

Design principles for work-integrated learning-based, alternative doctoral training programs informed by PhD candidate feedback

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This study investigated PhD candidate feedback on research and employability skills training, delivered via work-integrated learning (WIL) within an alternative doctoral training model. Voluntary feedback was received using a mixed-methods survey consisting of 10 quantitative statements reflecting on learning, and qualitative feedback comprising best aspects and needs improvement comments. The results indicate candidates highly valued the WIL-based assessments, teacher interactions, workload, research-relevant problem-solving frameworks, work-related knowledge and skills, and confidence-building. The qualitative analysis also revealed some PhD candidates desired more peer interactions early in candidature. The study reinforces four emerging design principles for WIL in doctoral programs and provides a contemporary evidence-base for improving alternative doctoral training programs. Areas for further research include: understanding training motivation and needs including content complexity, internships, and culturally and linguistically diverse (CALD) candidate needs; benchmarking engagement with doctoral WIL; increasing doctoral peer interactions; WIL for new technologies; and communicating the value of doctoral WIL.

Keywords: PhD, doctoral, employability skills, research skills, co-creation, satisfaction, CALD, generative AI

Traditional doctoral research training is structured around a master and apprentice transmission model, relying predominantly on primary supervisors for candidate research training and post-doctoral career transitions (Bentley & King, 2020; Leder, 1995). In this model, professional development of candidates typically centers on discipline-specific knowledge and research techniques, plus oral and written academic communication. Additional professional development or work-integrated learning (WIL) activities – for example, activities that prepare candidates for non-academic employment or civic engagement (Bridgstock & Tippett, 2019) – are not included. Thus, candidate attributes typically poorly addressed by the master/apprentice model include critical thinking in non-academic contexts, cross-discipline/cross-sector communication, teamwork, and innovation. Over-reliance on a single master trainer can also harm candidate/supervisor dynamics and wellbeing, affecting candidate retention and attrition (Beasy et al., 2021; Devos et al., 2017; Harrison & Grant, 2015; Jones, 2013; Kis et al., 2022; Sverdlik et al., 2021; Wollast et al., 2023). Moreover, while development of confidence and professional identity by PhD candidates aids post-PhD employment (Hayter & Parker, 2019; Hemmings, 2012; Main et al., 2022; Mantai, 2019), recent evidence suggests key activities driving professional identity development (e.g., doing and talking research) occur informally in the master/apprentice model and independently of research supervisors (Mantai, 2017).

Alternative Doctoral Training Models Aim to Broaden PhD Candidate Training

Sector changes influencing doctoral training mean the master/apprentice model is increasingly perceived as suboptimal (Department of Education, Skills and Employment (DESE), 2021; McGagh et al., 2016; Oliver, 2015). These changes include: limited academic employment opportunities for graduates; increased candidate desire to work outside academia; and societal, industry, and government pressures to increase economic outcomes from academic research. Alternative doctoral

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training models aim to address these issues by broadening the training PhD candidates receive to suit more varied post-PhD workplaces. Some programs offer additional training via: non-assessed professional development activities, such as Cooperative Research Centers (CRCs) (Manathunga et al., 2012); industry internships (APR.Intern, 2015); credentialled non-WIL subjects, such as the Commercialisation Training Scheme (CTS) (DESE, 2013); or credentialled WIL-based subjects (O'Connor et al., 2023).

Recent Australian government policy changes aim to increase WIL in doctoral programs. The National Priorities and Industry Linkage Fund (NPILF) uses performance-based funding to increase student, including PhD candidate, participation in placements, projects, fieldwork, simulation/virtual, or other WIL activities. The aim is for participants to experience “work within curriculum (or as co-curricular), undertaken in partnership, through engagement with authentic and genuine activities with and for industry, business or community partners, and which are credit-bearing and assessed” (DESE, 2020, p. 3). Additionally, changes to the Research Training Program that provides funding for Australian higher degree research training, gives greater weighting for PhD completions involving internships organized in the first 18 months of candidature and completed in the candidature timeframe (DESE, 2021).

New Evidence Needed to Guide Incorporation of Work-Integrated Learning Activities into PhD Training

As alternative doctoral training models increase the breadth of content and skills training for PhD candidates, they risk tension between the tasks, time, and cognitive load required to develop qualified researchers as discipline stewards (Walker, 2006), and those required to learn and practice the additional, broader skillsets. Therefore, design and delivery of alternative training models, including doctoral WIL, needs to occur in a careful, considered and evidence-based manner to:

- a) attract candidates from any research discipline for whom the additional training is beneficial
- b) avoid candidates joining programs not matched to their prior employment or other experiences
- c) avoid disengagement from the additional training due to ineffectual content or WIL activities
- d) avoid stress due to inadequate communication or management of candidate and supervisor needs
- e) minimize cognitive load and workload of the additional training – without compromising its effectiveness – as doctoral candidates already experience a variety of stressors inherent to their PhD studies (O'Connor et al., 2023).

