Empirical Evidence of Elements that Positively Impact STEM Retention

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Partnership for Retention Improvement in Mathematics, Engineering, and Science

PRIMES Project Overview

PROJECT GOAL

Increase by 25% the number of STEM baccalaureate degrees awarded in biology, chemistry, engineering, geosciences, mathematics, and physics and astronomy by 2016.

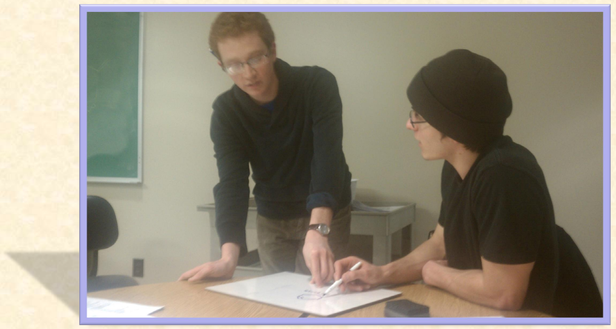
PROJECT STRATEGIES

PRIMES has 2 evidence-based project strands focused on the retention of STEM majors :

- **Transform teaching and learning** in STEM introductory courses. Improve retention by training and supporting cohorts of undergraduate teaching assistants (UTAs) that can serve as effective peer mentors equipped to better engage novice STEM learners.
- **Increase faculty-student interactions** and build a sense of both community and science identity among STEM majors. PRIMES will facilitate these interactions by sponsoring social and academic meetings by STEM Recognized Student Organizations and by hosting campus-wide STEM events.

PROJECT IMPLEMENTATION: UTA STRAND

- Creation and institutionalization of 9 STEM Practicum courses across 2 Colleges for enrolling UTAs.
- Collaborative training of UTAs via workshops and seminars with an emphasis on *experiencing* and *distilling* best practice strategies such as formulating guiding questions, addressing student preconceptions, using formative assessments, & promoting metacognitive learning.



- Supporting UTAs' pedagogical growth throughout the semester as they assume teaching assistant positions in recitations, teaching laboratories, or as leaders in peer-group supplemental instructional settings.

Project-Level Research Questions

1) What is impact of PRIMES on UTAs (cognitive, pedagogical, identity)?
2) What is the UTA impact on academic achievement of entry-level STEM majors?
3) What is the UTA impact on STEM degree persistence of entry-level STEM majors?
4) What is the UTA impact on STEM identity development of entry-level STEM majors?
5) What is the overall project impact on the institution (faculty, structures, culture)?

Student Impact Study: Detailed GenChem Example

STUDY-LEVEL RESEARCH QUESTIONS

1) Impact of UTAs on student academic achievement
2) Impact of UTAs on student persistence in STEM
3) Impact of UTAs on student STEM-identity

SAMPLE

594 CHEM 201 students (284 UTA treatment in 14 recitation sections; 310 in GTA comparison in 15 sections)

RESEARCH DESIGN & DATA & ANALYSIS

- Quasi-experimental treatment-comparison; random assignment
- Achievement = common final exam; Persistence = enroll in CHEM 202
- Post-survey on STEM identity
- Multi-level modeling (HLM) controlling for ACT & college GPA for achievement analysis. Logistic regression for persistence analysis

RESULTS

- Achievement: 8.5% higher final exam with UTA for those above GPA mean
- Persistence: 3 times more likely to enroll in CHEM 202 with UTA
- STEM Identity: Stronger STEM identity with UTA

Opportunity

- PRIMES success has created interest in education research among STEM faculty.
- The Leadership Team is helping STEM disciplinary faculty frame department-specific research studies on UTA impacts.

Project Impact Summary

IMPACT ON UTAs

- Stronger metacognitive learner
- Deeper understanding of foundational concepts in discipline
- Improved teaching & communication skills

IMPACT ON STUDENTS

- Stronger achievement, persistence, STEM identity (see detailed study example)
- Dosage effect – the more UTA semesters, the stronger the academic achievement impact (0, 1 or 2 semesters across CHEM 201 and CHEM 202)

IMPACT ON INSTITUTION & FACULTY

- Structured Practicum courses in each of 9 STEM departments
- Enhanced faculty conversations about pedagogical techniques (e.g. questioning, mental models)
- UTAs becoming highly desirable resource for faculty
- Integration of UTA-training elements into GTA-training in some departments

Next Steps

- Dept.-level studies across multiple STEM departments.
- Converging on various effective UTA-implementation approaches tuned to fit within existing departmental structures.
- Ongoing cross-departmental faculty conversations about supporting STEM students, including seeking additional external resources to advance these initiatives.

Project support provided by the National Science Foundation