Changing Your Department

Examples from Revolutionizing Engineering & Computer Science Departments

Panelists

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Supporting Participants

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Frontiers in Education
Erie, PA
October, 2016

This panel emanates from multiple grants to panelists and supporting participants from the National Science Foundation.

This panel discussion examines the experiences, change approaches, and initial findings of the 2015 cohort of Revolutionizing Engineering and Computer Science Departments grant recipients. Change in higher education is increasingly achieved through grassroots action. The possibility to create systemic change can hinge on initial successes and areas ripe for flexibility. Through this conversational exploration of experiences, we present both philosophy and actionable steps for others to model.

Keywords—academic change; engineering education; curriculum reform

Session Plan

Time	General Topic
10	Introduction of participants and RED program
15	Change strategies being used
5	Audience questions
15	Initial results of cultural exploration
5	Audience questions
15	Challenges experienced during start-up
20	Audience questions
5	Summary and final contributions from panelists

Panelists and supporting participants will be available for questions following the panel.

Inserts, in order…
Flyer announcing RED proposal development webinar series
Project narratives from the 2015 cohort of RED recipients
Artifacts submitted by selected teams
All RED teams departments and project titles
ASEE 2016 presentations with permanent URL
Change bibliography – practical guides and research literature
Example worksheets from Making Academic Change Happen support sessions
FIE panel session paper
Contact information for Making Academic Change Happen group

REVOLUTIONIZING ENGINEERING AND COMPUTER SCIENCE DEPARTMENTS NSF RED

Are you developing a NSF RED Proposal?

Join a free webinar series

October 19, 20, 21

"Developing a Competitive NSF RED Proposal"

Wednesday	October 19, 12:00-2:00pm PST	What is 'Revolutionary'?
Thursday	October 20, 12:00-1:30pm PST	Assembling a Winning RED Team
Friday	October 21, 10:30-12:00pm PST	Change Model Required

Are you preparing a RED proposal for your program? Are you struggling with what it means to be **revolutionary**? Are you unsure of who you need on your team to create a successful proposal? Are you confused about change models and how to use them to produce change? If any of the answers to these questions are 'yes' – join us for a free online webinar series hosted by previous RED grantees. We will share our experiences as we worked to create a successful proposal. This webinar series aims to instigate exchanges of revolutionary ideas, stimulate new directions that are well-aligned with the RED program description, and cultivate innovative potential in the production of RED grant proposals.

REGISTER FOR WEBINARS

Registration links available at https://academicchange.org

You can participate in the webinars of your choice. Register for each webinar separately. Send questions to williams@rose-hulman.edu (Julia Williams, Rose-Hulman Institute of Technology).

Wednesday October 19, 12:00-2:00 pm PST – "What is Revolutionary?"

On Wednesday, we will focus on what it means to start and sustain a revolution. Previous RED award winners will share their experiences coming up with revolutionary (and sometimes not-so-revolutionary) ideas.

Thursday October 20, 12:00-1:30pm PST – "Assembling a Winning RED Team"

On Thursday, we will focus on who is needed to start a revolution and how to put the right people into the required roles of engineering education researcher, social scientist, and evaluator.

Friday October 21, 10:30-12:00 pm PST – "Change Model Required"

On Friday, we will focus on change theories and how they can be used to help your revolution succeed.

This webinar series is supported by NSF Award #1654315 to Michelle Camacho and Susan Lord, University of San Diego.

Colorado State University Project Narrative

The current engineering educational system fails in two fundamentally critical ways. First, students who have the desire and aptitude to become accomplished and productive engineers are abandoning the discipline in startling numbers. Second, students who graduate are frequently not prepared for the realities of their chosen profession and are switching careers at alarming rates. A team of educators at Colorado State University propose a new organizational model that looks at the undergraduate electrical and computer engineering (ECE) degree as an integrated system, breaking down the barriers inherent in higher education structures and implementing novel pedagogical approaches that allow students of all backgrounds to see the utility of their knowledge and connections to professional practice. At the pedagogical level, the new approach combines rigor and flexibility in engineering education to improve student efficacy and content knowledge integration through building communities of learning and practice. At the organizational level, the transformational approach aims to energize faculty to collaboratively weave important knowledge and application threads throughout the curriculum, while utilizing a new learning model that connects disparate anchoring concepts. Whether demonstrating the relevance of content through research, labs, or hands-on projects, the ECE faculty will work as a multifaceted team, ensuring that every educational component gives consideration to the big picture, while simultaneously instilling a deep knowledge of the discipline. Colorado State's approach is expected to reverse the attrition trend in engineering education and fill the engineering pathway with motivated students of diverse backgrounds. These students will have the mastery of fundamental engineering knowledge, while being ready and excited to apply their knowledge to real-world applications. The pedagogical and organizational innovations provide a broad framework for transformative and sustainable changes in engineering departments, which are necessary to produce professional engineers of the future. Moreover, the approach builds a community of universities, community colleges, and industry partners for wide participation of effective teaching and learning. CSU's approach will propel a new engineering workforce that generates superior ideas, products, and services, ultimately contributing to the nation's economic vitality and global competitiveness.

Oregon State University Project Narrative

The purpose of this project is to make bold and deliberate changes to the educational environment and practices in the School of Chemical, Biological, and Environmental Engineering at Oregon State University. While society needs engineers from diverse backgrounds ready to face the challenges of the 21st century, most engineers are still educated using methods developed several decades ago. One of the most important shifts in thinking (that has yet to be incorporated into engineering education) is to move away from "decontextualized" content - in which what students learn is intentionally removed from the context of their lives, identities and future careers. Engineering students, therefore, are hindered from putting their whole selves into engineering and learning, and many talented students leave engineering as a result. The project team is redesigning the curriculum and investing in extensive faculty training to reshape the School of Chemical, Biological, and Environmental Engineering into a warm, welcoming environment that helps students build strong ties between the content in the classroom and the rest of their lives. The graduates will be dramatically better prepared to apply their knowledge to whatever new and unpredictable challenges face our society in the years to come.

Purdue University Project Narrative

Higher education institutions strive to improve the opportunities and preparation they give to students, especially in crucial professional skills like communication, creativity, and entrepreneurship. Very often, today's engineering graduates possess exemplary technical skills for analysis and design, but need further development of professional skills. American competitiveness, national security, and leadership in innovation are at stake. This project identifies the academic department as an organization whose alignment with these goals needs to be improved. The modern imperative to add value to a mechanical engineering (ME) education -- by focusing more closely on professional skills -- stimulates critical self-examination of the ME department. This project connects organizational dynamics to student outcomes, inspiring

changes in curriculum, the student experience, and most importantly the ways that students, staff, and faculty interact with each other. This is significant, because it is not currently known how an organizational model promotes or inhibits development of these professional skills in students. By remaking the organization to one based upon creativity and trust, using modern approaches to manage this change, this project orchestrates revolutionary change in student preparation for engineering careers.

