Research Statement – Indoor Air Cartoon Journal

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My scholarship is situated within Engineering Education Practice and is operationalised through a research-as-practice approach. It focuses on cognitive governance and value-oriented diagnostic reasoning and problem-solving in indoor air quality and sustainable building engineering education and practice. My research interests include mental modelling, cognitive governance, value-oriented diagnostic reasoning, risk assessment, and value-oriented problem-solving.

Rather than seeking primarily to explain engineering or educational phenomena, my scholarship seeks to design solutions that strengthen human capability for value-oriented problem diagnosis and solving. Consequently, my research is centred on the development and refinement of communication solutions, together with the design principles that underpin them.

As a Design Theorist in Engineering Education Practice, I develop and refine design principles for communication solutions that empower mental model development, stimulate value-oriented questioning for cognitive ability enhancement, support sound judgement and decision-making, and ultimately guide action for value-oriented problem diagnosis and solving.

The central premise of my work is that many persistent problems in indoor air quality and sustainable building engineering education and practice are not only technical problems. They are also cognitive problems. In many situations, relevant information already exists, but learners and practitioners may lack the mental models needed to connect variables, interpret interactions, ask the right questions, and make value-oriented judgements. My scholarship therefore addresses the cognitive barriers that prevent people from transforming information into knowledge, understanding, judgement, decisions, and effective action.

Despite decades of advances in indoor air quality and sustainable building engineering research, many real-world problems remain inadequately diagnosed or resolved. This is often not because technical knowledge is unavailable, but because learners and practitioners lack the cognitive capabilities needed to use that knowledge effectively.

Conventional empirical research has substantially advanced scientific understanding of engineering phenomena; however, comparatively less attention has been given to how communication itself can be intentionally designed to strengthen the cognitive capabilities required to transform existing knowledge into value-oriented judgement, decision-making, and action.

My research addresses this complementary gap. Rather than generating new technical knowledge, my research investigates how communication solutions can be systematically designed to cultivate a transferable way of thinking that strengthens cognitive governance for value-oriented problem diagnosis and solving across diverse real-world contexts.

This orientation is operationalised through a research-as-practice approach. Rather than separating research from practice, knowledge is generated through iterative cycles of designing, applying, reflecting upon, and refining communication solutions. Within this approach, communication solutions are not merely educational artefacts; they are primary research outputs, while the design principles underpinning them become the objects of scholarly inquiry. The objective is to develop an emerging design theory of communication solutions for cognitive governance that can inform both engineering education and professional practice.

The principal platform through which this work is developed and refined is the Indoor Air Cartoon Journal, a non-commercial living book series published as peer-level public scholarship. The journal functions simultaneously as a design laboratory, research platform, scholarly output, dissemination platform, and public educational resource.

Through fictional case stories, visual communication, storytelling, cognitive scaffolding, and engineering concepts, each publication investigates how communication can be intentionally designed to strengthen mental model development, value-oriented questioning, and cognitive governance while making complex engineering problems cognitively accessible without compromising intellectual rigour.

The fundamental research question that guides my work is:

How should fictional case stories be designed to function as communication solutions that bridge knowing and doing in real-world practice by empowering mental model development, stimulating value-oriented questioning to enhance cognitive capabilities, supporting sound judgement and decision-making, and ultimately guiding value-oriented problem diagnosis and solving?

This question positions communication solutions as primary interventions for cognitive governance rather than supplementary educational tools. It reflects my interest in understanding how communication can be intentionally designed to influence how learners and practitioners think, reason, judge, decide, and act in complex engineering contexts.

The originality of my scholarly contribution lies in four interconnected knowledge contributions:

(1) Development of original mental models as cognitive tools for value-oriented problem-solving, including the value delivery equations, the human performance equation, the education definition equation, and the value delivery spectrum. These models provide new ways of organising thinking to support understanding, judgement, decision-making, and action for value creation. **The originality lies in establishing new conceptual frameworks that explain and guide value-oriented reasoning and problem-solving**.

(2) Reinterpretation and cognitive internalisation of existing mental models to support value-oriented problem-solving, including epidemiological risk assessment, lean thinking, and IAQ mass balance equations. **The originality lies in transforming these existing models from analytical or computational tools into cognitive tools for understanding, judgement, decision-making, and problem-solving.** Rather than using these models solely for calculation or analysis, my work enables them to function as thinking tools that shape how people interpret, reason about, and respond to real-life problems. This generates new knowledge about how existing scientific and engineering models can be intentionally repurposed to develop cognitive capability.

(3) Development of communication solutions, governed by a design theory, to function as cognitive and emotional tools for developing cognitive governance. Unlike conventional communication that primarily transfers information, these communication solutions are intentionally designed to develop mental models, stimulate value-oriented questioning, strengthen cognitive abilities, and ultimately enhance value-oriented problem diagnosis and solving. **The originality lies in establishing design knowledge for intentionally developing cognitive governance through communication**.

(4) Definition and conceptual clarification of key concepts to establish the conceptual foundations necessary for sound value-oriented reasoning, including indoor air quality, healthy indoor air, healthy living, building information modelling, communication, sources of waste, etc. **The originality lies in providing clearer conceptual foundations that enable more consistent reasoning, sound judgement, and value-oriented decision-making across research and practice.** This contributes conceptual knowledge that reduces ambiguity and strengthens the theoretical foundations for value-oriented reasoning.