Alternative doctoral training programs require resources, support systems, qualified personnel, peer networks, and content (Bastalich, 2017; Blaj-Ward, 2011; Burnett, 1999; Choi et al., 2021; Cumming et al., 2009; Harrison & Grant, 2015; McGagh et al., 2016; Metcalfe & Gray, 2005). To best evolve and implement these programs, it is important to understand how candidates perceive the relevance and effectiveness of content, delivery, and professional development or WIL activities within a program.

Cooperative Research Centers as Alternative PhD Models

The CRCs aim to create “innovative doctoral programs focusing on cross-sectoral collaboration” (Manathunga et al., 2012, p. 845), by providing discipline-specific knowledge and professional/employability skills for “industry-ready” science-based graduates (Harman, 2004). However, CRCs do not typically involve a progressive suite of purposefully co-designed WIL activities to achieve the training goals (Bridge, 2017). Rather, PhD candidates are exposed to industry environments via workshops or retreats typically focused on research commercialization and/or

management skills (Harman, 2004). Evaluation of PhD candidate feedback suggests CRCs appear to provide “greater experience of industry and access to professional development” (Manathunga et al., 2012, p. 843) resulting in a higher percentage of graduates gaining employment outside academia (22% for CRC PhD graduates, 15% for non-CRC). However, this same study revealed large differences in CRC candidate experiences: “43% of CRC graduates do not recall attending industry or business meetings and 25% do not remember any interactions with professionals outside academe” (Manathunga et al., 2012, p. 852) indicating core training objectives were not met for many CRC PhD candidates. Feedback from CRC and non-CRC PhD candidates also showed the CRC environment did not increase candidate satisfaction with supervisor mentoring (quality, effectiveness, or interpersonal skills) or project design (Harman, 2004), with these aspects needing to be explored and addressed. Notably, the proportion of both CRC and non-CRC PhD candidates satisfied or very satisfied with their research experience was not high (59% and 56.2%, respectively).

The Commercialization Training Scheme Alternative PhD Training Model

Like CRCs, the CTS provided training for Australian science or technology PhD candidates. The CTS aimed “to provide 250 higher degree by research (HDR) students each year with the skills necessary to bring research-based ideas to market” (DESE, 2013, p. 1). The CTS enabled universities to offer commercialization training via subsidized, fee-free enrolment in credentialled Graduate Certificates; about two-thirds of the anticipated candidates completed the CTS (DESE, 2013). The CTS often used pre-existing courses and did not include WIL activities scaffolded at specific stages of research candidatures to meet the needs of PhD candidates. While a review of the CTS showed high candidate satisfaction with the training, key concerns were identified. This included “a lack of exposure to practical skills; difficulties balancing CTS training in conjunction with their research studies; and that some courses were not targeted to the needs of research students” (DESE, 2013, p. 2). Like CRCs, the CTS neglected the training needs of non-technology candidates, and technology-based candidates not interested in commercialization.

Four Emergent Design Principles for Alternative Doctoral Training Models

From the CRC and CTS program evaluations, four tentative principles emerge for design of effective alternative doctoral training models:

- Increase the breadth of content experts from whom PhD candidates receive training.
- Deliver content and WIL activities broader than commercialization.
- Scaffold program design, delivery and WIL activities to the specific needs of PhD candidatures, noting their needs change at different stages of their research candidature.
- Use purposefully (co-) designed WIL activities, as simply “placing research students in an industry environment or allowing them to collect data in industry settings does not always translate into a powerful learning experience” (Manathunga et al., 2012, p. 852-853).

Evaluating Candidate Feedback to a Work-Integrated Learning-Based Doctoral Training Program

The present study explored how PhD candidates responded to an alternative PhD training program based on these four emergent design principles. Design of the voluntary, credentialled, part-time, WIL-based program – the Graduate Certificate in Researcher Engagement, Development and Impact or GCREDI (O'Connor et al., 2023) – included benchmarking design and operationalization against other programs including CRCs and the CTS. In response to student feedback, and similar to the CTS, the program was established as a Graduate Certificate for domestic and scholarship-holding international

PhD candidates. No extra candidature time or scholarship funding was provided to enrolled candidates. The program scaffolded authentic, co-designed WIL activities to PhD candidature milestones, consistent with authentic as outlined by Stein and colleagues: that is, experiences “personally relevant from the learner’s perspective and situated within appropriate social contexts” (Stein et al., 2004, p. 239).

The program addressed the Australian Qualifications Framework (AQF) Level 8 Graduate Certificate criteria, “to qualify individuals who apply a body of knowledge in a range of contexts to undertake professional or highly skilled work and as a pathway for further learning” (AQF, 2013, p. 53). The WIL activities were designed to prepare candidates for academic, industry, or policy work environments, and exposed candidates to the United Nations Sustainable Development Goals. Candidates could choose WIL activities based on their career preferences (O'Connor et al., 2023). Within the program, research skills are defined as investigative and discipline-specific knowledge required to complete the PhD, plus ancillary skills that increase research efficiency (O'Connor et al., 2023). Employability skills relate to development of professional identity, critical thinking, cross-sector communication, teamwork, and innovation – consistent with literature (Manathunga et al., 2012) and encompassing professional skills, transferrable skills, vocational skills, and core skills (DESE, 2019). The program is consistent with guidance on WIL in higher education from the Australian Tertiary Education Quality and Standards Agency (TEQSA, 2022, p. 1), with a focus on “technical skill acquisition, professionalism, professional responsibility, identity and values, [and] enculturation to professional roles” while also “build[ing] towards the learning outcomes of a course.”