University of North Carolina Charlotte Project Narrative

The Connected Learner project at the University of North Carolina at Charlotte is a re-orientation of undergraduate computing and informatics education to focus on student learning that connects to peers, the profession, and the community. The project vision is to transform the student entering an undergraduate computing and informatics program from a person with an interest in computing - to a person with an identity as a computing professional. The project will transform faculty attitude towards education, shifting their attitudes and behaviors away from knowledge transmission and lecturing toward a refreshed approach of developing educational activities that scaffold the computing knowledge and skills to build successful computing professionals.

University of San Diego Project Narrative

The University of San Diego's (USD) Shiley-Marcos School of Engineering is embarking on a multi-year project to revolutionize engineering education with the goal of developing "Changemaking" Engineers. The project addresses how an engineering education that integrates traditional technical skills, enhanced social awareness and an integrated professional spine produces connected learning that empowers graduates to improve society - by practicing engineering within the contexts of social justice, peace, humanitarian advancement, and sustainable practices. An incubation model is being developed where new courses in a general engineering program are designed to include rich changemaker context and professional skills. Learning modules from these classes are transferred to the more traditional, disciplinary engineering programs to promote change in those curricula. The project examines the impact of infusing a professional spine and the changemaker engineering canon on student motivation and attitudes by measuring the impact in attracting and retaining a more diverse population of engineering students. The new course materials developed are being published as companion materials for traditional course textbooks. Finally, a national symposium of scholars and commensurate community is being established to promote changemaking engineering.

Arizona State University Project Narrative

The Polytechnic School at Arizona State University focuses on the education ecosystem that empowers faculty to be agents of change in the way that they teach engineering courses -- with a special focus on the four year project sequence, the 2nd and 3rd year engineering fundamentals courses, and the upper division concentration area disciplinary courses. The project takes a systems and community building perspective on how to sustain a mindset of risk-taking, making and innovation to instill creative confidence in students and faculty. The project approaches this challenge by attending to the larger ecosystem within which innovation happens, and by using evidence-based methods to make continuous teaching and learning advances within the engineering program. The specific objectives of this project are to:

1. Characterize the ecosystem within the Polytechnic School to establish the foundation for enacting innovation across the faculty, impacting students and other stakeholders.
2. Realize a mindset of additive innovation in the students and faculty to promote sharing, scaling, sustainability, and propagation of unique understandings within the community.
3. Establish an understanding of the engineering program culture and dynamics to assess the catalysts and barriers to establishing a culture that is risk seeking.
4. Identify and implement administrative structures to support cultural change and remove perceived barriers that may inhibit such innovation.

National Science Foundation
Division of Engineering Education and Centers (EEC)

NSF 17-501

IUSE/Professional Formation of Engineers: REvolutionizing Engineering and Computer Science Departments (RED)

- **Key Challenges Addressed:**
  - Bridging innovations in introductory- and capstone-level engineering and computer science education across the entire undergraduate experience, including extracurricular professional activities and student transitions in and out of the program
  - Faculty development, faculty reward systems, and academic cultures that encourage engagement of faculty and students of diverse backgrounds in the full undergraduate-level PFE process
- **Funding Level**
  - $1M to $2M for up to 5 years

Deadlines:
LOI 12/9/16
Proposal 1/18/17

National Science Foundation
Division of Engineering Education and Centers (EEC)

NSF 17-501

IUSE/Professional Formation of Engineers: REvolutionizing Engineering and Computer Science Departments (RED)

- **Team Members**:

PI – Dept. Chair/Dean

Education Researcher

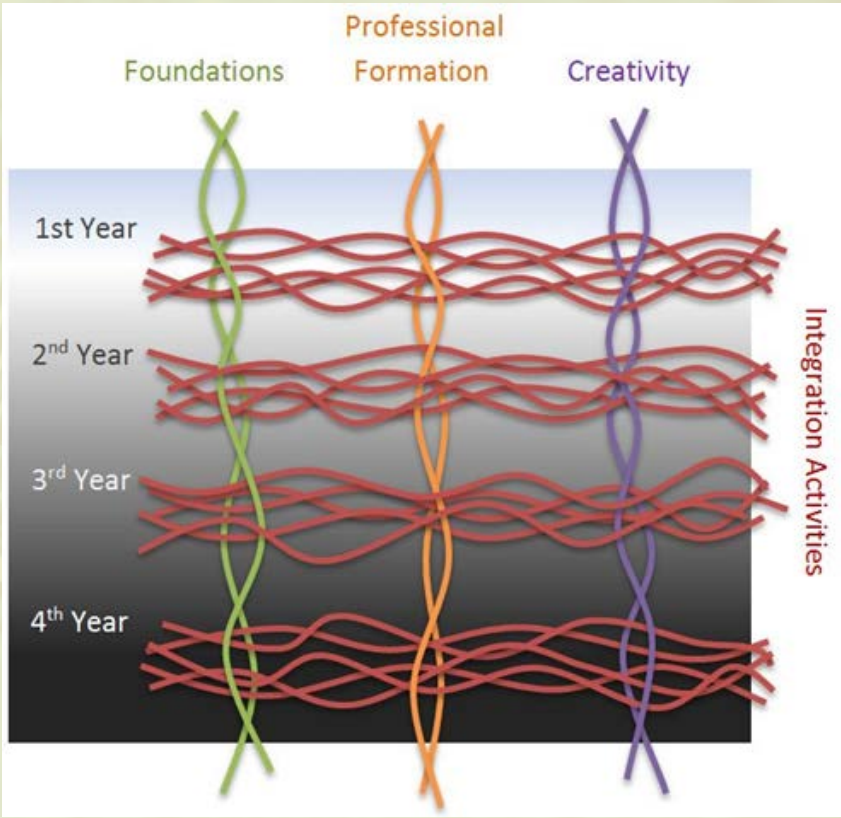
Social Science Expert

RED Outcomes

- Fund programs that can serve as exemplars of change
- Revolutionary change to middle two years of undergraduate curriculum
- Connect engineering education research and practice
- Contribute to the literature on change

Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation

- Holistic structure approaches degree as integrated system
- Throwing away courses to facilitate knowledge integration and weave threads throughout the curriculum
- Reimagined faculty roles
  - Thread Champions
  - Integration Specialists



Purdue RED: An Engineering Education 'Skunkworks' to Spark Departmental Revolution

Need: History, culture, and scale drive many challenges in professional formation of engineers and students achieving professional outcomes; our grant is about addressing them.

Approaches: Two current paths, one research, one research-to-practice.