Considering the four points, my design research generates original design knowledge governing how conceptual foundations can be intentionally integrated and interpreted

within fictional case story communication solutions to enable readers to internalise a transferable way of thinking that develops cognitive governance. In doing so, it provides **upstream readiness** for value-oriented problem diagnosis and solving in scientific research, applied research, and professional practice.

While my work does not primarily produce empirical or field-based engineering evidence, it provides experiential evidence of how people can be guided to think, reason, judge, decide, and act in a value-oriented manner. My fictional case stories facilitate the internalisation of value-oriented thinking through context-relevant mental model development, value-oriented questioning, sound judgement, decision-making, and action for value delivery. Consequently, readers can transfer this way of thinking to diagnose and solve unfamiliar real-world IAQ and sustainable building engineering problems independently.

The primary outputs of my research are communication solutions embodied in the Indoor Air Cartoon Journal, including fictional case stories, visual narratives, original mental models, conceptual frameworks, definitions, and teaching resources. These outputs operationalise the design principles developed through research-as-practice and function as cognitive and emotional tools for engineering education and professional practice.

The primary outcome of these outputs is the development of a transferable way of thinking that strengthens cognitive governance for value-oriented problem diagnosis and solving. This enables learners and practitioners who engage with the communication solutions to develop context-relevant mental models, ask value-oriented questions, exercise sound judgement and decision-making, and diagnose and solve unfamiliar real-world problems in a value-oriented manner.

The primary impact of my scholarship is on my own research and design practice. Through iterative cycles of designing, applying, reflecting upon, and refining communication solutions, the work continuously strengthens the underlying design principles and contributes to the evolution of an emerging design theory of communication solutions for cognitive governance. Each iteration generates practice-based insights that inform subsequent communication solutions, resulting in progressively more coherent, rigorous, and effective designs.

A secondary impact arises when educators, learners, practitioners, industry, and the wider community engage with or adapt the communication solutions. By internalising the transferable way of thinking embedded within them, they can develop cognitive governance for value-oriented problem diagnosis and solving, thereby informing their own educational and professional practice.

To facilitate broader engagement, I developed a teaching note that enables educators to adapt the communication solutions across different disciplines and learning contexts. The

scholarly visibility of the Indoor Air Cartoon Journal is further strengthened through Google Scholar indexing and curation by the SIT Library.

Together, these mechanisms support the dissemination, adoption, and continued scholarly engagement of the communication solutions beyond my own research and design practice. They also support curriculum innovation, professional development, industry and community sensing, and future scholarly inquiry through the identification of cognitive barriers, overlooked assumptions, emerging needs, and contextualised engineering problems.

While evidence of such secondary impacts may emerge through adoption and application in practice, their systematic evaluation lies beyond the primary scope of my research-as-practice programme, which is principally concerned with the iterative design and refinement of communication solutions and the design principles that underpin them.

The significance of this scholarship therefore lies not only in the communication solutions it produces but also in the design principles and design knowledge it generates. Together, these contributions advance an emerging design theory of communication solutions for cognitive governance that can inform future communication design in engineering education and professional practice. In doing so, the scholarship contributes a transferable way of thinking for value-oriented problem diagnosis and solving while providing a foundation upon which future research, educational innovation, and professional practice can build.

Consequently, my scholarship should be evaluated according to the cognitive problems it addresses, the originality and rigour of the design principles it develops, the quality of the communication solutions it produces, and their capability to develop transferable cognitive governance for value-oriented problem diagnosis and solving. It should also be evaluated according to the value these communication solutions create for learners, practitioners, industry, and society.

The primary investment required for this work is intellectual and creative effort rather than extensive laboratory infrastructure or research funding. Accordingly, its contribution is more appropriately assessed through its conceptual originality, practical relevance, educational usefulness, and its contribution to developing transferable cognitive governance for value-oriented problem diagnosis and solving.

In conclusion, my scholarship does not seek to explain teaching and learning phenomena, nor does it seek to investigate unexplained indoor air quality or sustainable building engineering phenomena. Instead, it focuses on the design, development, refinement, and application of communication solutions that strengthen cognitive governance and support value-oriented problem diagnosis and solving.

Through research-as-practice, I contribute an emerging design theory of communication solutions for cultivating transferable cognitive governance. The theory demonstrates how communication can be intentionally designed to develop mental models, stimulate value-oriented questioning, strengthen cognitive capabilities, and support sound judgement and decision-making. Ultimately, it guides value-oriented problem diagnosis and solving across engineering education, professional practice, industry, and the wider community.

Useful links:

Teaching Integration

To support the adoption of the Indoor Air Cartoon Journal in higher education, I developed a teaching note that guides educators in integrating the journal's communication solutions into their academic modules. The teaching note provides practical strategies for using the journal's fictional case stories and communication solutions to reduce cognitive barriers and strengthen value-oriented problem-solving across disciplines.

https://indooraircartoon.com/teaching-note/

Research Methodology

The research methodology underpinning my research-as-practice scholarship and the development of communication solutions in the Indoor Air Cartoon Journal is described at:

https://indooraircartoon.com/research-methodology/

Curriculum Innovation and Educational Impact

The impact of my scholarship on engineering education and curriculum development is further evidenced through Built Environment Artistic Research Sharing (BEARS). BEARS is a scholarly dissemination platform that curates student-generated creative and engineering artefacts as evidence of curriculum innovation, cognitive governance development, and value-oriented problem diagnosis and solving arising from learning activities informed by my scholarship.

https://bearsmof.com