



UC San Diego Cognitive Science

Lu Sun's Dissertation Defense

From Guidelines to Interactive Guidance: AI Systems to Scaffold the Academic Peer Review Ecosystem

Monday, December 1st, 2025

11:00am – 1:00pm, Design & Innovation Building, Room# 306

or <https://ucsd.zoom.us/j/4205509153>

Abstract:

Peer review lies at the heart of scientific communities, serving as the primary mechanism for assessing contributions and improving the quality of research. Yet, the recent exponential growth in submissions has led many venues to rely heavily on novice reviewers who often struggle with the complexity of evaluating, synthesizing, and articulating constructive feedback. Current practices, such as providing static guidelines, offer limited support for navigating the multifaceted and context-dependent nature of scientific authoring and reviewing.

This dissertation explores how intelligent, interactive scaffolding can help novice researchers align better with experts by integrating dynamic, context-aware guidance into their workflow. Drawing on advances in Large Language Models (LLMs), I designed and evaluated a series of systems that deliver tailored contextual scaffolding aimed at different aspects of scientific writing and reviewing. 1) ReviewFlow scaffolds review writing through contextual cues, in-situ knowledge support, and a notes-to-outline synthesis pipeline. A within-subjects evaluation showed that ReviewFlow enabled novices to generate more comprehensive and higher-quality reviews, while also increasing their confidence in the reviewing process compared to writing reviews without scaffolding. 2) MetaWriter uses extractive and generative summarization to scaffold meta-review writing, helping meta-reviewers synthesize diverse and often conflicting perspectives into balanced recommendations. In a mixed-methods study, MetaWriter improved the clarity, comprehensiveness, and confidence of meta-reviews, yet it also revealed risks of diminished reviewer judgment, such as being subject to bias and over-reliance, highlighting both the potential and the pitfalls of AI-assisted reviewing. 3) Going beyond peer review, I developed ScienceJury, a system that scaffolds authors by simulating reviews from a jury of scientific experts. While LLMs can provide quick feedback, their responses often reflect a single perspective and require authors to manually integrate suggestions. ScienceJury offers diverse perspectives within the writing environment to avoid homogeneity and facilitates multi-threaded jury discussions organized by specific issues, enabling authors to explore alternative viewpoints and iterate strategically. By reducing the friction of applying feedback, it fosters diverse, and deeper engagement, advancing inclusive and context-aware scaffolding for knowledge work.

Together, these systems demonstrate how intelligent scaffolding, grounded in users' real-time context within the workflow and augmented by LLMs, can support scientific writing and reviewing by enhancing transparency, efficiency, and reflection. At the same time, this research surfaces important risks and tensions, such as over-reliance, bias, and misplaced trust in AI-generated content, that call for careful design and critical reflection. This work contributes empirical insights, design principles, and computational methods for building human-AI systems that not only scaffold the science writing and reviewing process but also advance more reflective, inclusive, and collaborative forms of knowledge production. Through these studies, we also acknowledge the potential perils and skepticism such systems may raise in shaping how humans reason, create, and produce knowledge with AI.

Committee members:

Dr. Steven Dow (Co-Chair) - UCSD Cognitive Science

Dr. Kristen Vaccaro (Co-Chair) - UCSD Computer Science and Engineering

Dr. Julian McAuley - UCSD Computer Science and Engineering

Dr. Haijun Xia - UCSD Cognitive Science