Research

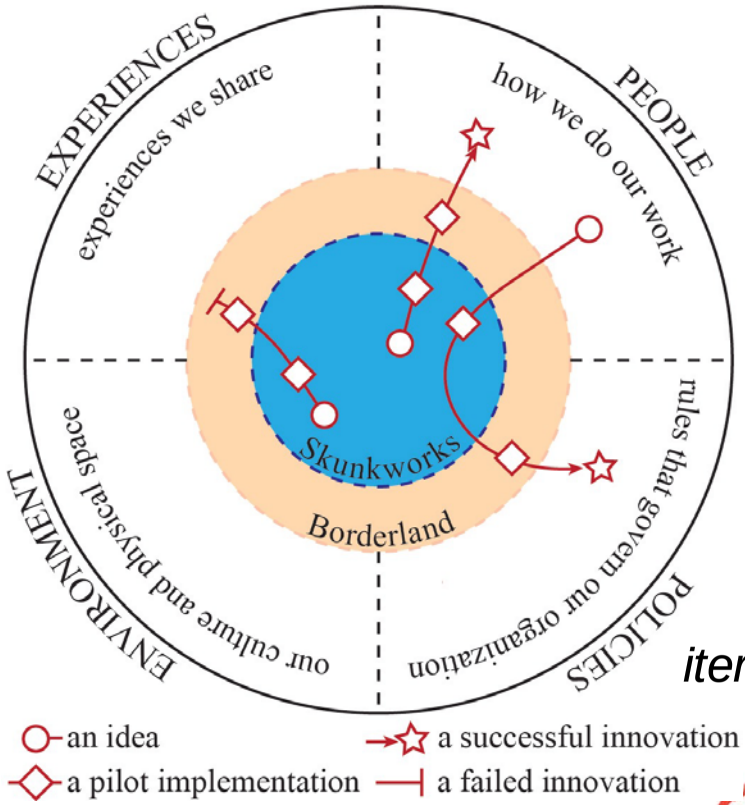
Pedagogical borderland
(competing sets of incentives)

Scalable assessment
(competing sets of priorities)

Departmental ethnography
(competing sets of goals and orientation)

linear endeavors

Research-to-practice



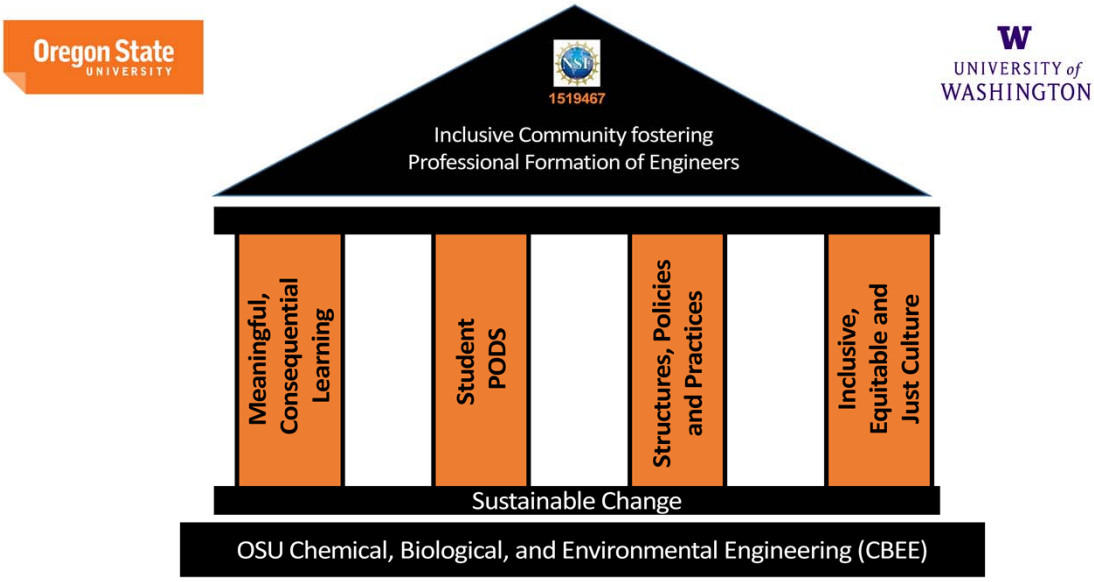
iterative endeavors

EEC-1519421

Bajaj, Berger, Briody, Morrison, Ramos, Wirtz, Guruprasad, Senkpeil, Padilla

Re-Situating Student Learning in CBEE - A Revolution at OSU

James D. Sweeney, Michelle K. Bothwell, Milo D. Koretsky, Devlin Montfort,
Susan Bobbitt Nolen, and Susannah C. Davis



We seek revolutionary change in the School of Chemical, Biological, and Environmental Engineering (CBEE) at Oregon State University (OSU) through construction of a culture of inclusion and a shift in our learning environments from sequestered activities to realistic, consequential work. This requires a fundamental change in the nature of department culture as characterized by the department values, norms and structures.

1. ***Curricular Change in the Core***. Re-situate learning activities in 9 core sophomore- and junior-level studio classes around meaningful, consequential learning.
2. ***Student Professional Development PODS***. Longitudinally mixed student teams where students help one another understand the university experience and how it relates to professional practice.
3. ***Structural Changes and Sustainability***. Provide sustainability through implementing formal changes in governing policies and procedures within CBEE. Initial work has focused on flexible position descriptions.
4. ***Creating a Culture of Inclusion***. Re-situate faculty and students' capacity to engage issues of inclusivity by shifting their cognitive and affective knowledge of power and privilege.
5. ***Research and Evaluation***. Investigate the ways the activity systems in CBEE are changing and the processes and perspectives that lead to change and resistance.

PROJECT SUMMARY

OVERVIEW

We propose revolutionary change in the School of Chemical, Biological, and Environmental Engineering at Oregon State University, replacing a business-as-usual approach with a holistic, inclusive, professionally-based learning environment woven through both the curricular requirements and the co-curricular opportunities. While the department provides many innovative learning opportunities, the extent to which these efforts are marginalized and isolated limits their influence. We will address social inequality by creating engineering educational systems and interpersonal interactions that are professionally and personally life-affirming for all people across their differences. Change will come through construction of a culture of inclusion and a shift in our learning environments from sequestered activities to realistic, consequential work. This requires a fundamental change in the nature of department culture (values, norms and structure).

Core activities include: (1) curricular redesign of 9 core sophomore- and junior-level studio classes to include more ***realistic, consequential work*** leveraging research-based pedagogies like ***problem-based learning*** and ***model-eliciting activities***; (2) growing faculty and students' ***capacity to engage issues of inclusivity*** by shifting their cognitive and affective knowledge of power and privilege; (3) planning and implementing ***student professional development pods***, longitudinally mixed student teams where students help one another understand the university experience and how it relates to professional practice; and (4) implementing ***formal changes in governing policies and procedures*** within CBEE.

