

Exploring Transdisciplinary Approaches To STEM Teaching and Learning

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Research Questions

How can Transdisciplinary Epistemic Practices (TEPs) provide a conceptual framework for faculty development in a higher education art and design context?

How can faculty use this conceptual framework to design and execute transdisciplinary STEM learning opportunities for all students?

Introduction

To meet the challenges of the 21st Century, students will need to be prepared to operate within transdisciplinary contexts. To meet this goal, our project supports theoretical and applied research on transdisciplinary epistemic practices (TEPs) that bridge ways of knowing in STEM and art/design fields. We begin with previously developed TEP research on STEM and art in informal learning settings. We then develop a TEP framework for higher education designed to increase STEM engagement among non-majors and prepare students to thrive in a transdisciplinary workplace.

Research Process

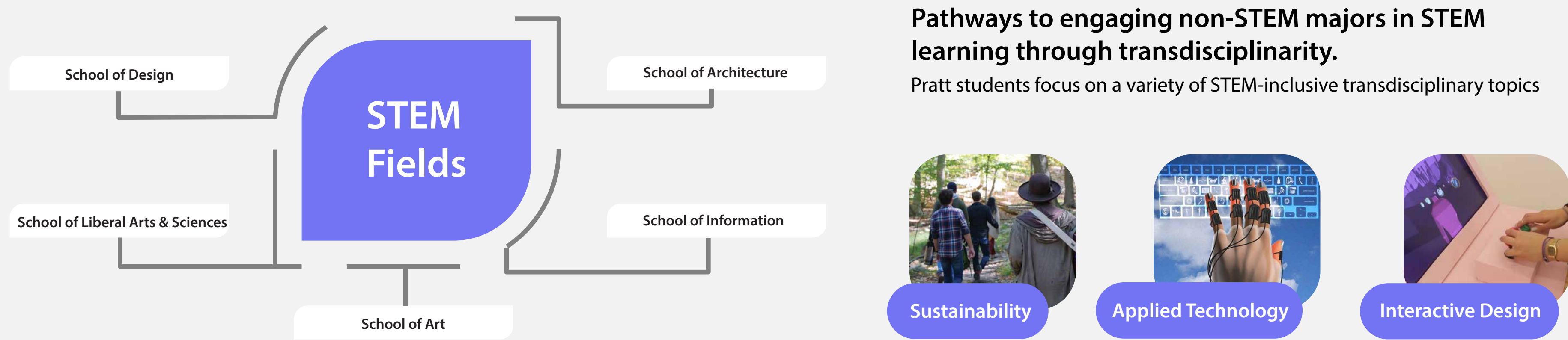
Our project is centered on a transdisciplinary Faculty Learning Community (FLC) composed of 8-12 members from across Pratt's diverse majors, each selected for their inclusion of transdisciplinary STEM in their existing courses. Taking a Scholarship of Teaching & Learning (SoTL) approach, FLC members will use group inquiry, peer observation, and reflection to illuminate best practices for including TEPs in undergraduate courses for art and design students. The Principal Investigators will facilitate the FLC and analyze FLC research to better understand how TEPs in higher education can support STEM learning.

Research Outcomes

Our project will foster three simultaneous research tracks: individual research conducted by FLC members in their courses, collaborative FLC research, and analysis of the FLC research process and findings by the principal investigators. FLC members will design, implement, and share novel learning experiences incorporating TEPs, and the FLC will use peer observation and student interviews/work to identify best practices for incorporating TEPs. The FLC members and PIs will jointly develop a TEP framework for higher education. The PIs will conduct research on the professional development model for supporting TEPs and individual FLC members, sharin and publishing their findings.

Research Context: STEM Courses in Art & Design

All five schools at Pratt include a substantial segment of discipline-based and integrated STEM courses.



Foundational research: Transdisciplinary Epistemic Practices (TEPs)

Our project will build on the foundation created by the TEP framework of Bevan et al. 2019, shown below.

