

Planning Transformation of STEM Education in a Research University

G. Meisels, R. Potter, P. Stiling, J. Lewis,
C. Beneteau, K. Yee, R. Pollenz

supported by USF and NSF-DUE 1347753
Widening Implementation and Deepening Educational Reform
(WIDER)
Planning Grant



University of South Florida

Characteristics

- Carnegie: Research very high, community engaged university; (50th in research expenditures)
- Main campus: Tampa Florida
 - >30,000 undergraduates
 - 55% female, 45% male
 - Diverse student body:
 - 7% Asian, 11% Black, 20% Hispanic, 53% White, 5% Int.

Planning Processes

- Developing a common vision and process for change
- Data gathering and analysis (student pathways)
- Analysis of institutional context and relevant policies
- Developing short term action plans for a grant-sponsored seminar series, faculty learning community, Advisory Board
- Evolving a longer term action plan for change
 - based on institution-specific data
 - capitalizes on knowledge and momentum of seminar
 - builds on current instructional success and expertise
 - identifies resources external and internal to support the change needed

Vision and Mission of Planning

Vision:

A comprehensive plan whose implementation will lead to all students enrolled in STEM courses at USF being encouraged and supported so that they become and remain proficient STEM majors.

Mission:

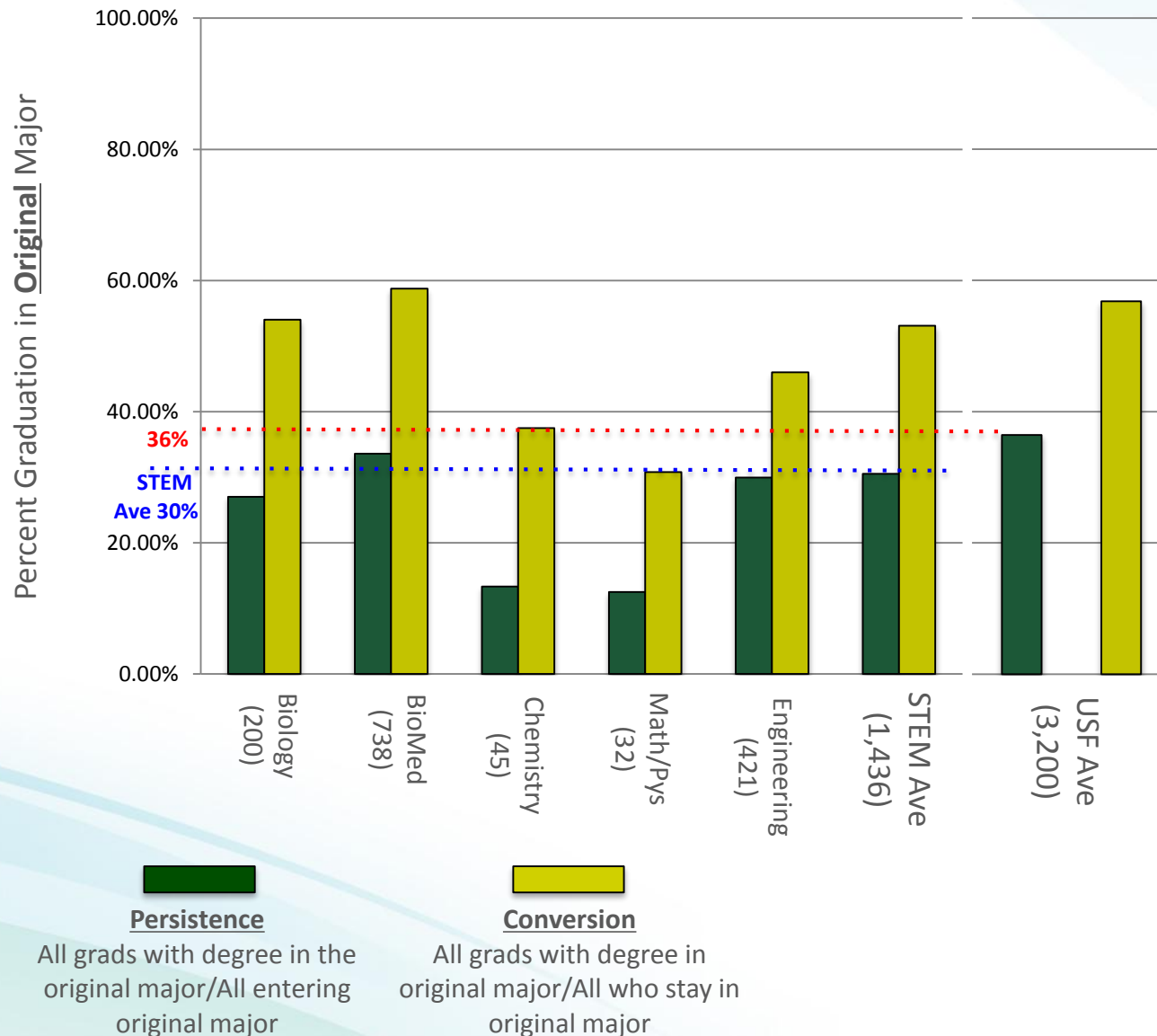
Create a plan for increasing the number of well-prepared graduates, especially those in under-represented groups, in the STEM disciplines