INTELLECTUAL MERIT

The project uses a situative theory of change using activity systems to account for social, contextual and organizational processes of reform. This systems-based approach is designed to overcome limitations that have limited the efficacy of reform efforts that focus on cognitive or structural elements alone. This project captures the potential of an important developmental moment in our institution as we adjust to changes in leadership, student enrollment, mission and role in the state and economy. Our design-based implementation research methodology will simultaneously help achieve the vision of change and allow other institution to adapt this approach to their defining features and circumstances. This project will provide first well-documented case study of institutional, cultural change in engineering making use of a situative theory. Our team brings together broad experience in conducting and researching such changes, including methodological expertise in institutional change, design-based implementation, curricular change, systems of privilege and oppression, project-based learning, model-eliciting activities, and cultural and pedagogical faculty development.

BROADER IMPACTS

The proposed work has the potential to broadly benefit society in two ways. ***First***, students experiencing an inclusive culture and engaging with realistic, consequential work will be healthier, happier and more empowered individuals. They will also be more efficacious in solving the engineering problems of an increasingly globalized and rapidly changing society. We expect the proposed changes to result in graduates with measurably greater conceptual understanding, flexibility in problem-solving and abilities to work with diverse teams. With more than 200 annual graduates expected in the near future, changes to our student body would result in a significant benefit to society. ***Second***, the sound theoretical foundation makes the project approach scalable and adaptable both within OSU and to other universities. As more institutions and faculty experience an inclusive culture centered on engaging students with work that connects to engineering practice as well as their own identities and communities, we expect retention, recruitment and graduate numbers to increase. Additionally, faculty empowered to participate holistically in their teaching and research would reap personal benefits likely to be reflected in measurable outcomes such as research productivity, teaching effectiveness and growth.

IUSE/PFE: RED: The Connected Learner: Design Patterns for Transforming Computing and Informatics Education

Award Number: 1519160

UNC CHARLOTTE
College of Computing and Informatics

Lead PI: Mary Lou Maher, Dept. Chair, Software & Information Systems; PIs: Bojan Cukic, Dept. Chair, Computer Science; Larry Mays, Dept. Chair, Bioinformatics & Genomics; Celine Latulipe, Associate Professor, Software & Information Systems; Jamie Payton, Associate Professor, Computer Science; Steven Rogelberg, Professor, Organizational Science; Audrey Rorrer, Research Associate

Lessons Learned in Year 1:

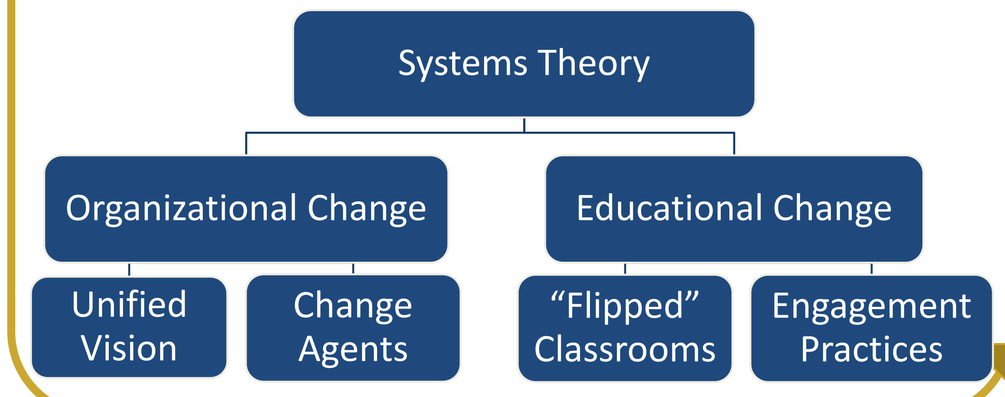
- CCI undergoing other significant changes (new unified degree, outgoing Dean); we must be patient and realign our methods and goals as needed
- Need marketing and consistent messaging for our CCI faculty and students to create a sense of "presence" in our community
- Move forward with intention and strategy

Vision

- Connect Learners to peers, the profession, and the community. Create a teaching environment that transforms the student entering our undergraduate program from a person with an interest in computing to a person with an affinity identity (Gee, 2000) as a computing professional.

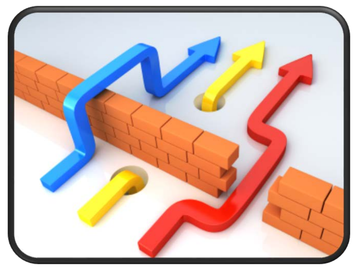
Students	• Move toward computing professional identity within an engaged community, more than merely a sum of accrued courses. • Improve student academic performance, increase experiential learning, retention, and graduation rates.
Faculty	• Move toward active learning experiences rather than lecture. • Increase pedagogical research and dissemination of pedagogical design patterns for connecting learners.
Organization	• Engage faculty, engage students, and engage community, thereby improved educational quality. • Tightly connect and embed computing pedagogy practices and scholarship in organizational strategy.

Theory of Change

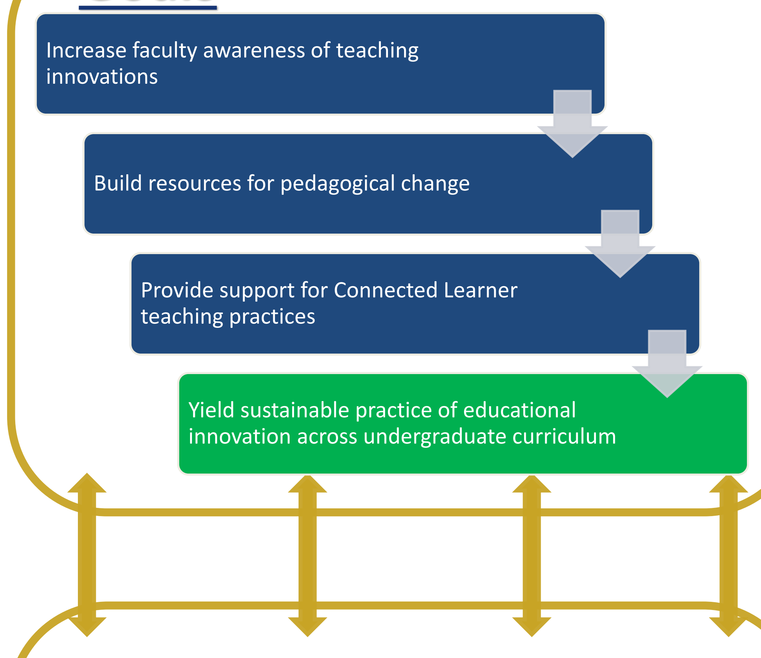


Barriers

- *Faculty lack resources for pedagogical change*
- Began building a repository of resources and holding teaching workshops
- *Time cost to create active learning materials*
- The repository will help alleviate the time cost; Design Patterns will provide "how-to" teaching roadmaps for faculty
- *Students expect lecture style courses*
- Active learning will be deployed in core courses in Fall 2017, exposing students at the beginning of their educational journeys