Candidates completed six of eight program units (i.e., subjects) with program delivery initially including face-to-face, synchronous, and asynchronous formats; in-person delivery ceased due to COVID-19. Candidate feedback was obtained via formal, mixed-methods, Student Feedback on Unit (SFU) surveys that collected quantitative data (via ten reflective statements) and qualitative data (free-text “Best Aspects” and “Needs Improvement” comments). The results are discussed in terms of using WIL and alternative doctoral training models for research and employability skills training.

METHODS

Participant, Procedure and Human Research Ethics Approval

Seven program Student Feedback on Unit reports, from subjects delivered from 2019 Semester 2 to 2022 Semester 1, contained 36 of 74 possible responses (Table 1). The Western Sydney University (WSU) Surveys Team distributed the surveys, collated the data, and provided summary reports of processed responses as described below. Permission to use the data was granted by Dr Jason Ensor in the context of sections 8.6.7 and 8.6.8 of the Human Research Ethics Approval H10462: “The Western Sydney University Research Program for Learning and Teaching.”

TABLE 1: Summary of student feedback on unit reports analyzed for this study.

Unit position in the program	Unit name	Delivered:	Number of PhD candidates	Number of responses	Response rate:
2	Career and Personal Development	2021, 2 nd Half ^d	13	2*	15%
3	Knowledge Translation	2019, 2 nd Half ^a	7	3*	43%
3	Knowledge Translation	2020, 1 st Half ^b	11	6	55%
3	Knowledge Translation	2021, 2 nd Half ^c	9	5	56%
3	Knowledge Translation	2022, 1 st Half ^d	14	11	79%
4	Research Engagement and Impact	2022, 1 st Half ^c	8	1*	13%
6 (Capstone)	Grant Proposals and Applications	2021, 2 nd Half ^b	12	8	67%

Notes: ^{a-d} indicate nominal candidate cohorts, however, some candidates changed cohorts, for example, as indicated by the different number of enrolled candidates for cohorts ^{b-d}; *to protect survey respondent anonymity, comments from these surveys were not analyzed.

Mixed Methods Survey Instrument and Initial Data Processing

In each SFU survey, quantitative data was collected via 10 reflective statements (Table 2). Statements 3 (Assessments) and 9 (Work related knowledge and skills) directly related to the program's WIL activities. Other statements aligned with the WIL activities, including: Statements 1 (Learning activities); 2 (Learning materials); 4 (Peer interactions); and 8 (Critical and analytical skills development). The remaining survey statements related to unit support structures: Statement 5 (Use of technology); 6 (Access to help and advice); 7 (Workload); and 10 (Overall satisfaction).

Program candidates voluntarily rated the statements using a five-point Likert-style scale: Strongly disagree (1); Disagree (2); Neutral (3); Agree (4); Strongly agree (5). To create summary reports for each unit, the Surveys Team aggregated the data for each statement, converted to percentage values based on the five-point scale, then reported the data under the following terms (Table 2): Explicit disagreement (Strongly disagree & Disagree responses); Broad agreement (Neutral, Agree & Strongly agree responses); and Explicit agreement (Agree & Strongly agree responses). The Surveys Team also included on each SFU report an average rating for the ten survey statements calculated from the responses received from all other surveys across the University for that semester.

Candidates could also provide free-text "Best Aspects" and "Needs Improvement" comments, with commenting optional to maximize the number of survey responses received. These qualitative data were processed by the Surveys Team to remove names and profanities (Scott & Willison, 2021). To protect respondent anonymity, comments have only been reported for surveys with at least five responses. As survey completion was anonymous, respondent demographics are unknown.

Analyses of Student Feedback on Unit Reports for this Study

For the quantitative analysis, the survey statement values were averaged across the seven SFU survey reports; the same process was used to obtain average values from the all WSU units combined data. The average Explicit agreement and Broad agreement values for the program were then compared against the average all WSU units values using the student's t-test (Table 2).

For the qualitative data analysis, a constructivist grounded-theory thematic analysis was used (Kiger & Varpio, 2020) to acknowledge that different research candidates could experience the same unit

content and delivery in different ways based on their individual circumstances. Best aspects and needs improvement comments were collated and examined to generate initial data codes. The comments were then reviewed, and each comment categorized using the codes to define data themes. Where individual candidate comments addressed more than one code, then each specific comment element was attributed to the relevant code. The total number of coded-comments were counted and the percentage of comments in each theme calculated relative to the total number of coded-comments (see Tables 3 and 4). For the representative quotes provided, spelling and grammar errors have been reproduced here. Due to the number of errors in many quotes, the indicator [sic] has not been included to maintain fluency of the quotes.

