Closing Equity Gaps: Identifying How an Ecological Belonging Intervention in Engineering Affects Students

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BELONG COLLABORATIVE
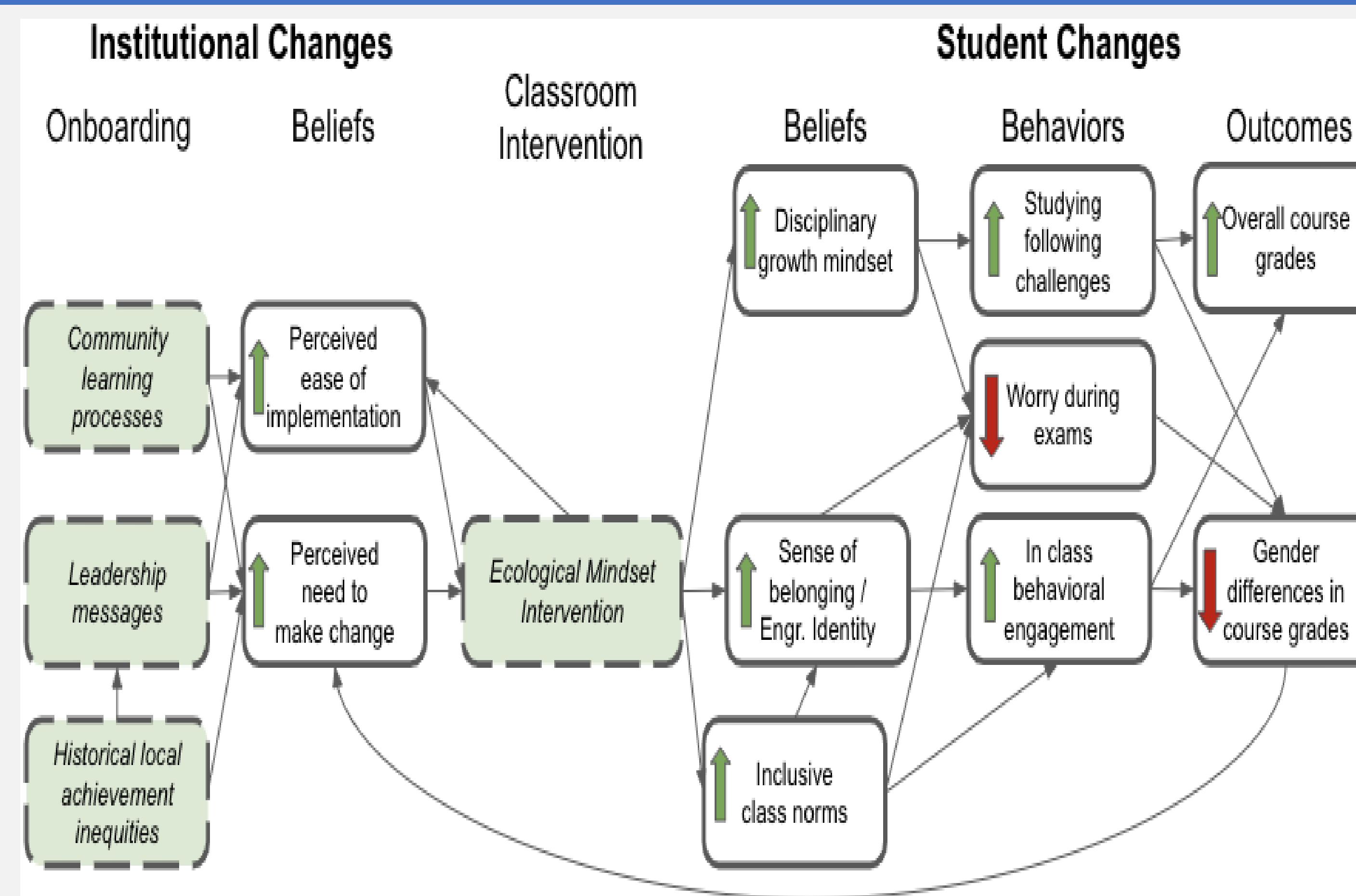Transforming Higher Education

Project Summary

Our grant – *Course-based Adaptations of an Ecological Belonging Intervention to Transform Engineering Representation at Scale* – uses an **ecological belonging intervention** approach (Binning, et al., 2020) that requires **one-class or one- recitation/discussion session** to implement and has been shown to erase long-standing equity gaps in achievement in introductory STEM courses. However, given the wide social and cultural heterogeneity across U.S. university contexts (e.g., differences in regional demographics, history, and political climates), **it is an open question if and how the intervention may scale.**

This project brings together an interdisciplinary team of higher education scholars, psychologists, and disciplinary specialists from across three strategically selected universities – University of Pittsburgh (Pitt), Purdue University, and University of California, Irvine (UCI) - to design, test, and iteratively improve an approach to systematically **identify which first and second-year courses would most benefit from the intervention**, **reveal student concerns** that may be specific to that course, **adapt the intervention** to address those concerns and evaluate the universality versus specificity of the intervention across university contexts.