Goals



Objectives

- Increase student retention, learning, and graduation
- Improve student learning outcomes in core computing courses
- Create cohort of faculty champions through workshops, tiered mentoring, incentives, and repository of active learning techniques
- Map Connected Learner Taxonomy of Peers, Profession, and Community onto Bloom's Taxonomy
- Increase CS education innovation research
- Create Design Patterns for transfer to other universities

Research Questions & Plan

Student Learning and Connectedness

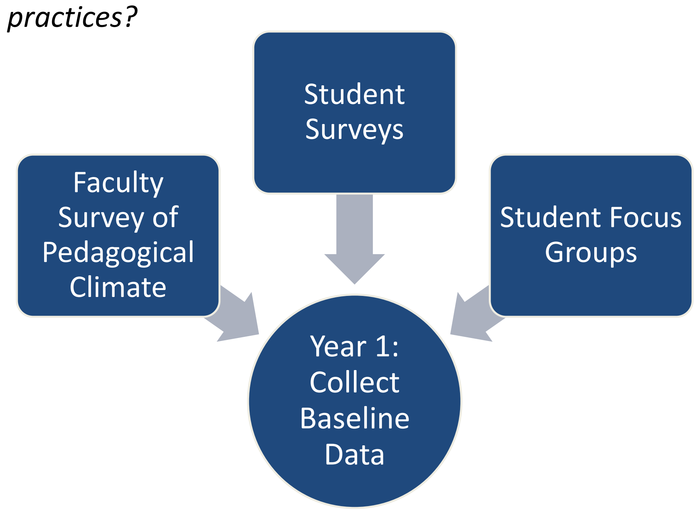
- *Does Connected Learner pedagogy improve retention, reduce time to graduation and develop professional identity? How?*
- *Do students feel more connected to their peers, their profession, and their community?*

Faculty Development

- *How do faculty attitudes and perceptions about teaching change?*
- *What design patterns are adopted? Do faculty incorporate research and computing practice into their teaching?*

Organizational Change

- *What organizational changes are most effective and efficient at motivating and sustaining shifts in teaching practices?*

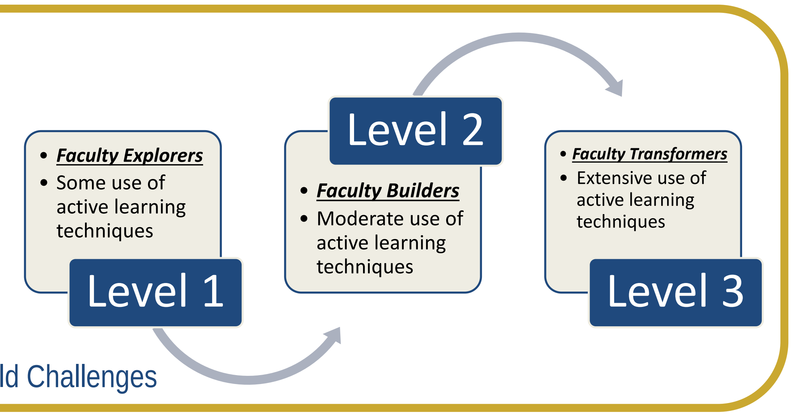


Success Stories

- Collected baseline data from both CCI students and faculty (quantitative and qualitative)
- Grew cohort of faculty champions from ~15 members in Fall 2015 to ~25 members in Spring 2016
- Regularly held Connected Learner seminar discussions with faculty champions during academic year
- Held Inaugural Connected Learner Summer Institute and funded first cohort of 6 faculty fellows
- Began building connections across our campus, such as our partnership with the UNCC Center for STEM Education
- Disseminated initial results within CCI, the UNCC community, and at conferences (ACM SIGCSE; EnFUSE; IEEE FIE)
- Development of Design Patterns and creation of Design Patterns Wikibook
- Transformation of 4 traditional classrooms in our building to active learning classrooms
- *Future Indicators of Success: improved student outcomes, measurable change in the data, more faculty champions*

Roadmap for Scaling and Adaptation

- Implement faculty development and incentives
  - Inaugural Connected Learner Summer Institute
  - Create faculty repository of active learning techniques
  - Orchestrate organizational shifts in RPT
- Flip 90% of CCI courses by 2020
  - Incremental growth rate 15-20% each year of the project
- Develop toolkit of Design Patterns for local and national distribution
- Leverage CCI business partners in the greater Charlotte region via Real-World Challenges



UNC CHARLOTTE
College of Computing and Informatics

The Connected Learner: Design Patterns for Transforming Computing and Informatics Education

Principal Investigators:

Mary Lou Maher, Dept. Chair, Software & Information Systems

Bojan Cukic, Dept. Chair, Computer Science

Larry Mays, Dept. Chair, Bioinformatics & Genomics

Celine Latulipe, Associate Professor, Software & Information Systems

Steven Rogelberg, Professor, Organizational Science

Audrey Rorrer, Research Associate, College of Computing & Informatics

NSF Award Number: 1519160

Connect learners to peers, profession, community

Active learning and "flipped" classrooms

Design patterns and resources for pedagogical change

Organizational change for sustainable educational innovation

Developing Changemaking Engineers

**Chell Roberts, Lead PI; Susan M. Lord, Engineering Education Research Lead and EE Transfer;
Michelle M. Camacho, Social Scientist; Rick Olson, Leadership Workshops;
Ming Huang, Faculty Empowerment Workshops and ME Transfer; Leonard Perry, Stakeholder Forums and ISYE Transfer**

- To become a leader in developing a larger community of *Changemaking* engineering educators that contributes to a new canon emphasizing social justice, humanitarian development, peace, and sustainability.
- To infuse professional values and skills into the engineering curriculum.
- Faculty will mirror the values and skills of the Changemaker model.

