachary Riordan for designing this infographic.

Appendix D.
UTS Exemplar

The UTS Faculty of Engineering and Information Technology Summer Studio engaged students, staff, community and industry partners in over 15 interdisciplinary-focused, open-ended, project-based studios creating design solutions for real-world problems. This learning community, which was a successful experiment of scale and the use of innovative pedagogical strategies was designed and coordinated by Dr Roger Hadgraft and included students from the faculties of Engineering and IT, Design, Architecture, Building and Transdisciplinary Innovation.

Over 190 students enrolled in 18 studios in 2020 led by about 21 staff and students serving as studio learning facilitators and included about 11 community and industry partners. The studios launched with a design thinking boot camp and continued for 6 weeks providing the students with six credit points. The Summer Studio closed with a university-wide showcase event scheduled during university orientation week that was open to all university students, parents, community partners and industry representatives.

The UTS Summer Studio teaching team, engaged the studio participants in a variety of design and agile project management techniques to launch innovative and entrepreneurial projects such as designing liveable cities, tackling global warming, re-conceptualising healthcare solutions using medical devices to designing community spaces with indigenous and community stakeholders in Broken Hill using culturally-sensitive, stakeholder-centric design techniques.

Students in all of the studios started with learning about design thinking skills and entrepreneurial mindsets and then broke into teams to utilise techniques for empathising with stakeholders, problem framing, ideating potential solutions, validating stakeholders' needs, prototyping, and testing early-stage designs. In addition to design thinking, students in each studio learned the technologies and the requisite knowledge from the multiple disciplines involved in solution creation as they developed prototypes. These technologies included using enterprising mindsets and deploying technologies enabling cyber security, data analytics, robotics, math modelling, sensor design, Internet of Things, artificial intelligence and machine learning, quantum computing, augmented reality, space applications, medical devices and techniques for product development and leading culture change.

The student teams demonstrated their learning, employability skills and prototypes in an interactive environment that facilitated further work integrated learning and community and industry engagement opportunities. Students have opportunities to extend their project work by enrolling in the UTS Startups and UTS Techcelerator programs, capstone project-based learning subjects, industry internships, and a variety of innovation and entrepreneurial learning activities at UTS.

Appendix E.
Step-by-step Planning Process

While the actual learning resulting from interdisciplinary project-based learning needs to accommodate flexibility and personalised learning, the process of designing and implementing this form of WIL should follow some prescribed tasks. The tasks need to be followed sequentially as each step is informed by the preceding one as outlined in Table 10 below.

Table 10

Tasks in Designing and Implementing Interdisciplinary Project-based Learning

Task	Description and purpose
1. Source an industry partner	The industry partner may be one with whom there is an existing collaboration. It is important to identify a partner who has scope to allocate resources to working with students and is keen to engage in student learning.
2. Negotiate a suitable project with partner	The initial conversation between the industry partner and university staff member leading the project is important for establishing roles and responsibilities and scoping the project parameters.
3. Identify appropriate disciplines and qualification level for the project	Once the project has been scoped and there is clarity about the potential project outcomes, discipline expertise required to execute the project is identified.
4. Consult with university staff from relevant disciplines	Identify and consult with university staff who have teaching responsibilities in the relevant discipline areas. Staff may be unfamiliar with this mode of learning so may require support and encouragement.
5. Identify the appropriate program for each discipline	Programs (unit/subject) appropriate to the ethos of interdisciplinary project-based learning are identified. This will require additional consultation with the program leader.
6. Reframe programs to accommodate the new learning experience	Changes to program learning outcomes, learning experiences and assessments are likely to be required.
7. Provide professional development to build capacity of staff from discipline areas	Staff may require ongoing support and targeted professional development in adopting this educational methodology.

Task	Description and purpose
8. Select students	Student selection may be undertaken in a variety of ways including offering the opportunity to specific students or selecting students through a competitive process. Where this learning applies to a whole class cohort, student selection will not be necessary.
9. Meet with all stakeholders to finalise the learning experience through a collaborative process	Conduct a forum with all stakeholders–university staff, students and industry partners–to collaboratively develop the final project, process and intended outcomes. This should include exploration of the problem to be solved from all perspectives and clarification of the roles and responsibilities of all stakeholders. Prepare students to work autonomously as a group to shape how the project will be enacted.
10. Provide ongoing support to students	Ensure ongoing support for students through regular meetings with university staff and, where possible, an industry representative(s).
11. Interim workshop with all stakeholders (OPTIONAL)	Conduct an interim workshop where all stakeholders can monitor and review progress, and reshape outcomes as required.
12. Conduct final presentation	Students lead a presentation where final outcomes of the project are presented to all stakeholders. Invite students and staff not involved in the project to promote the initiative, acknowledge the efforts and outcomes of the stakeholders, and facilitate broader engagement for future opportunities.
13. Produce and present final artefact	The high quality final artefact (e.g., report, prototype, video, poster) produced by the students is provided to the industry partner ('client') in alignment with the final outcomes and deliverables.
14. Evaluation and reflection	Evaluation and reflection may be undertaken through focus groups or individual interviews, review of reflective writing (e.g., journal, essay, portfolio). Ensure all stakeholder perspectives are captured.
15. Negotiate ongoing collaboration	Discuss future opportunities immediately following the conclusion of the project to maintain momentum.