RESULTS

To investigate PhD candidate feedback on the WIL-based alternative doctoral training program, SFU survey reports were analyzed to determine whether the quantitative, reflective statement data might corroborate the qualitative Best aspects and needs improvement data. Seven survey reports were obtained containing 36 responses with feedback data (Table 1).

Program Feedback Ranked Higher for Five of Ten Survey Statements

The average values for the ten reflective statements are shown in Table 2. For eight statements, the average Explicit Agreement values were above 86%, indicating the doctoral candidates highly valued the course learning material, WIL activities, and teaching methods across the three-year program. The low standard error for most statements (except Statements 4 and 5; discussed below) indicates similar responses regardless of candidate cohort or program unit.

Comparing the average values for the ten reflective statements, between the program and the 'all WSU units combined', helped identify program areas most highly valued specifically by the doctoral candidates. For three statements (1. Learning activities; 2. Learning materials; and 8. Further developed my critical and analytical skills), the Explicit Agreement values trended higher for the program units than for all WSU units combined, though not significantly higher (Table 2, grey background).

For the following five statements, the Agreement values were significantly higher for the program than for all other WSU units combined (Table 2, black background):

3. Assessments (i.e., authentic, career-relevant WIL activities)
6. Access to timely help and advice
7. A reasonable workload relative to other units
9. Included work related knowledge and skills
10. Overall: I was satisfied with the quality of this unit.

For Statement 5 (Technology), the Explicit Agreement value was similar to all other WSU units (Table 2), with the survey reports showing no trend for higher agreement values in earlier or later program units. For Statement 4 (Opportunities to work with other students), the average Explicit Agreement value was lower for the program units than for all other WSU units (Table 2). The survey reports showed Statement 4 Agreement values were lower in the 2nd and 3rd units (0%-50%) but higher in the 4th and 6th units (75%-100%), regardless of cohort. These data suggest respondents in earlier program units desired more peer interactions, while respondents in later units were more satisfied with their level of peer interactions.

TABLE 2: Average doctoral candidate responses to the quantitative SFU survey statements.

	Data Level	Agreement					
		Explicit		p	Broad		p
		Avg.	SE			Avg.	
My learning in this unit was effectively supported by:							
1. Learning activities	U	86%	5.7%	0.24	97%	2.9%	0.28
	W	79%	0.4%		92%	2.0%	
2. Learning materials	U	89%	3.1%	0.03	97%	2.9%	0.31
	W	81%	0.5%		92%	1.7%	
3. Assessments [i.e., WIL activities]	U	95%	3.1%	0.00	100%	0.0%	0.000
	W	78%	0.6%		91%	2.0%	
4. Opportunities to work with other students	U	47%	12.6%	0.19	70%	12.7%	0.17
	W	66%	0.7%		84%	2.9%	
5. Technology	U	77%	6.1%	0.83	89%	7.1%	0.50
	W	76%	0.7%		91%	2.4%	
6. Access to timely help and advice	U	95%	3.1%	0.01	100%	0.0%	0.000
	W	79%	0.7%		91%	1.8%	
7. A reasonable workload relative to other units	U	95%	3.1%	0.00	100%	0.0%	-
	W	78%	0.7%		90%	1.9%	
What I learnt in this unit:							
8. Further developed my critical and analytical skills	U	90%	3.7%	0.07	96%	2.9%	0.72
	W	82%	0.6%		93%	1.7%	
9. Included work related knowledge and skills	U	93%	3.2%	0.02	100%	0.0%	0.000
	W	83%	0.6%		93%	1.5%	
Overall:							
10. I was satisfied with the quality of this unit	U	89%	3.1%	0.01	100%	0.0%	0.000
	W	79%	0.6%		90%	1.7%	

Note. Seven SFU survey reports were analyzed as per Table 1. U = data from the program units; W = data from all other WSU units; Avg. = average; SE = Standard Error; p = p-value.

Best Aspects Feedback Themes

Analysis of the Best aspects comments identified 48 coded comments across the SFU reports. Nine themes were identified (Table 3), with most of the comments (88%) captured by the top six themes.

The Webinars/Content/WIL Activities Best Aspect theme is consistent with candidate feedback to Statements 1 (Learning activities), 2 (Learning materials), and 3 (Assessments). For example: "It was extremely relevant to where I am in my study. I enjoyed the short videos, they were easy to watch and to the point" (6th/capstone unit, Grant Proposals and Applications, 2021 Semester 2).

The Communications/Access to Unit Coordinators Best Aspect theme is consistent with candidate feedback to Statement 6 (Access to timely help and advice). For example, "The coordinator was very responsive and gave practical feedback on assignments and relevant advice where needed" (3rd unit, Knowledge Translation, 2021 Semester 2).

The Increased Confidence Best Aspect theme is consistent with candidate feedback to Statements 8 (Further developed my critical and analytical skills) and 9 (Included work related knowledge and

skills). For example: “Help me to identify my stakeholders, how to communicate with them, how to negotiate with them. Help me to be more confidence in my future career” (3rd unit, Knowledge Translation, 2022 Semester 1).