Ways of knowing at the intersection between STEM and art & design



A TEP framework for K-12 informal settings

	STEM PRACTICES	TRANSDISCIPLINARY PRACTICES	ARTS PRACTICES
Exploring	Asking questions/defining problems Planning and carrying out investigations Using mathematical and computational thinking	Noticing and questioning Exploring materiality Defining the problem space	Deep noticing Deconstructing component elements and their respective meanings
Meaning-Making	Developing and using models Analyzing and interpreting data Constructing explanations/designing solutions	Producing tentative representations Conducting principled iterations/revisions Engaging multiple modalities Finding relevance	Applying artistic principles to augment meaning Designing interrelations within and across multiple sign systems Referencing or combining existing works and ideas
Critiquing	Arguing from evidence/peer review Evaluating and communicating findings	Critical historicity; Hacking the ideas of others Cultivating dissent Holding commitments to standards of the field Sharing results/"Audienicing"	Critical historicity; negotiating what constitutes a "good" project Given a particular artistic goal, evaluating how successfully this goal has been met

How to translate TEPs for higher education?

Transdisciplinarity in Pratt courses

Pratt courses taught by FLC members already incorporate a variety of the TEPs, but offer the possibility for cross-pollination across courses.

Courses	Transdisciplinary Practices	Noticing and questioning	Exploring materiality	Defining the problem space	Producing tentative representations	Conducting principled iterations/revisions	Engaging multiple modalities	Finding relevance	Critical historicity	Cultivating dissent	Holding commitments to standards of the field	Sharing results/"Audienicing"
Mixed Realities												
Collaborative Game Design												
Anatomy of Motion												
Carved/Fabbing Studio												
Disrupting Image Manipulation												
Sustainability & Production												
Designed Biologies												
Post-Production												
Concepts of Materiality												
Languages												

Sources
Bevan, Brinways, Kylie Poppler, Mark Rosin, Lynn Scarff, Elizabeth Soep, and Jen Wong. 2019. "Purposeful Pursuits: Leveraging the Epistemic Practices of the Arts and Sciences in Converting STEM into STEM Programs." edited by Arthur J. Stewart, Michael P. Mueller, and Deborah J. Higgins. 521-38. Environmental Discourses in Science Education. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-25101-7_3
Pisk, L. Dec. 2013. Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses. Revised and Updated edition. Jossey-Bass Higher and Adult Education Series. San Francisco: Jossey-Bass.

Why Transdisciplinary Epistemic Practices?

Pratt students already produce an abundance of STEM-inclusive transdisciplinary work, demonstrating the potential in formalizing the TEP approach.

- Students need to be prepared for a transdisciplinary work environment.
- TEPs are a potential way to foster STEM engagement by non-STEM majors.

Transdisciplinary Ideas in Student Work from MSCI Courses



Image Credits

Industrial Design via gallery G006
Architecture Mihai Dumitrescu + Brandon Spinoso
Interior Design Yui Wu
Applied Technology Griffin Reynolds
Interactive Design Karl Munsdtadt

Student Projects

Evaluation of cranial appendages in the conividae and bovidae families by Y G Guntner
Hexapod Bee Forage Hunter by Audrey Korneseder

