

Project: Developing teachers' interdisciplinary expertise

Funded by the NSW Department of Education, Education Strategic Research Fund, Leveraging Grant scheme, 2021-2023

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Project description (abbreviated)

Overview

This project leverages our newly-funded ARC Discovery Project (DP) "Developing interdisciplinary expertise in universities" (2020-2024). This DP investigates how university researchers and students develop the expertise needed to work in interdisciplinary teams. The DP combines three perspectives investigating: how research and innovation communities create interdisciplinary knowledge, how interdisciplinary teams learn to function effectively and the personal resourcefulness that enables individuals to participate in interdisciplinary work. The DP provides a much sharper, holistic understanding of the qualities needed to work productively across disciplinary boundaries. Its intended outcomes include better strategies to support interdisciplinary learning at the university level.

This Leveraging project will *translate* and *extend* the DP outcomes to benefit schools. We will work on curriculum innovation and the development of research-based teaching resources with a state-wide network of collaborators in pre-service and in-service teacher education.

The aim is to help prepare teachers for teaching in an increasingly interconnected, dynamic and unpredictable world, so that they can help their future students build on firm disciplinary foundations *and* integrate different areas of knowledge and ways of knowing. To help students respond positively and creatively to emerging challenges in workplaces and communities, schools will have to help them learn how to make connections across diverse knowledge domains, and how to apply what they know.

In concrete and practical terms, this means teacher educators will have to help teachers understand interdisciplinary practices, learn to work flexibly and knowledgeably in teams, make good use of contemporary physical and digital learning environments, and employ contemporary cross-curriculum pedagogies to direct active learning. This combination is a prerequisite for teachers to create meaningful opportunities for their students to engage in authentic interdisciplinary practices, in which students learn to integrate and apply disciplinary knowledge rigorously.

NSW Education rightly emphasises the strategic importance of students learning to draw on knowledge across disciplines and apply it for solving complex real-world challenges.¹ It recognises the importance of teachers' flexibility and the skills needed to engage in co-teaching, implement project-based learning, respond to students' diverse needs, and develop their general capabilities. Our project aims to strengthen the activities of NSW Education in this critical future-focused area. In collaboration with teacher educators, we will co-create design resources for interdisciplinary teaching that could be re-used in other teacher education programs and in schools.

Rationale

Interdisciplinary expertise refers to the capabilities needed to engage skilfully in those kinds of knowledge work that involve several established knowledge fields and to foster connections between them. Interdisciplinary expertise does not replace disciplinary knowledge; it builds on it. For example, solving sustainability issues, responding to global health challenges, engaging in STEM- and AI-driven innovation all require capabilities to integrate knowledge from different disciplines taught in separate school subjects. This also involves the capabilities needed to apply disciplinary knowledge rigorously and creatively in making decisions and creating products that have practical outcomes.

Interdisciplinary expertise is vital to future economic prosperity, health, and social wellbeing. However, its nature is not well-understood, which makes it unnecessarily hard to create opportunities for people to become adept at collaborating with others across different fields of knowledge. It is currently very hard for schools and teachers to develop the expertise needed to prepare students for interdisciplinary work. As a result, interdisciplinary project-based learning often lacks rigour and fails to achieve expected learning outcomes. For example, a recent literature review of interdisciplinary STEM education shows that students' interdisciplinary learning is poorly assessed.ⁱⁱ Similarly, a recent review of STEAM education shows a lack of emphasis on students' learning to engage in interdisciplinary practices.ⁱⁱⁱ

Despite the stark recognition of the urgent need to develop people's capabilities to work across disciplines^{iv}, pre-service teacher education and in-service teacher professional development programs rarely focus on developing teachers' competencies to teach students to integrate disciplinary knowledge and work across disciplinary boundaries. As the UK Higher Education Academy's review concludes, interdisciplinary pedagogies is one of the most poorly understood and implemented aspects of contemporary education.^v

This Strategic Leveraging project will extend our collective understanding of interdisciplinary expertise, and how to enhance its development for pre- and in-service teachers and, through that, how to strengthen students' capabilities for interdisciplinary work. This project will produce an overarching framework that articulates the main constituents of teachers' interdisciplinary expertise and co-create a set of practical reusable design resources for embedding the development of teachers' interdisciplinary expertise in pre-service education and in-service professional development.