Scope of Institutional Data Analysis

Full First Time In College (FTIC) Cohorts 2006 and 2007

- **Full FTIC Population with a Declared Major at Entry (~7,000 student records)**
 - Entry major, major changes, major at last enrollments status (graduation)
 - Persistence and Conversion across all disciplines
 - Demographics
- **Full STEM FTIC Population (2,958 student records)**
 - Gain and loss from all STEM majors
 - Persistence and Conversion
 - Demographics
- **Biology/Biomedical Sciences Population (1,944; 67% of entering STEM FTIC)**
 - Academic progression analysis for all students who left Bio/BMS and earned non-STEM USF degree (553 student records)
 - Degree attainment for all students who left USF from the Bio/BMS majors (595 student records)

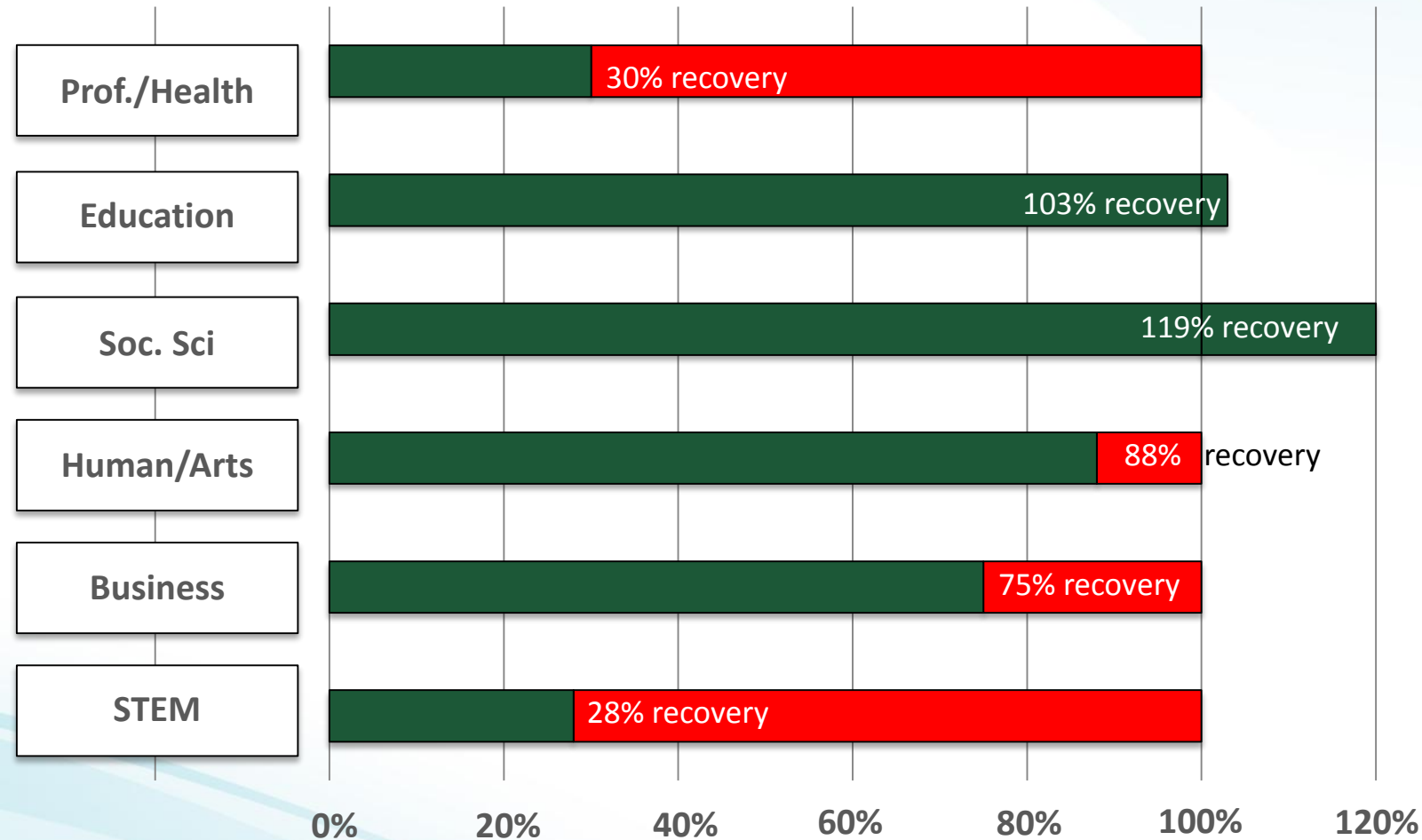
Persistence and Conversion in STEM Majors (2007 Cohort)



