TRANSDISCIPLINARY STEM ENACTMENT:

AN EXPLORATORY CASE STUDY IN THE QUEENSLAND CONTEXT

AUTHOR

Kristie Schulz
Head of Curriculum (Secondary)
M.Phil (Ed), B.Ed (Hons)

AFFILIATIONS

James Cook University Australia

Parklands Christian College
Foundations for life

SUPERVISORS

A/Prof Hilary Whitehouse
Dr Tanya Doyle
James Cook University

STUDENTS PRESENTING TO EXECUTIVE TEAM

In 2022, a group of Year 10 identified an issue within the school community, and developed an app for visitors when they are visiting the school's 46-acre, complex site. They professionally presented the app to the College Executive team.

INTRODUCTION

Enacting STEM education in Australian schools is an ambitious task, in a climate of unclear definitions and little implementation advice. Should STEM education simply refer to an umbrella-term of subjects that Australian students need to improve in, or could a cross-disciplinary pedagogy that engages students in authentic problem-solving be realised? Parklands Christian College designed and enacted a transdisciplinary (Helmane & Briska, 2017), student-centred ideology of STEM education in 2017. The program has continually evolved using a transdisciplinary pedagogical framework (Figure 4).

THE CONTEXT

Enacting STEM in Queensland can be complex, given the lack of policy and advice. Schools can often rely on common practices seen in other places, without interrogating policy or best practice.

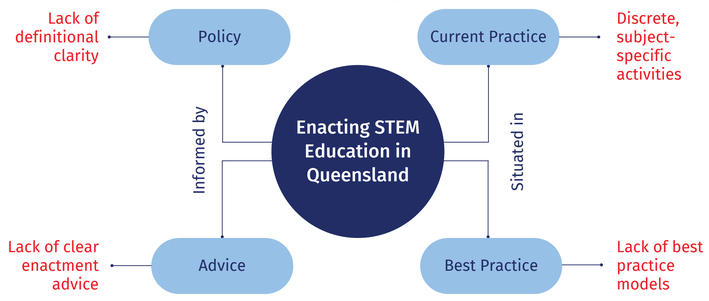

Figure 1. The complex context of STEM enactment in Queensland.

TRANSDISCIPLINARITY

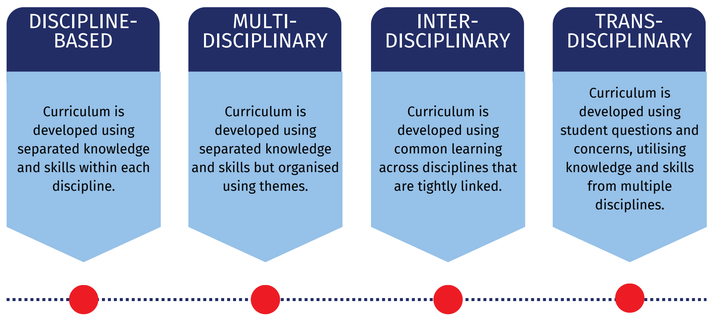

Figure 2. Defining transdisciplinary curriculum on a spectrum of instructional styles, adapted from Helmane & Briska (2017).

2023 PREP STEM

In 2023, the transdisciplinary STEM program at PCC was extended to the three Prep classes, using projects appropriate to 5-year olds.

The three rules of STEM in Prep at Parklands are...

"I AM A WORLD EXPLORER!"
"I CAN HAVE SILLY IDEAS!"
"I CAN MAKE A DIFFERENCE!"

RESEARCH QUESTIONS

1. What are the core constructs of STEM education in Queensland schools, as described by national and state education policy?
2. How is one example of middle-school STEM curriculum conceptualised at one Independent Secondary School in Queensland?
3. What are the critical principles of enactment to enable the case study's STEM curriculum to be transferred to another school setting?

METHODOLOGY

The methodological approach of this study began with a policy analysis conducted via systematic literature search (Xiao & Watson, 2019), content analysis (Denscombe, 2014) and critical policy analysis (Diem, Young, Welton, Cummings-Mansfield & Lee, 2014). Data was then collected via autoethnographic records and semi-structured interviews, that were analysed using Phronetic Iterative Analysis (Tracey, 2019). Findings from each method were then triangulated and synthesised, to distil critical principles of enactment utilised by the Parklands curriculum innovation, and a descriptive, instrumental case study.