The Relevance to Research Candidature/Problem-Solving Frameworks theme is consistent with survey Statements 8 (Critical and analytical skills) and 9 (Work related knowledge and skills). For example: “I really valued this units focus on communicating with different stakeholder groups and found the concepts of knowledge encodation and translation between different groups particularly insightful and applicable to my own research” (3rd unit, Knowledge Translation, 2022, Semester 1).

Similarly, the Unit Format Best Aspects theme is consistent with Statements 1 (Learning activities) and 2 (Learning materials). For example: “The unit was well structured with user friendly site” (6th/capstone unit, Grant Proposals and Applications, 2021 Semester 2).

TABLE 3: Themes from best aspects comments.

Themes	# of comments	% of comments
Webinars/Content/WIL activities	13	28%
Communications/Access to Unit Coordinators	8	17%
Increased Confidence in Research Impact/Stakeholders/Own Career	7	15%
Relevance to Research Candidature/Problem-Solving Frameworks	5	11%
Unit Format	5	11%
Assessments	4	9%
Reflective Practice	2	4%
Spiral Learning	2	4%
Peer Interactions	2	4%
Total	48	100%

Best Aspects Feedback Themes Reflect Key Work-Integrated Learning Design Elements of the Program

To minimize the potential for cognitive overload in candidates, the program assessments were designed as dual-purpose WIL activities. They generated written content applicable to the PhD candidature and thesis, while also teaching desirable graduate attributes through opportunities to apply and practice disciplinary learning in the context of authentic, post-doctoral workplaces. These WIL assessments fall under three categories:

- Category 1: authentic WIL activities scaffolded to key PhD milestones (Early Candidature Plan, Confirmation of Candidature, etc.). These WIL activities also provide training in skills relevant to post-doctoral careers (project management, critical thinking, oral/written communication, etc.).
- Category 2: reflective practice WIL activities (ePortfolio writing tasks, CV development, etc.). These WIL activities develop professional identities through reflection on – and written communication of – knowledge, skills, and research outcomes obtained through the candidates’ research (and, where relevant, their prior experiences). These activities also stimulate candidates to demonstrate these skills to career-relevant professional networks.
- Category 3: authentic WIL activities based on PhD research outputs. These WIL activities provide draft content for the PhD thesis (e.g., chapter-specific Introduction, Methods, Results and Discussion sections), plus real outputs relevant to academic and non-academic

employment. For example: fellowship application content for candidates interested in academia; business plans and team-based innovation projects for candidates interested in entrepreneurship or industry; and policy proposals for candidates interested in employment in policy settings.

Identification of the Assessments and Reflective Practice Best Aspects themes indicate PhD candidates valued these WIL design elements. For example, the assessments theme comment: "The assessments are very interesting. I really like the e portfolio assessment. It really helps students improve themselves days by days" (3rd unit, Knowledge Translation, 2020 Semester 1). Also the Reflective Practice Best Aspects comment: "The content [that prepares for the WIL activities] that encouraged space and opportunity to consider my research in the context of the wider industry in which my research could be applied" (3rd unit, Knowledge Translation, 2020 Semester 1). The Assessments and Reflective Practice themes are also consistent with the high (>93%) candidate agreement to the WIL-related SFU survey Statements 3 (Assessments), 9 (Work related knowledge and skills), and 7 (Reasonable workload) – suggesting the majority of responding PhD candidates highly valued the WIL design elements.

As previously reported (O'Connor et al., 2023), spiral learning theory was used during program design to minimize cognitive overload in the enrolled candidates. Identification of the Spiral Learning_Best Aspects theme indicates at least some candidates recognized and valued how the course content was delivered across units with increasing complexity. For example, the Best aspects comment: "Building on the content of previous units to refine our research skills" (3rd unit, Knowledge Translation, 2021, Semester 2). This theme is also consistent with the candidate response to Statements 1 (Learning activities), 2 (Learning materials), and 7 (Reasonable workload relative to other units).

Limited Needs Improvement Feedback

Compared to the 48 best aspects comments, only 17 needs improvement comments were available from the survey reports (Table 4); almost a quarter of these (4 comments, 24%) were grouped under the Nothing Needs Improving theme. For example: "I do not think that this unit needs any improvement, content is clear and helpful" (3rd unit, Knowledge Translation, 2022 Semester 1).

A small number of candidates voiced different perspectives on the content. The Online Sections/Resources theme (3 comments) suggested improvements to the content, such as: "More resources would be useful" (6th/capstone unit, Grant Proposals and Applications, 2021, Semester 2). The Explore Content More Deeply theme (2 comments) suggested greater exploration of content could increase engagement for some PhD candidates. For example: "I didn't find this unit sufficiently engaging... The lectures did not seem to progress very far... perhaps a guest lecture from someone within industry to talk about what they were looking to get from hdrs" (6th/capstone unit, Grant Proposals and Applications, 2022, Semester 1). Two comments from the Cover More Disciplines theme requested examples from more disciplines be included. For example: "There were not many examples that related back to research in the social science discipline. Specific examples to demonstrate theory from my areas of research would have been very useful" (3rd unit, Knowledge Translation, 2020 Semester 1).