Research Plan

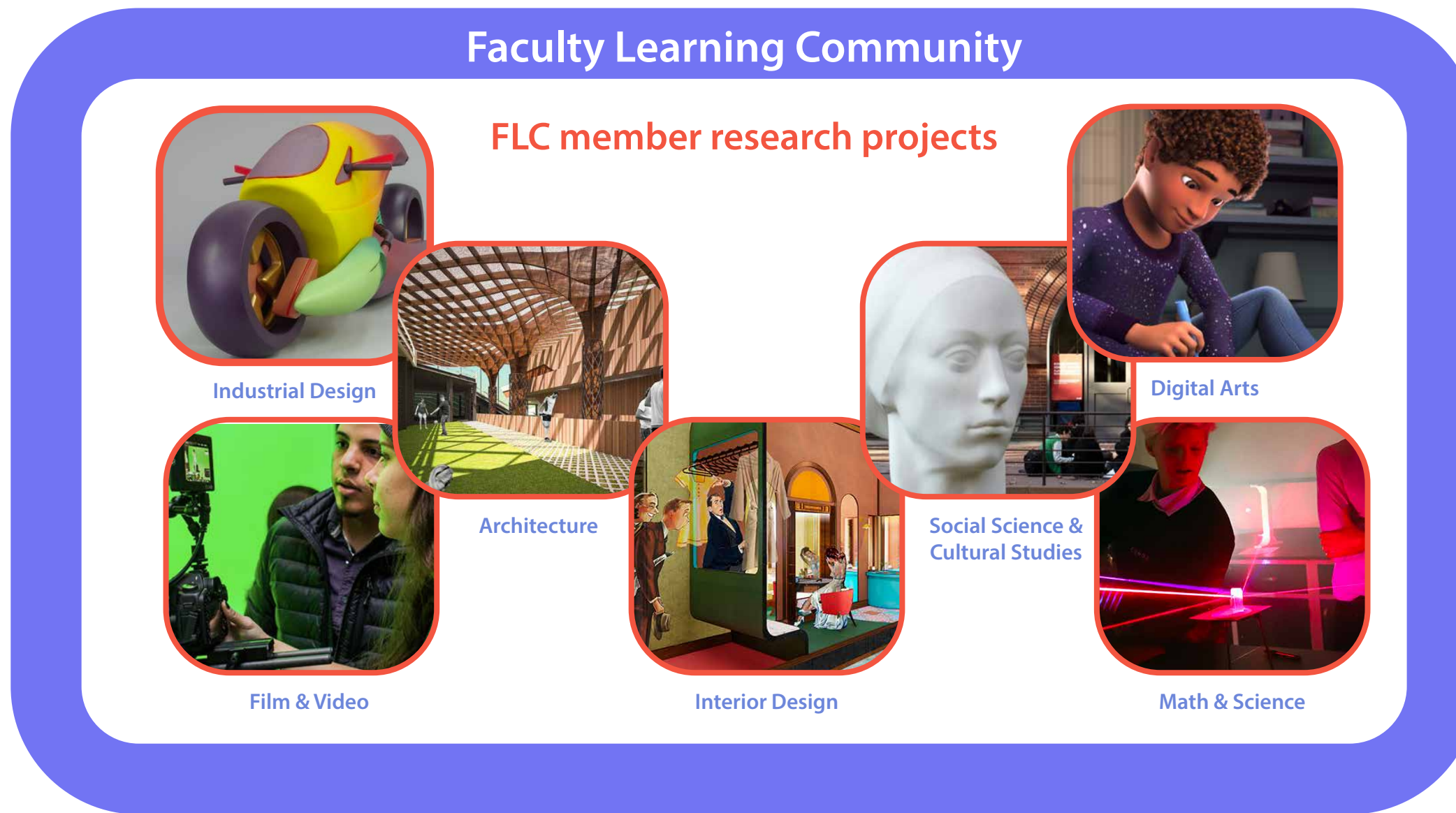
A Transdisciplinary Faculty Learning Community (FLC)

The project will convene a faculty learning community of 8-12 members from across the five schools at Pratt.