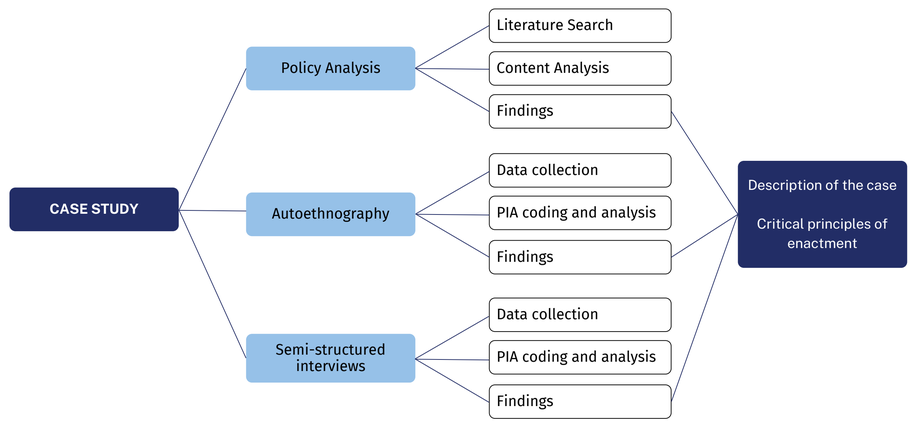

Figure 3. The methodological approach of the descriptive, instrumental case study.

FINDINGS

Findings of the policy review suggest that the policy-scape of STEM education in Australia experiences tensions between seemingly competing understandings. Many policy documents refer to either the discipline-based learning areas or cross-disciplinary approaches that endeavour to integrate learning areas. Findings from primary data suggest that the transdisciplinary enactment strategy employed by the case study school aligns with policy language of cross-discipline STEM and other STEM education priorities including authentic problem-solving and preparing students for the future of workplaces. Through this case, policy descriptions, pedagogical techniques, curriculum structures and staff characteristics have been explored to extract critical principles of enactment (Table 1).

TABLE 1. CRITICAL PRINCIPLES OF ENACTMENT

AGREED IDEOLOGICAL POSITIONING	In the development of a STEM curriculum innovation, schools should closely consider STEM education definitions and then align strategic pedagogical and curriculum decisions with an ideological understanding.
COLLABORATION AND RISK MANAGEMENT	Logical constraints such as timetabling and staffing may emerge but can be overcome through the collaborative approach of administration and teaching staff to risk management.
STAFF CHARACTERISTICS	Staffing decisions for a transdisciplinary STEM curriculum innovation should consider the values, personal characteristics and ways of working. STEM education curriculum innovations should further consider the specific roles that each of the actors hold and determine contextual descriptions of success.
PRIORITISE STUDENT AGENCY	Curriculum structures of a transdisciplinary STEM prioritise student agency and the development of fit-for-purpose assessment strategies that privilege the student voice.
RESPONSIVE PEDAGOGY	Pedagogical techniques should consider a range of emotional responses that students may exhibit in response to different ways of working, and explicit inclusion of connections to the world beyond the classroom.
PROBLEM-FRAMING FOCUS	Pedagogical techniques selected for use should have foundation in the ideological positioning of the curriculum innovation. This can lead to a pedagogical framework that draws on a rich understanding of problem-solving Problem-solving in a school context should include explicit teaching of problem-framing.