Key Finding

Average persistence for ALL FTIC in initial majors is 36%

Recovery of Student Loss by Discipline



Key Finding

Small recovery of lost majors in STEM compared to other majors

Academic Progression of Lost STEM Majors Who Earned a USF Degree

	Credentials of Students (HIGH)	Credentials of Students (MEDIUM)	Credentials of Students (LOW)
Academic Progression Rubric Score	> + 4 points	< +4 to > -2	< -2 points
N and Percent of Total Students	169 (30.4%)	264 (47.7%)	121 (21.9%)
Q SAT Average	575	522	525
STEM Courses Taken Before Change	7.27	3.37	7.38
Average Score/Course	1.25	0.15	-1.03
Took Calculus Before Change	58.0%	11.0%	5.8%
Took Biology I Before Change	54.8%	25.8%	37.2%
Total Hours at Change	60.73	41.33	60.43
Total Semesters Before Change	5.13	3.51	5.72
GPA at Major Change	3.26	2.94	2.59
Number of Major Changes	1.18	1.27	1.29
GPA at Graduation	3.36	3.11	2.81
USF Credits at Graduation	137.93	127.25	129.27
Time to Degree (yrs)	4.28	4.19	4.71

Key Finding

A large population of students who are making high academic progression leave the majors



Planning Team

- Catherine Beneteau, Mathematics & Statistics, co-PI
- Scott Campbell, Chemical Engineering
- Allan Feldman, Science Education
- Gladis Kersaint, Mathematics Education and Associate Dean of Education
- Randy Larsen, Chair of Chemistry
- Jennifer Lewis, Associate Chair Chemistry, co-PI
- Gerry Meisels, Coalition for Science Literacy and Chemistry, PI
- Richard Pollenz, Cell, Molecular, and Micro Biology and Associate Dean of Undergraduate Studies
- Robert Potter, Chemistry/Biochemistry and Associate Dean, College of Arts and Sciences, co-PI
- Les Skrzypek, Chair of Mathematics and Statistics
- Peter Stiling, Past Chair of Integrative Biology, Special Faculty Assistant to the Provost for STEM Initiatives co-PI
- Kevin Yee, Director Academy for Teaching and Learning Excellence

Adventures in Planning

- **Develop common language and goals**
 - Team met at least biweekly and at Seminars (80% attendance throughout)
 - Diversity of backgrounds and experiences essential
- **Implementation plan evolved from our team's diverse expertise, continuing discussions and our collective learning from speakers.**
 - Seminar series to build awareness and momentum for change (40-80 attendance 150 different people)
 - Faculty learning community (15-20 faculty and graduate students) facilitated exploration of evidence based practice
 - Policy analysis (identify beneficial and detrimental)