Three needs improvement themes consisted of single comments: the More Cross-School Communications theme "Communication with schools about when presentations occur ours was post due date for same" (3rd unit, Knowledge Translation, 2022 Semester 1); the Modify Unit Format theme "Without the strong facilitation of the unit coordinator this project would have been near impossible"

(6th/capstone unit, Grant Proposals and Applications, 2021 Semester 2); and the Modify Assessment Format theme “Personally there was a lot of writing in this semester and considering it is the last unit I think just having the final assessment and maybe writing a reflection piece on the PhD journey would have been more suited to where I am at with my PhD” (6th/capstone unit, Grant Proposals and Applications, 2021 Semester 2).

TABLE 4: Themes from needs improvement comments.

Themes	# of comments	% of comments
Nothing Needs Improving	4	24%
More Peer Interactions	3	18%
Online Sections/Resources	3	18%
Explore Content More Deeply	2	12%
Cover More Disciplines	2	12%
More Cross-School Communications	1	6%
Modify Unit Format	1	6%
Modify Assessment Format	1	6%
Total	17	100%

Peer Interactions

Peer interactions were identified via both the Best Aspects Peer Interactions theme (2 of 48 comments) and the Needs Improvement More Peer Interactions theme (3 of 17 comments). For the Peer Interactions theme, candidates valued working with others. For example: “It was great to work with other HDR students from a range of disciplines on one project. This supported my teamwork skills, positioning my knowledge within the work of others and engaging with a range of approaches to the project” (6th/capstone unit, Grant Proposals and Applications, 2021 Semester 2). The More Peer Interactions theme indicates some candidates desired more peer interaction. For example: “I think it will be better if we can organize more student discussions (e.g., every month) so that we can have more connection in PhD life” (3rd unit, Knowledge Translation, 2020 Semester 1). These themes are consistent with the high variation in response to Statement 4 (Opportunities to work with other students).

DISCUSSION

The program investigated here applied four emerging design principles for alternative PhD training programs. Professional development training was provided via authentic WIL activities scaffolded to PhD milestones, with research skills training weighted towards the early units and employability skills towards the later units (O'Connor et al., 2023). Each unit involved short, weekly lectures provided by internal and external experts (guest lecturers). Voluntary, weekly workshops run by the unit coordinators provided candidates an opportunity to seek advice on content, assessments, or PhD research in general, and also the opportunity to meet other PhD candidates.

PhD Candidates Valued Access to Additional Content Experts

To address the first design principle, this program provided access to a broad pool of content experts beyond the candidates' research supervisors. The very high Explicit Agreement value (95%) to Survey Statement 6 indicates PhD candidate learning in the program was effectively supported by “Access to timely help and advice.” Consistent with this feedback, 17% of the best aspects comments related to

the theme Communications/Access to Unit Coordinators, and included words like “helpful,” “practical feedback on assignments” (i.e., WIL activities), “relevant advice,” “available,” and “direct communication.” These data support the emerging doctoral training principle that PhD candidates value access to relevant experts beyond their research supervisors. These experts provide a direct link to authentic WIL activities by providing content and context, co-design, and (co-) delivery. The additional context experts also linked to the other emerging principles, and the Best aspects themes, for example the Best aspects response:

Expertise of [teacher], very obvious in the content and presentation of lectures. Assessment items which support progression in PhD [i.e., WIL activities]. Formalising/confirming concepts not talked about elsewhere in PhD undertaking concept of stakeholders is the biggest thing that contributed to my learning. (3rd unit, Knowledge Translation, 2022, Semester 1)

PhD Candidates Valued Access to Broad Content

As noted above, the non-credentialled, non-WIL CRC training is typically tailored to technology PhD candidates, therein not catering for many other PhD candidates. Additionally, not all CRC candidates access core program elements – with 43% of CRC graduates (and 69% of non-CRC graduates) not recalling any access to industry or business meetings (Manathunga et al., 2012). Similar to CRCs, the credentialled/non-WIL CTS program was developed for candidates interested in commercialization, thereby not providing employability skills training for the many PhD candidates not interested in commercialization. While “98% of students were satisfied or very satisfied with the training”, issues included insufficient practical skills (or WIL), onerous training workload impacting research time, and some courses not addressing research student needs (DESE, 2013, p. 2).

Therefore, to address the second emerging design principle (content broader than commercialization), the credentialled, WIL-based program investigated here was tailored for PhD candidates from all disciplines, not just science or technology candidates. The program content, research skills training, and employability skills training incorporated – but was much broader than – technology and commercialization. For example, it also covered: research skills and professional identity; academic and non-academic communication of research outcomes and impact to stakeholders; and choice of specialized content and WIL activities based on candidate career goals (Table 1, O'Connor et al., 2023). In contrast to CRC candidate feedback, the very high Explicit Agreements to Statements 1 (Learning Activities), 2 (Learning materials), 3 (Assessments/WIL activities), 6 (Unit coordinators), 7 (Workload), 8 (Critical and analytical skills), and 9 (Work related knowledge and skills) indicate most respondents engaged with and valued the content and WIL activities. This is supported by the populous best aspects theme Webinars/Content/WIL Activities that intersected with other Best aspects themes including Communications/Access to Unit Coordinators, Confidence, and Reflective practice themes. While three needs improvement themes (7 comments) suggest broadening the course resources or content, changes already implemented may address this issue. For example: “The lectures were easy to understand, were not discipline specific[,] and [were] accessible” (3rd unit, Knowledge Translation, 2021 Semester 2). Alternatively, these needs improvement comments might reflect candidates wanting more depth of content due to having more knowledge or experience prior to commencing the program and their PhD.