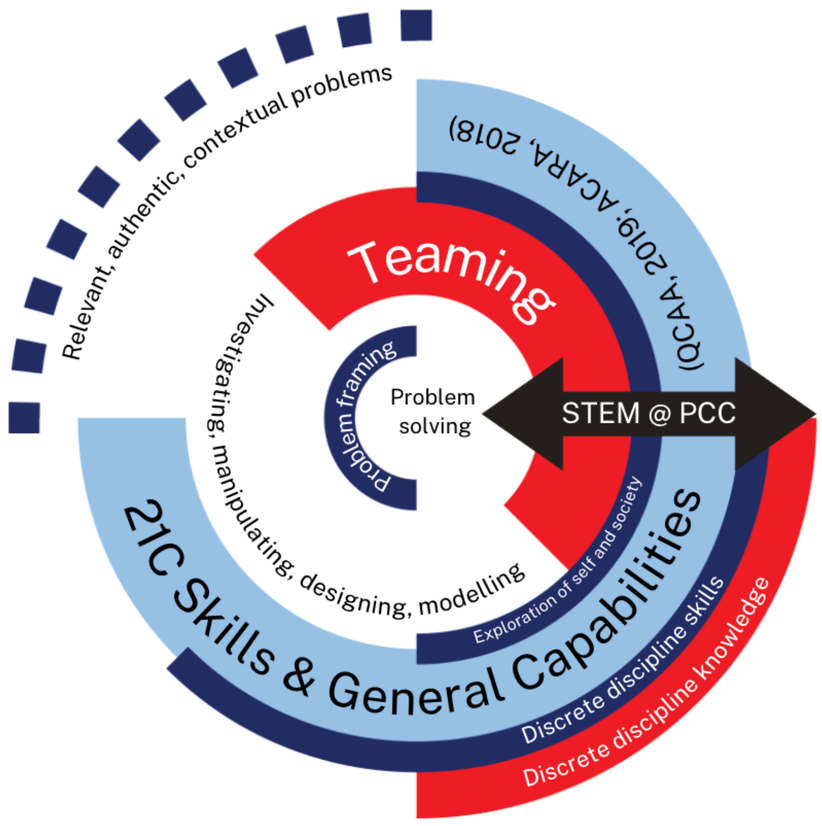

Figure 4. The transdisciplinary pedagogical framework for the enactment of STEM education at Parklands Christian College.

PEDAGOGICAL FRAMEWORK

In the process of exploration, a pedagogical framework for enacting a transdisciplinary STEM curriculum innovation was formed. Figure 2 represents the spiralled approach that the curriculum innovation takes to enacting STEM education. The figure is designed to be read from the outermost layers first, circling inwards as aspects of the framework, in increasing complexities, are drawn into the process. The outer layers of the model represent the discrete discipline knowledge and skills are taught outside the STEM Studies classroom. The relevant, authentic and contextual problems, represented by individual boxes, also begin outside of the STEM Studies classroom, but are quickly drawn into the process, as students seek them out through their lived experiences and learnings. Teachers build structure to the course from policy documentation and iterative cycles of investigation, modelling, problem-framing and finally problem-solving can occur. The black, multidirectional arrow signifies that at any point in the spiral, the process can change direction, regress, jump ahead or revisit a layer.

CONCLUSION

Conclusions of this research demonstrate that the identified critical principles of enactment and transdisciplinary pedagogical framework (Figure 4) could provide the basis from which schools in other settings could respond to the burden of policy that describes STEM education as an influential factor in the futures of young Australians. This research argues that to authentically actualise polysemy of STEM education definitions in Australian policy, schools could embrace a transdisciplinary pedagogical framework. This, alongside traditional learning areas, can give students the opportunity to meaningfully apply knowledge, skills and 21st century skills to real-world contexts.

REFERENCES

- Denscombe, M. (2014). Case studies. In M. Denscombe (Ed.), The Good Research Guide for small-scale social research projects (5th ed., pp. 35-47). Open University Press.
- Diem, S., Young, M. D., Welton, A. D., Mansfield, K. C., & Lee, P.-L. (2014). The intellectual landscape of critical policy analysis. International journal of qualitative studies in education, 27(9), 1068-1090. https://doi.org/10.1080/09518398.2014.916007
- Helmane, I., & Briška, I. (2017). What is Developing Integrated or Interdisciplinary or Multidisciplinary or Transdisciplinary Education in School? Signum Temporis, 9(1), 7. https://doi.org/10.1515/sigtem-2017-0010
- Tracey, S. J. (2019). Qualitative Research Methods: Colleting Evidence, Crafting Analysis, Communicating Impact. John Wiley & Sons Ltd.
- Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. Journal of planning education and research, 39(1), 93-112. https://doi.org/10.1177/0739456X17723971

For full text thesis or full reference list, please contact Kristie Schulz at kschulz@parklands.qld.edu.au

THE PARKLANDS CURRICULUM INNOVATION HIGHLIGHTS A RARE AND PRECIOUS OPPORTUNITY, UNEARTHED FROM A LACK OF CLARITY, CURRICULUM AND GUIDANCE, FOR STEM EDUCATION TO BE A CASE STUDY TOWARDS A COURAGEOUS EVOLUTION OF EDUCATIONAL PHILOSOPHY.