# Mentoring, Belonging, and Feedback Loops: A System Dynamics Model of Foundational Mathematics Course Coordination

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Coordinated collegiate mathematics courses are complex systems wherein social dynamics, mentoring structures, and institutional factors shape how graduate student instructors (GSIs) approach teaching. We focus on eight faculty members who coordinate and teach foundational math courses (FMCs) taught by GSIs (Rogers & Long, 2025), including College Algebra, Precalc, Quantitative Reasoning, Intro Statistics, Math for Architecture & Construction, Math for Elem. Teachers, & Calculus. We hypothesize how implementing professional development (PD) focused on teaching math through active-learning (AL) strategies (Freeman et al., 2014; Laursen & Rasmussen, 2019) for FMC coordinators can enhance their sense of belonging and increase their use of AL in teaching and course coordination. We assess sense of belonging with a modified version of the survey developed by Sidney et al. (2025). Our study considers: (1) How do course coordinators' orientations toward humanistic growth (Martinez et al., 2022) shape their GSI mentoring and engagement with AL within PD contexts? (2) How does course coordinators' participation in PD influence their sense of belonging and relate to evolving approaches to mentoring and instructional change? Together, these RQs lead to: *What interrelated mechanisms among coordinators' humanistic orientations, mentoring structures, and experiences of belonging support emergence and maintenance of meaningful instructional change in FMCs?*

To explore these foci, we developed a qualitative system dynamics model using Vensim simulation software (Mohaghar et al., 2017). By thematically analyzing course coordinators' dialogue and surveys, we found 12 key constructs shaping the FMC coordination landscape; we list the six most prevalent: *Shared Time*, *Resource Accessibility*, *Communication Channels*, *Recognition Events*, *Workload Policy Support,* and *Barriers to AL*. We organized the 12 constructs into five key areas of influence, i.e., system stocks: *AL Use in Coordination*, *Humanistic Growth (HG) Coordinator Orientation*, *Mentoring Structure*, *Instructor Belonging*, and *Exclusion Among Instructors*. We then mapped feedback loops for how these areas interact:

- *Mentoring Loop*: how shared time, trust, and modeling reinforce effective mentoring
- *HG Orientation Loop*: how values and coordinator identity sustain reform
- *Exclusion Brake*: structural barriers that disrupt coherence and inclusion

Our model highlights how mentoring and coordination are not isolated interventions, but dynamic systems shaped by institutional conditions and relationships. When policies support HG mentoring goals and create a collaborative space, FMC instructors are more likely to use AL strategies and experience a stronger sense of community. Conversely, when access, time, or recognition are constrained, exclusionary pressures can dampen change efforts. Rather than presenting coordination as a fixed structure, this model conceptualizes it as a responsive system whose trajectories can shift depending on feedback dynamics, institutional levers, and interpersonal trust. By using system dynamics modeling, we visualize how instructional change emerges through interconnected loops of mentoring, belonging, and institutional structure. The framework makes visible both leverage points and tensions within departmental systems and offers a way to design mentoring structures that are equity-minded, sustainable, and context-sensitive; insights that can inform future PD programs and coordination policies.

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