Arizona State University	Engineering Education	Additive Innovation: An Educational Ecosystem of Making and Risk Taking
Colorado State University	Electrical & Computer	Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation
Oregon State University	Chemical, Biological, and Environmental Engineer-	Shifting Departmental Culture to Re-Situate Learning and Instruction
Purdue University	Mechanical	An Engineering Education Skunkworks to Spark Departmental Revolution
University of San Diego	Multi-Department	Developing Changemaking Engineers
University of North Carolina - Charlotte	Multi-Department	The Connected Learner: Design Patterns for Transforming Computing and Informatics Education
Rowan University	Civil Engineering	Rethinking Engineering Diversity, Transforming Engineering Diversity
Iowa State University	Electrical & Computer	Reinventing the Instructional and Departmental Enterprise to Advance the Professional Formation of Electrical and Computer Engi-
University of New Mexico	Chemical	Formations of Accomplished Chemical Engineers for Transforming Society
University of Texas El Paso	Computer Science	A Model of Change for Preparing a New Generation for Professional Practice in Computer Science
Boise State University	Computer Science	Computer Science Professionals Hatchery
University of Illinois Urbana Champaign	Biomedical	Defining the Frontiers of Bioengineering Education at Illinois and Beyond
Virginia Polytechnic Institute and State University	Electrical & Computer	Radically Redesigning the Fan-in and Fan-out of an Electrical and Computer Engineering Department

ASEE 2016 Presentations

Preliminary Work on Weaving Professionalism Throughout the Engineering Curriculum
https://peer.asee.org/25946
Ms. Alma H. Rosales (Colorado State University), Ms. Andrea M. Leland (Colorado State University), Mrs. Olivera Notaros (Colorado State University, ECE Department), Mr. Richard F. Toftness (IEEE High Plains Section), Dr. Thomas J. Siller (Colorado State University), Prof. Michael A. De Miranda Ph.D. (Colorado State University), Mr. Alistair Cook (Colorado State University), Ms. Melissa D. Reese (Colorado State University), Prof. Zinta Byrne (Colorado State University), Mr. James Warren Weston (Colorado State University), and Prof. Anthony A. Maciejewski (Colorado State University)

Instigating a Revolution of Additive Innovation: An Educational Ecosystem of Making and Risk Taking
https://peer.asee.org/27315
Dr. Ann F. McKenna (Arizona State University, Polytechnic Campus), Dr. Nadia N. Kellam (Arizona State University), Dr. Micah Lande (Arizona State University, Polytechnic Campus), Dr. Samantha Ruth Brunhaver (Arizona State University, Polytechnic Campus), Dr. Shawn S Jordan (Arizona State University, Polytechnic Campus), Dr. Jennifer M Bekki (Arizona State University, Polytechnic Campus), Dr. Adam R Carberry (Arizona State University), and Dr. Jeremi S London (Arizona State University, Polytechnic Campus)

Shifting Departmental Culture to Re-Situate Learning
https://peer.asee.org/26183
Dr. Milo Koretsky (Oregon State University), Dr. Michelle Kay Bothwell (Oregon State University), Dr. Susan Bobbitt Nolen (University of Washington), Dr. Devlin Montfort (Oregon State University), and Prof. James D. Sweeney (Oregon State University)

Mastering the Core Competencies of Electrical Engineering through Knowledge Integration
https://peer.asee.org/25683
Prof. Tom Chen (Colorado State University), Prof. Anthony A. Maciejewski (Colorado State University), Prof. Branislav M. Notaros (Colorado State University), Prof. Ali Pezeshki (Colorado State University), and Ms. Melissa D. Reese (Colorado State University)

A Pedagogical Borderland? Comparing Student and Faculty Attitudes and Actions About Teaching and Learning
https://peer.asee.org/26388
Dr. Edward J. Berger (Purdue University, West Lafayette), Mr. Ryan R Senkpeil (Purdue Engineering Education), Elizabeth K. Briody PhD (Cultural Keys LLC), and Edward F Morrison (Purdue University, West Lafayette)

Selected References for Applicable Strategies

Buller, J.L. 2015. *Change Leadership in Higher Education: A Practical Guide to Academic Transformation*. Jossey-Bass, San Francisco.

Cialdini, R.B. 2006. *Influence: The Psychology of Persuasion.* William Morrow, New York., NY.

Collins, J. 2005. *Good To Great and the Social Sectors*. Harper Collins, New York, NY.

Druskat, V. & S. Wolff. 2001. Building the emotional intelligence of groups. *Harvard Business Review* 79(3): 80-90.

Eckel, P.D., M. Green, B. Hill, & W. Mallon. 1999. On change III. Taking charge of change: A primer for colleges and universities. American Council on Education, Washington, DC.

Eckel, P.D. & M. Hartley. 2008. Developing academic strategic alliances: Reconciling multiple institutional cultures, policies, and practices. *The Journal of Higher Education* 79(6): 613-637.

Eddy, P.A., & M.J. Amey. 2014. *Creating Strategic Partnerships: A Guide for Educational Institutions and Their Partners*. Stylus Publishing, Sterling, VA.

Gardenswartz, L. & A. Rowe. 1995. *Diverse Teams at Work: Capitalizing on the Power of Diversity*. Irwin Professional Publishing.

Godin, S. 2008. *Tribes*. Penguin Books, New York, NY.

Goldstein, N.J., S.J. Martin, & R.B. Cialdini. 2008. *Yes: 50 Scientifically Proven Ways to Be Persuasive*. Free Press, New York, NY.

Grenny, J., K. Patterson, D. Maxfield, R. McMillan, & A. Switzler. 2013. *Influencer: The New Science of Leading Change*. McGraw-Hill Education, New York, NY.

Harvard Business Review. 2013. *On Teams*. Harvard Business Review Press, Boston, MA.

Katzenbach, J. & D. Smith. 2005. The discipline of teams. *Harvard Business Review* 83(7/8): 162-171.

Kotter, J.P. 2012. *Leading Change.* Harvard Business Review Press, Boston, MA.

Kotter, J.P. & L.A. Whitehead. 2010. *Buy-In: Saving Your Good Idea From Getting Shot Down*. Harvard Business Review Press, Boston, MA.

Stone, D., B. Patton, & S. Heen. 2010. *Difficult Conversations*. Penguin Books, New York, NY.

Selected References for Theoretical Base

Ben-Ner, A., B.P. McCall, S. Massoud, & H. Wang. 2009. Identity and in-group/out-group differentiation in work and giving behaviors: experimental evidence. Journal of Economic Behavior & Organization 72: 153-170.

Besterfield-Sacre, M., M.F. Cox, M. Borrego, K. Beddoes, and J. Zhu. 2014. Changing engineering education: views of U.S. faculty, chairs, and deans. *Journal of Engineering Education* 103(2): 193-219.

Bolman, L.G. & T.E. Deal. 2013. *Reframing Organizations: Artistry, Choice, and Leadership* (5th ed.). Jossey-Bass, San Francisco, CA.

Fumasoli, T. & B. Stensaker. 2013. Organizational studies in higher education: A reflection on historical themes and prospective trends. *Higher Education Policy* 26: 479-496.

Gumport, P.J. 2000. Academic restructuring: Organizational change and institutional imperatives. *Higher Education* 39(1): 67-91.