Aims and objectives

This project has two main aims:

1. *to produce an overarching framework* that articulates the main aspects of teachers' interdisciplinary expertise; and
2. *to co-create a set of practical reusable design resources* for embedding the development of teachers' interdisciplinary expertise in pre-service education and in-service professional development.

This project will use innovative co-design methods and patterns-based approaches to representing reusable design knowledge to co-create, test and disseminate design resources that capture and communicate successful practice.

Key objectives:

1. *To identify* the principal challenges and barriers teachers face—and the capabilities and resources they need—when developing their students' abilities to engage in productive interdisciplinary project work.
2. *To create a framework* for developing teachers' interdisciplinary expertise, including a set of *reusable design resources* for integrating the development of interdisciplinary expertise in pre-service teacher education and in-service professional development.

3. *To apply, test, refine and expand* this framework and associated resources in a robust, iterative co-design process with experts, stakeholders and end-users.
4. *To disseminate* the framework, resource kit and associated project outcomes.

Conceptual and methodological approaches

This translational project, like the DP, will build on the conceptualisations of professional capabilities for practical, knowledge-informed innovation developed by CIs Markauskaite and Goodyear in their earlier ARC-funded DP.^{vi} It will first articulate what constitutes teacher interdisciplinary expertise and how it can be developed. This work will culminate in the construction of a teacher interdisciplinary expertise framework and will draw on extensive consultation and a scoping review, described below. Then, it will produce a set of re-useable design resources. This will involve joint co-design work with a network of collaborators in pre-service and in-service teacher education from across NSW.

The project will use two main methodological approaches. First, the participatory co-design methods developed by CI Wrigley^{vii} will be used for co-developing the teacher interdisciplinary expertise framework and, later, for facilitating course redesign for embedding interdisciplinary expertise development in pre-service and in-service education. Second, patterns-based approaches to representing reusable design knowledge developed by both Wrigley and Goodyear^{viii} will be used to co-create and test design resources and present them in a rigorous and easy to re-use in new teacher education and professional development contexts form.

Project design

The project will include two phases.

Phase 1: Consultation and scoping study and initial development of teacher interdisciplinary expertise framework. This phase will include two components.

First, we will use outcomes of the ARC DP and our earlier ARC-funded projects to produce an initial consultation paper on the nature of interdisciplinary expertise and how it is learnt. Using this paper as a stimulus, we will carry out a series of consultations with the main stakeholder groups (e.g. NSW Education, in-service and pre-service teachers and teacher educators) to identify current areas of teacher interdisciplinary practices and challenges, as well as practices and barriers in developing pre- and in-service teachers' interdisciplinary expertise, and to translate these ideas to Australian and NSW school contexts. In parallel, we will conduct a scoping literature review on the development of teacher interdisciplinary expertise to identify current models, key elements of effective practice, evidence, as well as gaps in the literature.

Secondly, building on the outcomes of the first stage, we will design and conduct a model-building workshop to create an initial framework for the development of teacher interdisciplinary expertise. We will use the participatory design-led approach with interested parties from initial teacher education and professional development, experts from interdisciplinary research centres and other stakeholders (e.g. NSW Education, pre-service and in-service teachers, N=20). This work will help ensure the alignment of the outcomes with the existing practices, challenges and aspirations of all parties involved in NSW education. It will also ensure that the proposed teacher interdisciplinary expertise framework, and approaches to develop it, draw on state-of-the-art evidence and knowledge (Outputs 1-5).

Phase 2: Development and testing of design resources in pre-service teacher education and in-service professional development.

This will include: 1) development of initial resources for course redesign, drawing on the interdisciplinary expertise framework; 2) course redesign workshops, conducted using a design-led innovation approach, involving in- and pre-service education providers from NSW, to help them embed interdisciplinary expertise development in their teacher education programs for preservice and in-service teachers; and 3) follow-up

distributed design work with teacher educators from 5-7 programs, to develop and test a set of specific design patterns. This phase will build on participatory innovation design and patterns-based approaches to produce reusable design resources. This will ensure that the design resources we create generate immediate benefits and are reusable (Outputs 6-9).

To ensure inclusion and representation of diverse participants who could benefit from the project the most, we will create criteria and select participants for each phase of the project in consultation with the project reference group.

To ensure relevance and quality, we will present interim products to stakeholders in a range of formats and at multiple points during the project. Our strategies will include consultations with the reference group and individual stakeholders, webinars and conferences, peer-review, expert evaluation and feedback via the project website (Outputs 1-12).