This systematic approach also **includes persuasion and training processes for onboarding the instructors** of the targeted courses. The instructor onboarding and the intervention adaptation processes are **guided by a theory-of-action** that is the backbone of the project's research activities and iterative process improvement. A synergistic mixture of qualitative and quantitative methods are used throughout the study.

Research Questions - Students

RQ1: How do **students**, with a focus on minoritized students (i.e., Black, Latinx, and Indigenous students, women and non-binary students), **describe** their lived **experiences** in **courses** that show demographic-based achievement differences?

RQ2: How does the **ecological belonging intervention** change **students' feelings of belonging** in the course, their disciplinary-based growth mindset, and **perceptions of** academic **norms** in the course, major, and engineering overall?

RQ3: What **effect** does the **intervention** have on short- and long-term academic success as measured by **achievement** (course-specific, overall GPA) and choice (retention, engineering career pathways)?

Investigations of the Theory of Action

Institutional Changes — Onboarding, Beliefs, Classroom Intervention
Student Changes — Beliefs, Behaviors, Outcomes

The Nature and Structure of Learning Engagement
McChesney et al. (under review)
Method: 3,003 STEM students, 7 courses, 3 institutions
Analysis: Exploratory, confirmatory, and comparative factor analysis
Findings Highlights: STEM learning engagement depends on the activity space in which it occurs (e.g., exam studying, recitation, group work) as well as behavioral/cognitive distinctions
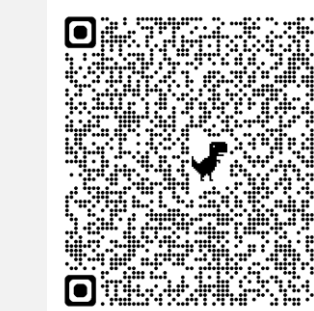
How Virtual Learning Impedes Women Students' Belonging in Engineering
DeAngelo et al. (2024)
Method: 22 engineering students, 7 focus groups
Analysis: Thematic analysis
Findings Highlights: Virtual learning negatively impacted the development of women engineers' sense of belonging
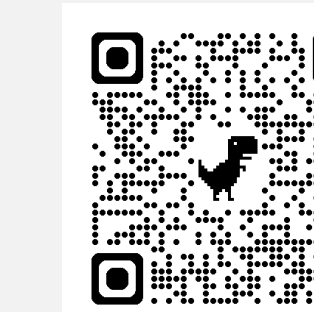
Engineering Students' Description of Challenges in a First-Year Programming
Rhode et al. (under review)
Method: 29 students in 6 focus groups, 2 institutions
Analysis: Thematic analysis
Findings Highlights: Peer comparisons, gendered interactions, and team conflicts form barriers to underserved engineering student success

Supporting Continued Engineering Enrollment
Bahnson et al. (under review)
Method: 1185 engineering students, 1 institution
Analysis: Multigroup SEM path analyses
Findings Highlights: Intervention is correlated with increased enrollment for BLI students

Belonging in Engineering for Black, Latinx and Indigenous Students
Godwin et al. (2023)
Method: 691 engineering students, 1 institution
Analysis: Repeated-measures ANCOVA
Findings Highlights: Intervention is correlated with increased belonging and higher grades for BLI students

A Narrative Analysis of BLI Sense of Belonging in Engineering at a PWI
Dorvè-Lewis et al. (2023)
Method: longitudinal interviews with 8 BLI engineers, 1 institution
Analysis: Narrative analysis
Findings Highlights: Engagement in a range of communities helps mitigate the negative effects of identity-related obstacles and increases belonging

Race/Ethnicity and Gender Differences in First-Year Engineering Identity
Bahnson et al. (in press)
Method: 834 engineering students, 1 institution
Analysis: SEM path analysis
Findings Highlights: Engineering identity is predicted by self-efficacy, disciplinary interest, and sense of belonging

First-year Women's Interpretations of Self-efficacy after a Belonging Intervention
Nortz et al. (in press)
Method: in-depth interviews with 4 women, 1 institution
Analysis: Thematic analysis
Findings Highlights: Intervention exposure may positively alter meaning-making processes around self-efficacy and -concept

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