Henderson, C., A. Beach, & N. Finkelstein. 2011. Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *Journal of Research in Science Teaching* 48(8): 952-984.

Kezar, A. & J. Lester. 2009. Supporting faculty grassroots leadership. Research in Higher Education 50(7): 715-740.

Kezar, A. 2014. *How Colleges Change: Understanding, Leading, and Enacting Change*. Routledge, New York.

Kezar, A. & P.D. Eckel. 2002. The effect of institutional culture on change strategies in higher education: universal principles or culturally responsive concepts? The Journal of Higher Education 73(4): 435-460.

Pentland, A. 2012. The new science of building great teams. *Harvard Business Review* 90(4): 60-70.

Schein, E.K. 2010. *Organizational Culture and Leadership* (4th ed.). Jossey-Bass; San Francisco, CA.

Tierney, W.G. 1988. Organizational culture in higher education: Defining the essentials. *The Journal of Higher Education* 59(1): 2-21.

Vaira, M. 2004. Globalization and higher education organizational change: A framework for analysis. *Higher Education* 48(4):483-510.

Risk Assessment and Management

All change involves risks. Preparing for change should include identifying and judging potential threats, then finding the best ways to avoid or deal with them. Proactive is always better than re-active. Use these pages to walk through a risk consideration activity.

Identify sources of risk associated with your project. Think broadly.

- Increased access to lab facilities increases likelihood of accident/injury with equipment
- Loss of long-time, high-level administrative champion
-
-
-
-
-
-
-
-

Assign each risk to a quadrant. Consider the events that have happened on your campus recently. Consider leadership styles and the types of things people talk about in break rooms. Think about the last couple of high profile projects and the comments you heard about those efforts. Consider your colleagues, their dispositions, and the general mood of discussions in department meetings and school or university-wide events. Remember the experiences of program or project directors with respect to stress level, project communications, project longevity, reputation, etc.

High Probability of Occurrence Low Severity of Consequence Lab accidents (most require first aid only)	High Probability of Occurrence High Severity of Consequence
Low Probability of Occurrence Low Severity of Consequence	Low Probability of Occurrence High Severity of Consequence Loss of long-time, high-level administrative champion

Understanding and dealing with risks includes recognizing the kinds of crises the risks could create. Crises can be…
1. Creeping - foreshadowed by a series of events that decision makers don't view as a pattern
2. Slow-burn - some advance warning, before the situation has caused any actual damage
3. Sudden - damage has already occurred and will get worse the longer it takes to respond
Assign each risk to a "potential crisis" category. Examples are given in red.

Creeping Lack of a rumor control system - damaging rumors proliferate Inadequate two-way communication with audiences/partners, internal and external Process overdependence on one person - not institutionally-"owned," subject to interruption Microhostilities or uncollegial colleagues
Slow-burn Non-compliance with standards (copyright, safety, employment, etc.) Misunderstanding/misrepresentation by upper-level administration or marketing Not addressing a continuing source of student dissatisfaction, growing activism Constraints on a fundamental resource (classroom or building space, technician time, etc.)
Sudden Unanticipated death/medical/mental/emotional crisis of key personnel or campus leaders Hostile outburst (in private, in public) regarding your project Audits or investigations by regulatory or accreditation agencies Fires

Having considered your identified risks from at least two perspectives, think now about management. Label each row with a risk and consider various approaches to manage that situation. Think to other projects in your experience, or things you've observed with similar projects. How can you be proactive in managing the inevitable risks that a project will have?

Risk	**Avoid** Eliminate if possible	**Control** Minimize impact	**Accept** Do nothing	**Transfer** Share risk
Key team member takes promotion to admin position at competitor institution	No way to avoid; only staff team with asst profs; intra-team contractual agreement	Cross-train skills within team; encourage team members to open personal networks within team; keep spectacular records of responsibilities, individual actions, etc.	Find someone with similar skill set once team member leaves; celebrate the promotion; mourn the change in the team and move on	Secure DH agreement that appropriate staffing is critical for team function

Building the Project Team

List the people by both name a position you believe are likely to become involved in your project sufficiently enough that you could call them a part of your team. Consider students, staff, off-campus partners, administrators, etc.

•	•
•	•
•	•
•	•
•	•
•	•
•	•

In your view, is it possible for this group to have the following desirable team attributes:

- □ Shared leadership roles?
- □ Individual and mutual accountability?
- □ Specific team purpose that the team itself delivers?
- □ Collective work products?
- □ Encourages open-ended discussion and active problem solving meetings?
- □ Measures performance directly by assessing collective work products?
- □ Discusses, decides and does real work together?

What are the issues you foresee, and what approaches could be taken to resolve those issues?

Michael: history of unfilled commitments; ask about how to establish priority of the team
Accountability: lack of obvious early wins; work with leadership to develop clear benchmarks

Name	Current Involvement	Competing Activities	Needed Involvement	Needed Function	Identity Elements	Incentives	Alternatives
Beth, Associate Prof	Expressed interest, has not attended small group meeting	Director of dept graduate programs, large research group	Critical to success, regular attendance at meetings, ~4 hours per week	Networking, marketing, and getting the right people together	Strongly identifies as mentor to new faculty, people person, connector/node	Participation in interesting community, opportunity to go to conferences	Mark in ME – he has a huge network through his development work

Supplemental Material – Exploring Partnerships

Different campus constituencies get involved in change actions in different ways, depending on their available time and energy. Working on your own, think about your proposed change. Who on your campus will fall into each of the following categories?

Change leaders (who orchestrate the process)	*Contributors* (who affect change through participation in subcommittees or task forces)
Resource people (who provide information or resources for others)	*Informed people* (who do not participate actively but who stay up to date about what is occurring and why)
Constructive skeptics ("loyal opposition" who contribute useful critiques and commentary)	*Resisters* (who are invested, for a variety of reasons, in preserving the status quo. Resistance can be passive or active)

Panel: Changing Your Department: Examples from Revolutionizing Engineering Departments

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***Abstract*—This panel discussion examines the experiences, change approaches, and initial findings of the 2015 cohort of Revolutionizing Engineering and Computer Science Departments grant recipients. Change in higher education is increasingly achieved through grassroots action. The possibility to create systemic change can hinge on initial successes and areas ripe for flexibility. Through this conversational exploration of experiences, we present both philosophy and actionable steps for others to model.**

Keywords—academic change; engineering education; curriculum reform

I. Introduction

Within the science, technology, engineering, and mathematics (STEM) education community, there are repeated calls for changing the way we educate our students (e.g., the National Academy of Engineering's Engineer of 2020; President Obama's Educate to Innovate program; AAU's Undergraduate STEM Education Initiative). And yet, despite the demonstrated improvements in student learning inherent in innovative teaching strategies, despite many years of funding and development under the auspices of a variety of foundations and corporations, change in STEM education is not pervasive.