All developed products will be available via the project website. The final products (the framework, a set of design patterns and associated resources) will be assembled into the resource kit and made available for all NSW teacher educators.

Outputs

This Strategic Leveraging project will include two phases (see Attachment) and will produce the following outputs:

Phase 1

1. **A consultation paper:** identifying and mapping current focus areas of teacher interdisciplinary practices and challenges, as well as practices and barriers in developing pre- and in-service teachers' interdisciplinary expertise in Australian and NSW school context (4 months). Responses to the paper will help create a broad network of interested parties in NSW Education and NSW universities.
2. **A scoping review report:** on the development of teachers' interdisciplinary expertise, covering current evidence, models, and key elements of effective practice, as well as gaps in the literature and other aspects identified through the consultation paper and responses received (7 months).
3. **Online and face-to-face events:** presenting the outcomes of outputs 1 and 2 for partners/stakeholders, especially for NSW Education and pre- and in-service education providers (8 months).
4. **Materials for facilitating a model-building workshop:** developing the interdisciplinary expertise framework (10 months).
5. **A technical report:** documenting workshop outcomes and presenting a framework that articulates the main aspects of teachers' interdisciplinary expertise (12 months).

Phase 2

6. **Materials for facilitating course redesign workshops:** for in- and pre-service education providers, embedding interdisciplinary expertise development (14 months).
7. **A design pattern-book:** a set of design patterns for embedding the development of interdisciplinary expertise in pre-service teacher education and in-service teacher professional development (18 months).
8. **A webinar:** presenting the outcomes of 5 and 7 for partners/stakeholders—NSW Education and pre-service and in-service teacher education providers (21 months).
9. **Final version of the resource kit:** framework, pattern-book and associated resources (24 months).
10. **A project website:** to host materials for stakeholder consultation, engagement, dissemination and re-use; curating outputs of the main stages of the project (updated regularly from month 1 to 24).
11. **Scholarly publications:** two research-based open-access academic papers, two presentations at the Australian Association for Research in Education (AARE) annual conference and two papers for professional practitioners.
12. **Key outputs made available** via the University's eScholarship repository and stored there in perpetuity.

Timeline

	Year 1				Year 2			
Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 1: Consultation and scoping study and initial development of teacher interdisciplinary expertise framework								
Consultation: Identifying current practices and needs								
Scoping literature review								
Development of resources for model-building workshop								
Framework development								
Phase 2: Development and testing of design resources in pre-service teacher education and in-service professional development								
Development of initial resources for course redesign and workshops								
Development of design patterns and testing								
Design of the final framework and resource kit								
Dissemination and engagement								
Webinars								
Journal publications								
Conference presentations								
Engagement with stakeholders (consultation, scoping & design)								
Website set-up and updates (incl. main deliverables)								

Endnotes

ⁱ NSW Government. Contemporary learning and teaching, 2020. Accessed 29-04-2021 from

<https://education.nsw.gov.au/teaching-and-learning/school-learning-environments-and-change/future-focused-learning-and-teaching>

ⁱⁱ Gao, X, P Li, J Shen & H Sun, Reviewing assessment of student learning in interdisciplinary STEM education. *Int J of STEM Education*, 2020. 7(1): 24. doi:10.1186/s40594-020-00225-4

ⁱⁱⁱ Katz-Buonincontro J. Gathering STE(A)M: Policy, curricular, and programmatic developments in arts-based science, technology, engineering, and mathematics education. Introduction to the special issue: STEAM Focus. *Arts Education Policy Review*, 2018, 119(2): 73-76.

^{iv} Cooke N J & M L Hilton, eds. Enhancing the effectiveness of team science. 2015, Washington: National Academy Press.

^v Lyall C. et al. Interdisciplinary provision in higher education: Current and future challenges. 2016, Heslington: Higher Education Academy.

^{vi} Markauskaite, L & P Goodyear, Epistemic fluency and professional education: Innovation, knowledgeable action and actionable knowledge. 2017, Dordrecht: Springer.

^{vii} Wrigley, C, Principles and practices of a design-led approach to innovation. *Int J of Design Creativity and Innovation*, 2017. 5(3-4): 235-255.

^{viii} Goodyear, P & S Retalis, eds. Technology-enhanced learning: design patterns and pattern languages. 2010, Rotterdam: Sense.