Carefully Selected Seminar Speakers And Topics

- Dr. Adrianna Kezar USC (December 10, 2013)
STEM Education, Shared Leadership, and You
- Dr. Vasti Torres USF (January 14, 2014)
Do Students Under-represented in STEM Experience the Learning Environment Differently?
- Dr. Richard Pollenz USF (February 18, 2014)
Understanding Institutional Data Can Inspire University-Wide Adoption of Evidence-Based Practices in STEM Education
- Dr. George Kuh IU (March 5, 2014)
Fostering STEM Student Engagement: What Matters
- Dr. Melanie Cooper MSU (April 18, 2014)
Evidence-Based Approaches to STEM Education

Year two seminar series

- Dr. E. William Wischusen LSU (Sept. 9, 2014)
Impact of a Pre-Freshman Boot Camp on Student Performance
- Dr. Jay Labov NAS-NRC (Oct. 8, 2014)
The Changing National Landscape of Undergraduate STEM Education
- Dr. Linda Slakey Sr. Adv. AAU STEM Ed. (Nov. 4, 2014) *Making Student-Centered Teaching the New Normal: Are We at a Tipping Point?*
- Dr. Shirley Malcom Head of Education and Human Resources Programs at AAAS (Dec. 2, 2014) *Undergraduate STEM Education: Moving Diverse Populations from the Margins to the Center*
- Dr. Gabriela Weaver U. Mass. (Jan. 20, 2015)
Shifting the Teaching Culture in a Research University to Student-Centered Approaches
- Dr. Michael Klymkowsky UC Boulder (Feb. 17, 2015)
The Challenges of Active Learning and Coherent Curricula in the Sciences

Example Seminar Announcement

You are invited to our third event on exploring strategies to transform STEM education at USF in order to increase the retention and proficiency of STEM majors, especially of those who are members of underrepresented groups.

We are excited to have as our seminar speaker:

Dr. Linda Slakey

Senior Advisor for STEM Education to the American Association of Universities
Former Director, Division of Undergraduate Education at NSF

“Making Student-Centered Teaching the New Normal: Are We at a Tipping Point?”

Tuesday, November 4, 2014, from 2:00-3:00 PM

Grace Allen Room (Located in the USF Library 4th floor)

(A post-seminar discussion will be held afterwards from 3:00-3:30 PM)

Pre-Seminar subject exploration and discussion of readings

Monday, November 3, 2014 3:00 PM in CHE301

(The pre-seminar discussion will provide the opportunity to develop an understanding of the relevance of this seminar to USF and to the overall objectives of the project. We will provide reading materials to responders about one week before the seminar.)

Please respond to goins@usf.edu to let us know which day(s) you can join us. We look forward to seeing you.

A broadly constituted planning team (see below) has invited national leaders to visit USF-Tampa so that they may help us identify best practices and ways to institutionalize their adoption. The first of a series of five began in December 2013 and we will be having another six this fiscal year.

Our Seminar Series is supported in part by a grant from NSF, “Transforming STEM Education in a Large, Urban-Serving Research University.”

The Academy for Teaching and Learning Excellence (ATLE) at USF will offer completion certificates to faculty members and Graduate Teaching Assistants who attend at least four of these events.

The Planning Team:



Example from invitation

- You are invited to our third event on exploring strategies to transform STEM education at USF in order to increase the retention and proficiency of STEM majors, especially of those who are members of underrepresented groups.

We are excited to have as our seminar speaker:

- Pre-Seminar subject exploration and discussion of readings
Monday, November 3, 2014 3:00 PM in CHE301
(The pre-seminar discussion will provide the opportunity to develop an understanding of the relevance of this seminar to USF and to the overall objectives of the project. We will provide reading materials to responders about one week before the seminar.)

Invitation cont.

Please respond to goins@usf.edu to let us know which day(s) you can join us. We look forward to seeing you.

A broadly constituted planning team (see below) has invited national leaders to visit USF-Tampa so that they may help us identify best practices and ways to institutionalize their adoption. The first of a series of five began in December 2013 and we will be having another six this fiscal year.

Our Seminar Series is supported in part by a grant from NSF, “Transforming STEM Education in a Large, Urban-Serving Research University.”

The Academy for Teaching and Learning Excellence (ATLE) at USF will offer completion certificates to faculty members and Graduate Teaching Assistants who attend at least four of these events.