The lack of systemic change points to an important problem with the approach to change that the STEM education community has pursued thus far. Change has been targeted at the course and curriculum levels, focusing on teaching and learning methods and proving their efficacy [1]. These beneficial activities have not, however, focused on the important role of the change agent nor have they addressed how the agent must learn new skills and adopt a new mindset, things necessary if the agent is to drive change at the course, program, department, and/or institutional level. Such change strategies and skills, like motivation, persuasion, communication, and collaboration, are well documented in the literature of other disciplines, such as organizational psychology [2] and higher education studies [3], but are not part of the conversation within STEM education in a rigorous, accessible way.

Diffusion of change or innovation requires "plans that promote transitions to stages of adoption beyond awareness" [1]. Further, successful change results from change agents maintaining a focus on stakeholders, rather than attempting to implement a specific activity (meeting the "emergent/environment" category) [1, 4]. Other researchers emphasize the critical importance of grassroots leadership emerging from the faculty level (rather than top-down, mandated change) [5]. This panel addresses these needs in the context of one major national initiative.

II. Goals and Objectives

The primary goal of this panel session is to introduce audience members to strategies for change applied across department and institution types, and their implementation in the first year of the National Science Foundation-supported Revolutionizing Engineering and Computer Science Departments (RED) program. Specifically, the discussion will…

- Explore the diversity of change strategies implemented by the RED teams
- Identify commonalities across the RED teams with respect to start-up experiences
- Consider how the cultural explorations of their initial data collection influenced their approach to change
- Discuss challenges associated with working with fellow faculty, IRB panels, institutional expectations and boundaries, etc.
- Articulate the interaction with the institution at large and the PIs changing roles as change-makers on their campuses

III. Revolutionizing Engineering Departments

This panel discussion explores the experiences of the Revolutionizing Engineering and Computer Science Departments recipients (from the 2015 application cycle) in administering the first year of their academic change projects. The Revolutionizing Engineering and Computer Science

Departments program emerged as a premier program from the Improving Undergraduate STEM Education activities. The explicit focus of the RED program is influencing the technical core in the second and third years, while creating departmental structures and culture that promote inclusion [6].

The 2015 RED recipients are…

- Arizona State University, Polytechnic School: Additive Innovation: An Educational Ecosystem of Making and Risk Taking
- Colorado State University, Electrical and Computer Engineering: Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation, represented on the panel by Tony Maciejewski, Professor and Department Head of Electrical and Computer Engineering.
- Oregon State University, Chemical, Biological, and Environmental Engineering Department: Shifting Departmental Culture to Re-Situate Learning and Instruction, represented on the panel by Milo Koretsky, Professor of Chemical Engineering.
- Purdue University, Mechanical Engineering: An Engineering Education Skunkworks to Spark Departmental Revolution, represented on the panel by Ed Berger, Associate Professor of both Engineering Education and Mechanical Engineering.
- University of North Carolina – Charlotte, College of Computing and Informatics: The Connected Learner: Design Patterns for Transforming Computing and Informatics Education, represented on the panel by Mary Lou Maher, Professor and Chair of Software and Information Systems.
- University of San Diego, Shiley-Marcos School of Engineering: Developing Changemaking Engineers, represented on the panel by Susan Lord, Professor and Chair of Electrical Engineering. [7]

The National Science Foundation (NSF) will be represented by Elliot Douglas, Ph.D. Dr. Douglas is the program director for Engineering Education Research and is the primary connection between RED teams and NSF. Dr. Douglas will provide the context relating to NSF's goals and vision for the RED program[1].

The cohort-based approach chosen for the RED programs leverages the experiences of these disparate institutions and technical areas to develop common understanding of strategies leading to both success and failure. Cohort activities have included regular conference calls, sharing documentary production (survey instruments, workshop advertisements, job postings, etc.), and focus group sessions. This work has generated understandings of the processes large-scale change requires [8]. These understandings are meant to be distributed to the engineering education community to promote adoption and adaption.

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IV. Session Agenda

This panel session loosely follows the agenda below. Audience questions are an important aspect of the panel session, as a key goal is to understand the questions others have regarding this significant change experience.

TABLE I. SESSION AGENDA

Time	General Topic
10	Introduction of participants and RED program
15	Change strategies being used
5	Audience questions
15	Initial results of cultural exploration
5	Audience questions
15	Challenges experienced during start-up
20	Audience questions
5	Summary and final contributions from panelists

V. Supporting Resources

Audience members will receive reference materials including an extensive bibliography, example work emanating from the RED teams (e.g. ASEE abstracts), panelist contact information, and example worksheets supporting key change skills.

Acknowledgment

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References

[1] M. Borrego, J. E. Froyd, and T. S. Hall, "Diffusion of engineering education innovations: A survey of awareness and adoption rates in U.S. engineering departments," J. Eng. Educ., vol. 99, pp. 185-207, July 2010.

[2] A. J. Day and K.S. Finnegan, "A bridge between worlds: Understanding network structure to understand change strategy," J. Educ. Change, vol. 11, pp. 111-138, May 2010.

[3] A. Kezar, How Colleges Change, 1st ed., New York: Routledge, 2014.

[4] C. Henderson, A. Beach, and N. Finkelstein, "Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature." J. Res. Sci. Teach., vol. 48, pp. 952-984, October 2011.

[5] J. Lester and A. Kezar, "Faculty grassroots leadership: Making the invisible visible," J. Professoriate, vol. 6, pp. 98-129, December 2012.

[6] "IUSE/Professional Formation of Engineers: Revolutionizing engineering and computer science Departments (RED)" Internet: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505105, [May 1, 2016].

[7] "NSF awards $12 million to spur an engineering education revolution" Internet: http://www.nsf.gov/news/news_summ.jsp?cntn_id=135379, [May 1, 2016].

[8] A. Kezar, "Understanding sensemaking/sensegiving in transformational change processes from the bottom up," High. Educ. vol. 65, pp. 761-780, June 2013.

Making Academic Change Happen

MACH grew out of a faculty grassroots effort – to figure out how to make change easier and spread this information to colleagues. Around lunch tables and in small conference rooms, this group developed the core principles that now comprise the MACH approach, all centered on two philosophical points: translating research to practice and learning by doing. Contact us to learn how MACH can help you and your colleagues become more successful at making change happen on your campus.

The Making Academic Change Happen workshop for 2017 is May 31-June 2 – join us for three days of intense learning and project-focused work.

back row: Eva Andrijcic and Steve Chenoweth
middle row: Ella Ingram and KC Dee
front row: Julia Williams, Rich House, Glen Livesay, and Matt Lovell
not pictured: Craig Downing

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