Appendix F.
Design Template

Items	Your project
Scope	
Students	
Place (setting)	
Disciplines	
Purpose	
Scenario	
Project activity	
Student (year level, number, program)	
Capabilities targeted (knowledge, skills, behaviours)	
Project output (poster, guide, etc.)	
Scheduling (length, semester, week)	
Resources	
Industry partner organisations	
Other staff/colleagues	
Other (instructions, multimedia, equipment)	
Facilities	
Funding	
Facilitation/teaching considerations	
Training for teaching team	
Other Considerations	
Preparation of students	
Sustainability	
Measurement/Assessment	
What?	
How?	
When?	
Who?	

Appendix G.
Evaluation Template

Project plan		
Description of the activity you want to evaluate		
Name of lead evaluator		
Project title		
Activity	**Comments**	**Decision**
Identify and engage key stakeholders	Make sure local stakeholders agree on what is being evaluated and why (rationale). Obtain access to evaluation sites if needed.	
Define purpose and formulate evaluation question(s)	In collaboration with curriculum team and other key stakeholders (e.g. students, industry) identify the evaluation purpose (i.e. formative and/or summative), develop questions and intended outcomes. Example questions: *What impact did the experience have on improving learner's interdisciplinary teamwork skills?* *What effect did the experience have on students understanding of the roles of other disciplines?* *How did the use of co-facilitation by staff from different disciplines affect the teaching and learning processes?*	
Consider theory	Think about the theory you might use in the evaluation to help frame data collection and analysis e.g. *social constructivism*	
Design the evaluation	Select a design that supports your evaluation question(s) - *Qualitative: ethnography, grounded theory, phenomenology, action research; Quantitative: randomised control trial, controlled before and after study, interrupted time series study, before and after design, mixed methods.*	

Appendix G.
Evaluation Template (continued)

Task	Description and purpose	Decision
Participants	Identify the participants and how will you collect the data.	
Measures	Determine the tools or measures you will use.	
Ethical considerations	What ethical issues do you need to consider? Do you plan to apply for formal ethical approval?	
Identify evaluator(s)	Will you use a member of development team, an internal staff member not associated with the project, or external evaluator(s).	
Develop a dissemination plan	Establish ground rules for authorship and presentations. Will students and/or industry be involved in the dissemination? Where might you disseminate the outcomes of the project?	

Note: Adapted from "Embedding Interprofessional Education in the Curriculum" by M. L. Brewer & H. Flavell, 2020, Higher Education Research and Development Society of Australasia.

Appendix H.
Additional Examples and Resources

Examples of interdisciplinary project-based learning globally

Whole of institution approach:
Olin College in the US has adopted project-based learning as the foundation for their engineering programs http://olin.edu/collaborate/collaboratory/%20

Reengineering HigherEd: Student-Centered Learning at Olin College https://www.gettingsmart.com/2016/10/reengineering-higher-ed/

Teaching project-based learning video from Stanford University https://teachingcommons.stanford.edu/events/teaching-project-based-course

Additional project-base learning resources

PBL Works Essential Project Design Elements Checklist https://my.pblworks.org/system/files/documents/PBLworks-Essential-Project-Design-Elements.pdf

PBL Works Project Planner https://my.pblworks.org/system/files/documents/Project_Planner_v2019.pdf

PBL Works Project Resources https://my.pblworks.org/resources

Additional work-integrated learning resources

EDGE entrepreneurial WIL project evidencing strategies http://acen.edu.au/wil-edge/evidencing-strategies/ and case studies http://acen.edu.au/wil-edge/case-studies-of-enterprise-and-entrepreneurial-wil/

Innovative models of WIL – snapshots https://acen.edu.au/innovative-models/snapshots/ and resources https://acen.edu.au/innovative-models/resources/

ACEN's WIL Good Practice guides http://acen.edu.au/wil-impact/resources-for-educators/

Australian Industry Group resource – *'Uni Students: Good news for your business'* https://cdn.aigroup.com.au/Workforce_Development/FactSheets/Employer_guide_UniStudents.pdf

Innovative Research Universities (IRU) WIL resources https://www.iru.edu.au/resources/

For further information
Visit the project website **www.multisectorprojects.com**

ADV126633