- **The Planning Team: all names followed**

Speaker Visit and Seminar Structure

- Pre-seminar readings and facilitated discussion (day before draws 5-15 faculty and graduate students)
- Speaker Meetings Pre-seminar: Planning team-selected members, Instructors, Discipline-Based Education Research faculty, Graduate students
- Seminar sign in and name tags distributed
- Seminar handouts include:
 - One page speaker bio.
 - List of past speakers and take home messages
- Different Planning team members welcome and introduce speaker and facilitate discussion (rotates through team)
- Extended interactive facilitated question and answer session
- Wrap up session for speaker with full Planning Team

Example of Seminar Handout Recounting Past Seminars

SEMINAR SERIES, Transforming STEM Education at USF

- **Dr. Adrianna Kezar (December 10, 2013)**

Professor of Higher Education and co-Director of Pullias Center for Higher Education,
University of Southern California

STEM Education, Shared Leadership, and You

Take-Home Lessons

- Start with vision first – change without direction won't work
- Use institutional data to determine how to proceed
- Faculty must be a central part of determining direction and impetus for change (it cannot be top-down)

- **Dr. Vasti Torres (January 14, 2014)**

Dean of College of Education and Professor of Education, University of South Florida

Do Students Under-represented in STEM Experience the Learning Environment

Differently?

Take-Home Lessons

- Students are very far from homogenous, and their unique circumstances or backgrounds may result in additional difficulties in completing a STEM major
- An ideal way to treat students is as unique individuals, with no preconceived notions on the instructor's side. This is partly accomplished by not assuming common cultural stereotypes or references when teaching.

Advisory Board

- **ERIC R. BANILOWER** Senior Researcher and Partner at Horizon Research, Inc.
- **MICHAEL N. HOWARD** Consultant in evaluation, research, program development, and technical assistance in support of mathematics, science, and technology education.
- **ADRIANNA KEZAR** Professor for Higher Education, University of Southern California and Co-director of the Pullias Center for Higher Education.
- **GEORGE D. KUH** Chancellor's Professor of Higher Education Emeritus at Indiana University Bloomington.
- **JAY B. LABOV** Senior Advisor for Education and Communication for the National Academy of Sciences (NAS) and the National Research Council (NRC).
- **ERIC M. EISENBERG** Professor of Communication and Dean of the College of Arts and Sciences at the University of South Florida in Tampa
- **RAFAEL PEREZ** Professor of Computer Science and Engineering and Associate Dean of Academic Affairs the College of Engineering.
- **VASTI TORRES** Professor of Educational Leadership and Dean of the College of Education at the University of South Florida in Tampa.

Faculty Learning Community

- Volunteers interested in learning about more effective ways to teach (15-20 faculty involved)
- Facilitated exploration of evidence based practices (from a menu of options), particularly flipped classrooms, peer learning/clickers, and interactive lectures
- Built a community of practice
- Created teaching-interested ambassadors within departments
- Established networking opportunities to encourage interdisciplinary projects in both research and teaching

Policies and Context

- **USF Policies that can hinder change**
 - Space allocation and room organization
 - Evaluation of teaching
 - Disciplinary faculty teaching assignments
- **USF Policies or context that help achieve change**
 - Strong student success initiative (part of USF strategic plan)
 - New tenure and promotion guidelines (excellence in both teaching and research)
 - State University System Performance Based Funding Model

Current Action Plan

- Continue seminar series: to build awareness, understanding and a common language around reform – make teaching more public
- Develop a coherent, engaging and rigorous STEM experience for students
 - Expand evidence-based practice into all gateway science and mathematics courses (involves curriculum/course content redesign)
 - Facilitate departmental and interdepartmental discussions of evidence based practice and interconnections in curriculum
 - Build meaningful connections between and among foundational courses across disciplines
 - Over time introduce evidence-based practice in upper division courses
 - Establish small-group student support systems
 - Chronicle processes and evaluate progress (faculty and student outcomes)
- Address remaining policy issues (space, teaching evaluations)

Final Thoughts

The current planning process is really many years in the making through a more informal network at USF

This WIDER planning grant brought:

- greater coherence,
- systemic thinking,
- greater will to act, and
- increased administrative and faculty attention to evidence based practice and the national concern about undergraduate STEM education



QUESTIONS ?