Simultaneous Research Tracks

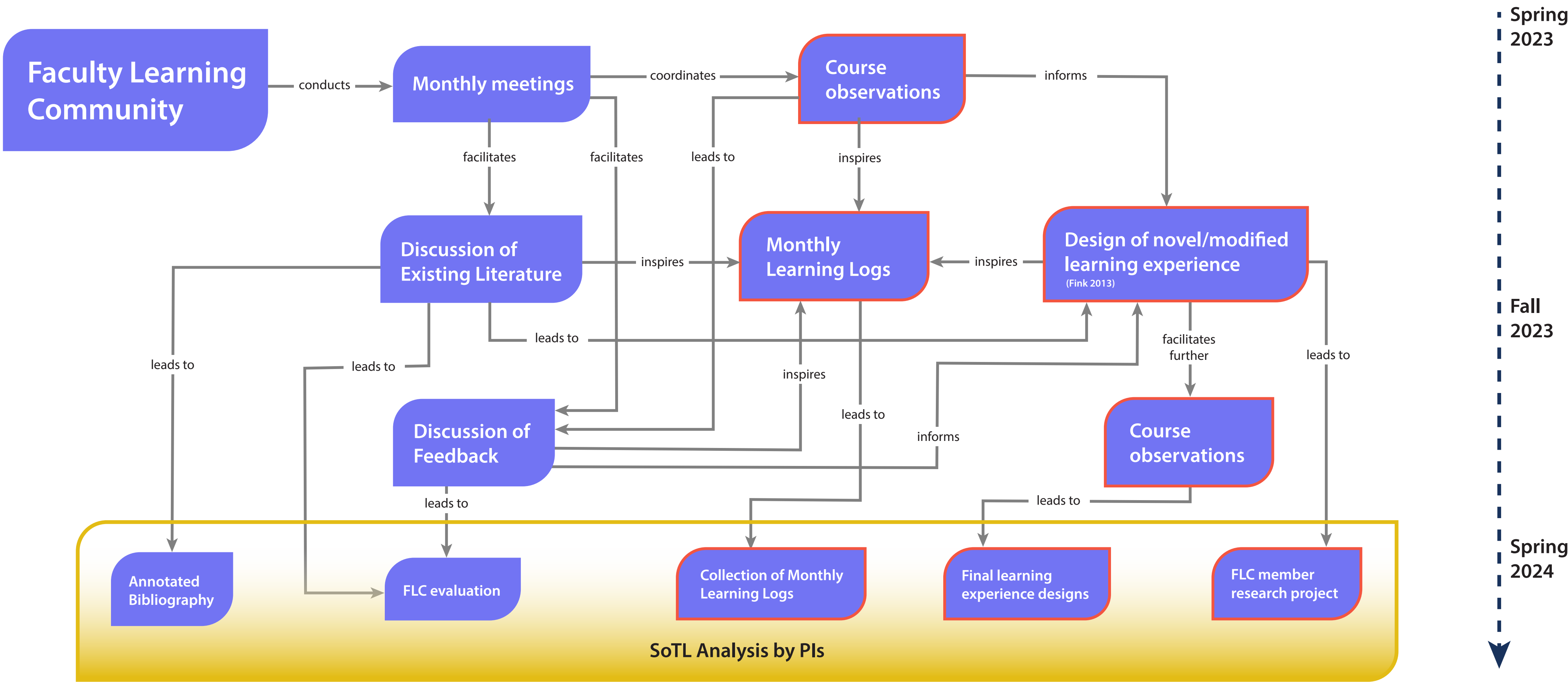
The members of the FLC will each be conducting their own pedagogical research project using TEPs, while the PIs will be conducting research on the FLC, its use of TEPs, and its findings.