The content-related findings, in the context of synchronous/asynchronous program delivery, align with literature. For example: “Asynchronous online discussions are valuable in online learning. When they are guided by the instructor, they have the ability to develop students’ cognitive skills and deepen their understanding of the content” (Martin & Bolliger, 2018, p. 217). Relative to CRCs and the CTS, the

content-related findings here suggest credentialled, WIL-based alternative doctoral training might stimulate better candidate engagement than non-credentialled/non-WIL programs. The program here was developed using feedback from undergraduate and postgraduate students – resulting in the part-time, scaffolded delivery and the skills-related content (O'Connor et al., 2023). The positive feedback indicates the program mostly met the needs of the responding candidates. However, not all candidates responded in the seven SFU surveys, and a small number of them withdrew from the course due to PhD candidature issues. Future studies could therefore further explore candidate interests and motivations for engaging and continuing with WIL and alternative doctoral training programs. Related areas of interest to explore could include prior candidate work experience, provision of introductory versus advanced content and WIL activities, PhD workload, career interests, and labor market challenges (Wall & Welsch, 2013). Consideration could also be given to the needs of culturally and linguistically diverse (CALD) candidates who might benefit from additional enculturation in research and employability skills training, and WIL.

PhD Candidates Valued Scaffolded Delivery of Work-Integrated Learning Activities Across Candidature

Workload is a key stress affecting doctoral candidate wellbeing, retention, and attrition (Nagy et al., 2019; van Rooij et al., 2021; Waight & Giordano, 2018). To address the third emerging design principle for doctoral programs (WIL scaffolded to the PhD journey), the content and WIL activities in the program here were scaffolded to PhD milestones across the three-year program. Doing so aimed to establish a manageable, wholistic training approach – whereby the skills delivered in any semester matched both the PhD research at that candidature stage, and future workplace skills needs. The difficulties some PhD candidates had balancing the CTS with their research was not replicated by the responding candidates here, despite both programs being delivered via Graduate Certificates. Here, candidates reported very high Explicit Agreement to Survey Statement 7 (Reasonable Workload). This suggests the pedagogical approaches underpinning course design, such as spiral learning and cognitive load theory (O'Connor et al., 2023), were valued by many respondents. Flexibility in subject enrolment also meant not all candidates completed one subject per semester to remain with their initial program cohort (typically due to PhD candidature issues); nevertheless, most still completed the program. While a single Modify Assessment Format Needs Improvement comment suggested reducing the amount of writing in the capstone unit, no needs improvement theme was identified relating to difficulties balancing the program with the research candidature. Benchmarking dates and times during semesters when candidates accessed online content could provide more detailed insights into how PhD candidates prioritize WIL and alternative doctoral training.

The learning quality achieved via the scaffolded WIL delivery is supported by the highly positive Explicit agreement to Statements 8 (What I learnt in this unit: Developed my critical and analytical skills) and 9 (Included work related knowledge and skills). Consistent with this, 25% of the Best aspects comments fell under the themes Increased Confidence and Relevance to Research Candidature/Problem-Solving Frameworks themes. Overall, the feedback supports the emerging doctoral training principle that PhD candidates value scaffolded delivery of research skills, employability skills, and WIL activities, and this can be achieved without workload stress of the CTS.

PhD Candidates Valued Purposefully Designed, Authentic Work-Integrated Learning Activities

The program investigated here, used purposefully co-designed and assessed WIL activities to address the fourth emerging doctoral program design principle. These WIL activities exposed candidates to authentic post-doctoral workplace tasks as well as external partner expectations and interactions. The

lectures provided background to, and contextualization of, the workplace skills required to successfully complete the WIL activities. This approach was used because, as noted for CRCs, simply immersing doctoral candidates in an industry setting does not guarantee an effective learning experience (Manathunga et al., 2012). The candidates' feedback shows the WIL design was highly valued, with high Explicit Agreement for Statements 1 (Learning activities), 2 (Learning materials), 3 (Assessments), 7 (A reasonable workload relative to other units), and 9 (Included work related knowledge and skills). This was reinforced by identification of six best aspects themes – related to content, confidence, research/problem solving, format, assessments (WIL), and reflective practice – that contained 75% of all best aspects comments. These data support the emerging doctoral training principles that candidates value authentic WIL activities scaffolded to relevant stages of the PhD research journey. This framework provides opportunities for novel internship or placement opportunities, such as the industry co-designed Innovation Team Challenge WIL activity in the capstone unit. Other paid or unpaid placement activities could also be incorporated consistent with the Research Training Program Internships program (DESE, 2021).

