Curricular Reform as Institutional Transformation: Infusing Active Learning into Introductory Life Science Courses

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Purpose

• Examine the extent to which active-learning is associated with learning in introductory Science, Technology, Engineering, and Mathematics (STEM) courses.

• Examine whether active-learning strategies disproportionately benefit learning among underrepresented racial minority (URM) students.
Landscape of STEM Education at UCLA

28,674 undergraduates enrolled (55% female, 22% URMs)

STEM: Life Science, Physical Sciences, Mathematics, Engineering students seeking B.S. degree (excludes Nursing, social science, and undeclared students)

URM: American Indian or Alaskan Native, Black Non-Hispanic, or Hispanic Domestic Student

SOURCE: UCLA Office of Analysis & Information Management (AIM), Fall 2013
UCLA Persistence Trends in STEM Majors

- Continuous loss of students from STEM majors
- Disproportionate loss of URM students compared to non-URMs
UCLA Graduation Trends Among STEM Majors

- Disproportionate percentage of...
  - URM completers compared to non-URMs
  - URM switchers to non-STEM majors compared to non-URMs
  - URM do not complete their degree as compared to non-URMs

N=1,526
N=251

What’s prompting students to switch to non-STEM majors or leave STEM all together at UCLA?
UCLA Faculty’s Teaching Methods

These items measure the frequency with which faculty utilize the following pedagogical methods in their courses.

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**Class discussions***
- STEM Faculty: 54.2%
- Non-STEM Faculty: 64.0%

***p < 0.001

**Cooperative learning (small groups)**
- STEM Faculty: 29.2%
- Non-STEM Faculty: 34.9%

***p < 0.01

**Extensive lecturing***
- STEM Faculty: 36.5%
- Non-STEM Faculty: 19.5%

***p < 0.05

**Using real-life problems***
- STEM Faculty: 30.3%
- Non-STEM Faculty: 25.0%

***p < 0.05

**Grading on a curve***
- STEM Faculty: 33.9%
- Non-STEM Faculty: 11.0%

15.8%

***p < 0.001, **p < 0.01, * p < 0.05

2014 HERI Faculty Survey
Teaching Methods

These items measure the frequency with which faculty utilize the following pedagogical methods in their courses.

- **Class discussions**: 16.1% frequently, 43.0% occasionally, 54.2% rarely
- **Cooperative learning (small groups)**: 21.4% frequently, 31.7% occasionally, 29.2% rarely
- **Extensive lecturing**: 29.1% frequently, 39.7% occasionally, 36.5% rarely
- **Using real-life problems**: 25.0% frequently, 45.8% occasionally, 30.3% rarely
- **Grading on a curve**: 15.8% frequently, 16.1% occasionally, 33.9% rarely

***p < 0.001, **p < 0.01, *p < 0.05

2014 HERI Faculty Survey
Enhancing Faculty Pedagogy

Hire Discipline-Based Educational Researcher (DBER) fellows

DBER Fellows worked with lecturers and ladder faculty to develop student-centered lesson plans, write clicker questions, and facilitate student-centered practices in the classroom.

Provide faculty and research team with formative and summative feedback about this transition.
Campus-Wide Partnership

Chair of the life sciences core
Director of the Center for Educational Innovation in the Life Sciences
Associate Dean of the Life Sciences for Academic Programs
Managing Director of the Higher Education Research Institute
Faculty in the life sciences
DBER fellows
Institutional research representatives
Data Collection

• Classroom Observation Protocol for Undergraduate STEM (COPUS)*

• Graduate student observers
  • Characterize how faculty and students spend their time
    • Faculty: Lecturing (Lec), posing a question (PQ), clicker question (CQ)
    • Students: Listening (L), student question (SQ), worksheet group work (WG)

• Two-minute intervals
• Introductory Life Science courses
• Summarize the extent of teaching and learning practices

*Smith, Jones, Gilbert, & Wieman (2013)
Data Collection cont.

• Pre/post concept tests
  • Direct measurement of student learning by pedagogy

• Pre/post student surveys
  • Measure students’ self-efficacy to think and act like scientists
  • Experiences in the course

• UCLA Registrar’s Office
  • Retention in STEM major
  • Course grades
Results
Figure 1. LS2 Concept Test Scores by URM Status and Pedagogy
Figure 2. LS3 Concept Test Scores by URM Status and Pedagogy
Figure 3. LS4 Concept Test Scores by URM Status and Pedagogy
Figure 7. LS2 Concept Test Scores by First-Generation Status and Pedagogy
Figure 8. LS3 Concept Test Scores by First-Generation Status and Pedagogy
Figure 9. LS4 Concept Test Scores by First-Generation Status and Pedagogy
Implications and Next Steps

Highlighting findings with team
- Encourage faculty to persist with use of active learning strategies
- Review COPUS findings about extent of student-centered teaching in active and flipped classrooms

Enhancing faculty teaching practices in other divisions

Disseminating results more broadly