

SEMINAL: A Project Studying Active Learning Mathematics at Different Institutions

Wendy M. Smith & Molly Williams, Center for Science, Mathematics & Computer Education
Allan Donsig & Nathan Wakefield, Department of Mathematics

Collaborative Research: NSF I-USE Grant

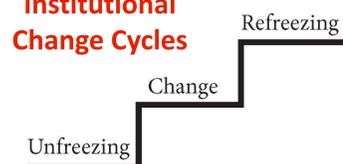
- 5-year, \$3 million, 2016-2020
- APLU (Association of Public and Land-grant Universities (Howard Gobstein)
- University of Colorado Boulder (David Webb, Rob Tubbs, David Grant)
- University of Nebraska-Lincoln (Wendy Smith, Allan Donsig, Nathan Wakefield)
- San Diego State University (Chris Rasmussen, Michael O'Sullivan, Janet Bowers)

Goal: better understand how to enact and support institutional change aimed at implementing active learning in undergraduate mathematics learning environments

Research Study:

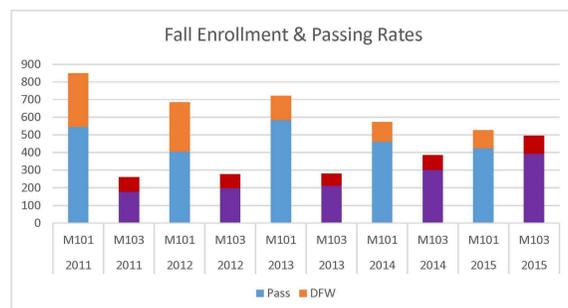
- Design research methodology
- Case studies
- Build theories of institutional change, studying successful and attempted changes
- Catalyze change
- Grounded in Networked Improvement Community
- Commitment to Active Learning Mathematics (ALM)

Institutional Change Cycles

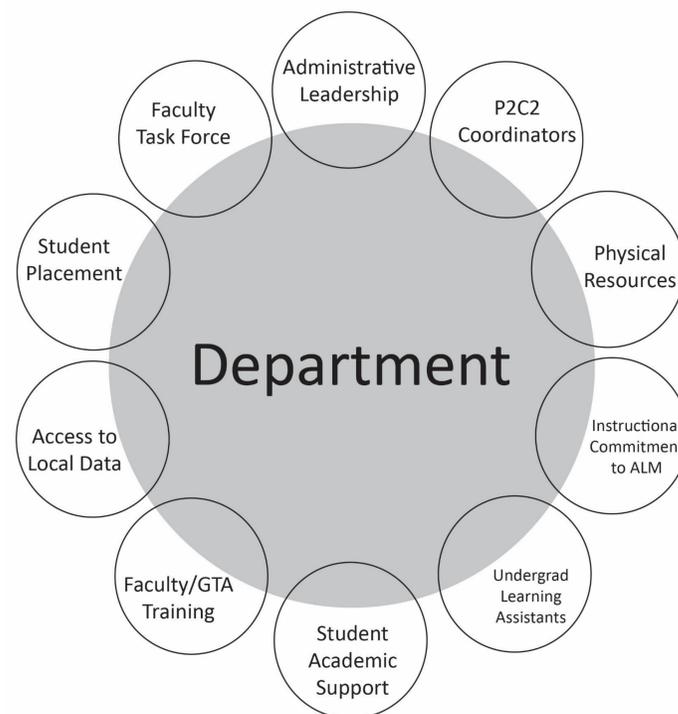


Freshmen Retention

- 67% of UNL freshmen enroll in math in their first semester
- No other dept garners even half that
- Initial UNL efforts: Math 101 & 103 (precalculus) then Math 100A (int. algebra), 102 (trig)
- DFW rates dropped from 40% to a stable 20% in precalculus
- Efforts now being extended to calculus courses (Math 104, 106, 107)

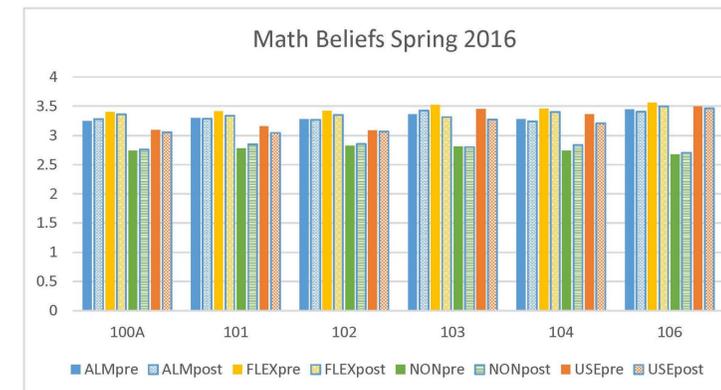


Institutional change requires concurrent attention to multiple key features (Kezar, 2014)



Understanding Our Students

Survey: usefulness of, beliefs about & orientation toward mathematics & active learning



Undergrads in active learning environments can learn more effectively, resulting in increased achievement and improved dispositions (Freeman et al., 2014; Laursen et al., 2014; Rasmussen & Kwon, 2007), particularly for underrepresented groups (Laursen et al., 2011)

Primary Research Question: What conditions, strategies, interventions and actions at the departmental and classroom levels contribute to the initiation, implementation, and institutional sustainability of active learning in the undergraduate calculus sequence (Precalculus through Calculus 2—P2C2) across varied institutions?

Phase 1: 6 Retrospective Case Studies

- Diverse sites include land-grant, Hispanic-serving and historically black universities
- Site visits of successfully transformed Mathematics Departments
- Extensive interviews, observations, and student success data

Phase 2: 9 Transformation Case Studies

- Will select diverse sites that exhibit will to change
- Incentivized case studies to induce & support departmental transformation
- Extensive interviews, observations, and student success data

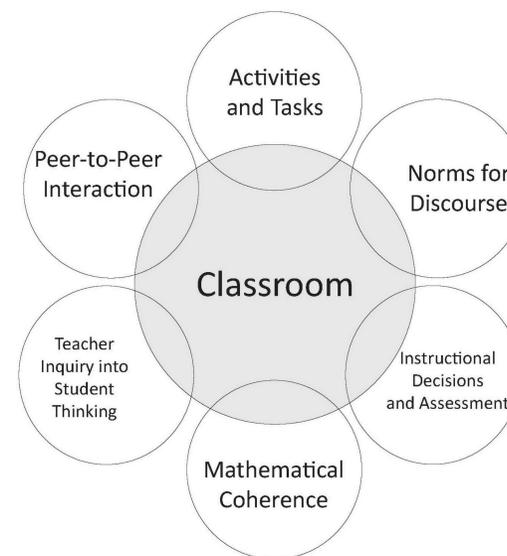
Active Learning of Mathematics: Teaching methods and classroom norms that promote:

- (1) students' deep engagement in mathematical reasoning
- (2) peer-to-peer interaction
- (3) instructor inquiry into student thinking.

Curriculum should focus on key mathematical ideas (sense making & procedural fluency)

Students propose questions, communicate reasoning, & share solutions in process.

Instructors promote student engagement & build on student thinking.



Broader Impacts

- Improve student success in math
- Impact STEM majors & careers
- Prepare future faculty (GTA training)
- Networked Improvement Community as model for departmental transformation & vehicle for scale-up

References

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, 111 (23). Retrieved from www.pnas.org/doi/10.1073/pnas.1312446111

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