Interestingly, recent small-scale reports suggest similar factors to those identified here are important to doctoral candidates, including: their motivation for the training; candidature stage; training authenticity, design and delivery; alignment with research candidature; peer interactions; and supervisor support (Candy et al., 2019; Valencia-Forrester, 2019). Related to these studies, the highly-positive, quantitative and qualitative feedback on the WIL activities identified here raises an important question – might PhD candidates similarly prioritize professional development activities in the absence of an assessed, credentialled program? Financial pressures are likely to significantly influence design, development, and refinement of alternative doctoral training programs. As PhD research is commonly a full-time and leading priority for PhD candidates (i.e., their main job), design or review of alternative PhD training programs with non-assessed professional development activities could benefit from considering learner participation in MOOCs and e-learning. In MOOCs, completion rates for self-guided/self-directed courses are impacted by factors including learner desire for certification, full-time employment status, and available learning time (Cisel, 2014). In e-learning, assessment is critical for learner engagement and skills development. As noted by Macdonald, "...the only time when most students will undertake activities is when they are linked to assessment. The assignment will always take priority, and may detract from non-assessed activities" (Macdonald, 2004, p. 220). Whether these findings apply to non-assessed doctoral professional development activities versus assessed doctoral WIL activities is worth investigating, particularly given the high value placed on the assessed WIL activities identified in the program here.

Doctoral Candidates Desire More Peer Interactions Earlier During Candidature

Across the first four units of the program investigated here, the WIL learning objectives mainly focus on research skills needed by individuals, with the skills also relevant to post-doctoral employment (Table 1, O'Connor et al., 2023). The later units focus on employability skills, although the WIL-based assessments also build draft content for PhD thesis development. Peer interactions to avoid candidate isolation (Ali & Kohun, 2006; Gardner, 2008, 2010) were promoted in all program units via voluntary weekly online workshops facilitated by unit coordinator. The lower average Explicit Agreement to Statement 4 (Opportunities to work with other students) was due to low candidate feedback from the early program units – suggesting at least some candidates desired more peer interactions early in the program. This interpretation is corroborated by identification of the best aspects and needs improvement peer interaction themes. This issue may be partly due to factors including: the online-only delivery necessitated by COVID-19; candidates later in the program not wanting distractions from

their thesis; and to the optional Innovation Team Challenge WIL activity in the capstone unit (O'Connor et al., 2023). Nevertheless, the data suggest alternative doctoral training programs should promote candidate interactions early in candidature. Doing so could improve the research environment and experiences for PhD candidates, stimulate valuable cross-disciplinary interactions, and help reduce candidate isolation and associated attrition (Ali & Kohun, 2006; Fenge, 2012). However, programs should still stimulate development of individual candidate capacities to aid both PhD research and future employment. Approaches to this issue could include re-offering face-to-face delivery, or establishing small group peer evaluations of WIL assessments – to stimulate peer interactions across traditional academic boundaries, and to develop skills in generating and receiving effective critiques relevant to academic and non-academic workplaces.

Other Considerations

A potential limitation of this study is the small number of needs improvement comments that might limit understanding of course improvement areas. However, the consistency between the quantitative and qualitative data and published literature suggests useful insights can be made into WIL and alternative doctoral programs – such as the future research areas identified above. While no needs improvement theme was identified relating to technologies, the lower Explicit Agreement for Statement 5 suggests more work is needed to understand technologies beneficial to PhD candidates. With the increasing power and broadening use of generative artificial intelligence (AI) in workplaces, incorporating authentic WIL activities for generative AI use seems timely and valuable.

CONCLUSION

Considered Design of Doctoral Work-Integrated Learning Activities Complements the PhD Experience

In summary, this study provides timely insights into design principles for WIL and alternative doctoral training models. Candidate feedback showed high satisfaction with the program design, content, WIL activities, delivery methods, workload (including flexible subject enrolment for course progression), and access to additional experts. These findings build on evaluations of the CRC and CTS models and extend recent small-scale studies of PhD candidate perspectives on doctoral WIL. They provide a contemporary evidence base for establishment or modification of doctoral WIL and employability skills training programs relevant to PhD candidates regardless of research discipline. Various alternative doctoral training program designs are possible, and potentially desirable, dependent on PhD candidate demographics and contexts. This study suggests if the four emergent design principles are realized, then alternative doctoral training programs can stimulate candidates to develop important research and employment-related skills. These skills provided candidates with knowledge frameworks, problem-solving skills, and confidence that complement PhD completion and are relevant to post-doctoral workplaces – without restriction to commercialization or science and technology candidates. Important future research areas were identified, including: understanding candidate motivation for, and communicating the value of, alternative doctoral training programs, including to CALD candidates; provision of introductory versus advanced content; increasing peer interactions early in candidature; incorporating paid or unpaid internships; investigating WIL activities for generative AI; and benchmarking PhD candidate engagement with assessed WIL versus non-assessed professional development activities.

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The International Journal of Work-Integrated Learning (IJWIL) publishes double-blind peer-reviewed original research and topical issues related to Work-Integrated Learning (WIL). IJWIL first published in 2000 under the name of Asia-Pacific Journal of Cooperative Education (APJCE).

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