PI Research on the FLC



SoTL (Scholarship of Teaching & Learning) approach

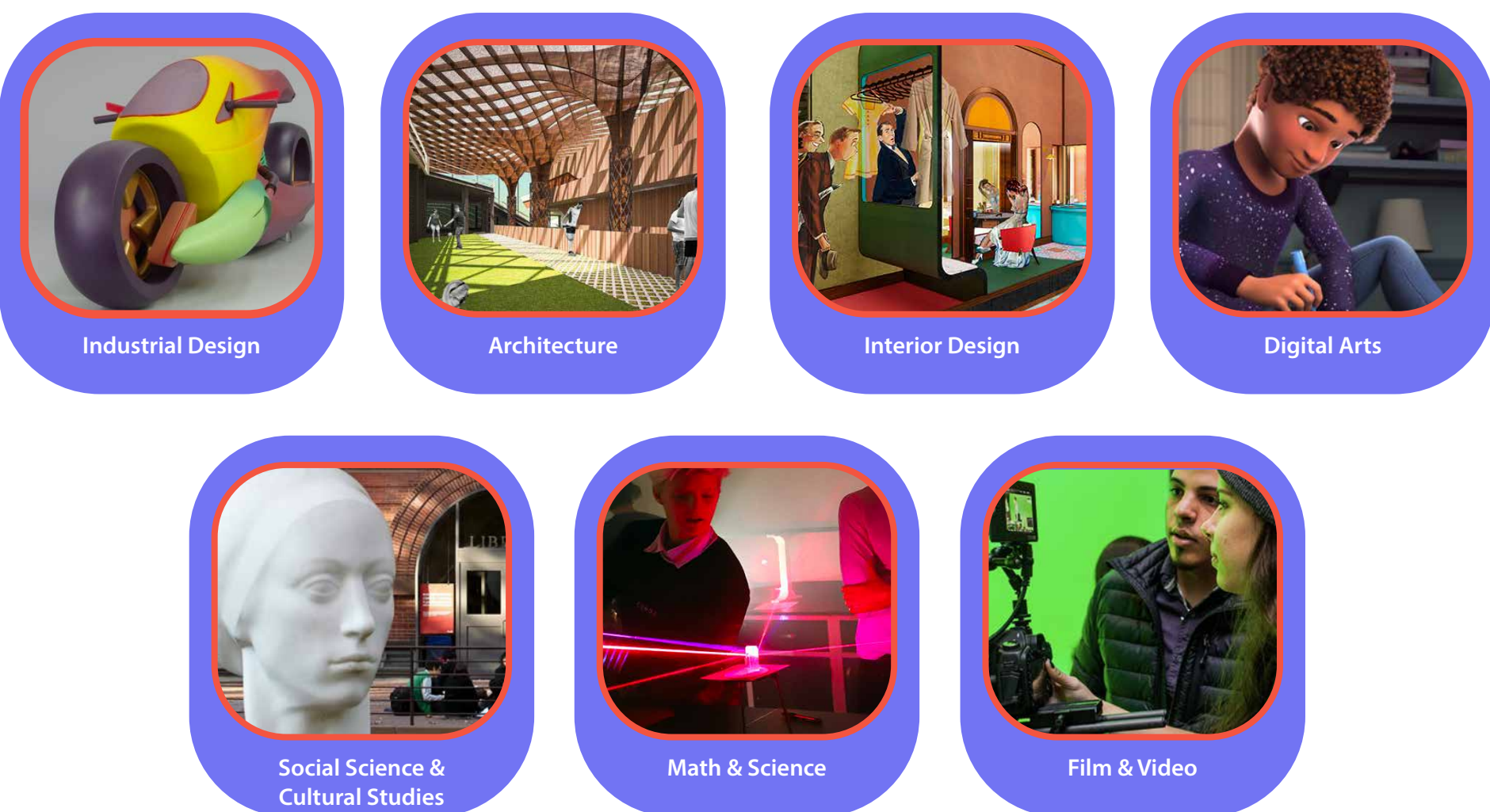
Our project is centered on a faculty learning community (blue shapes), composed of faculty (shapes outlined in red), who offer STEM-inclusive transdisciplinary courses.



Research Outcomes

The project will produce scholarship from FLC members, from the FLC as a whole, and from the Principal Investigators.

FLC member research projects



PI SoTL publication on FLC and STEM-inclusive transdisciplinarity

PI analysis of TEPs for higher education

FLC overall analysis of TEP findings

Pratt

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