Transforming Institutions

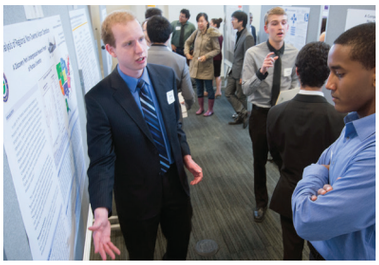
21st Century Undergraduate STEM Education Conference

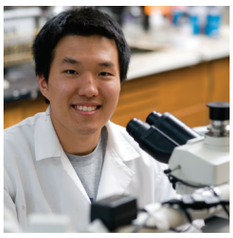
October 23-24, 2014 | NCAA Conference Center | Indianapolis, Indiana USA

Sponsored by the Discovery Learning Research Center at Purdue University

DISCOVERY LECTURE SERIES
PURDUE UNIVERSITY

IEEE





OUR MISSION:

Advance education in STEM and related disciplines through interdisciplinary research and innovation in teaching and learning.

OUR VISION:

Achieve a position as a world-leader with national impact and international influence in advancing educational research in STEM and related disciplines.

Discovery Learning Research Center faculty and staff are working to transform education, particularly in STEM and STEM-related disciplines. Since our inception in 2003, we have fostered more than $80 million in funded research focused on identifying, developing and nurturing interdisciplinary teams and projects that integrate, synthesize and promote discovery, learning and engagement.

To collaborate with the DLRC, please email **learningcenter@purdue.edu**.

Join us in the conversation about educational transformation.
Contribute to our online hub: **https://stemedhub.org**.
Follow us on Twitter: **@DLRCPurdue**.

DLRC
Discovery Learning Research Center
PURDUE UNIVERSITY

www.purdue.edu/discoverypark/learningcenter

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Dear Colleagues,

On behalf of Purdue University's Discovery Learning Research Center (DLRC), I am pleased to welcome you to the Transforming Institutions: 21st Century Undergraduate STEM Education Conference.

The 21st century economy requires a workforce that is far different from the workforce of the past. Modern manufacturing requires fewer, but much more highly trained employees that possess excellent technical knowledge coupled with well-developed soft skills. As a result, higher education is no longer limited to a largely well-prepared, affluent group — it is now a necessity for successful employment in almost every sector. Colleges and universities face the dual challenge of adapting to the changing needs of industry, while also responding to the changing demographics of students.

Recent policy actions and reports have drawn considerable attention to the opportunities and challenges inherent in increasing the number of highly qualified STEM graduates. Priorities include educating students to be leaders and innovators in emerging and rapidly changing STEM fields as well as educating a scientifically literate population. Both of these priorities depend on the nature and quality of the undergraduate STEM education experiences. How do we transform institutions largely designed in another time, to successfully meet the challenges of today? How do we maintain excellence while responding to changing paradigms?

The Transforming Institutions Conference brings together some of the most innovative and creative minds in higher education to examine best practice and consider possible strategies for transforming undergraduate STEM education. Through this convergence of innovation and transformation, we hope to lay the groundwork for systematically investing in new approaches for enhanced STEM teaching, learning, assessment, support and research at the undergraduate level.

The conference is grounded in four signature themes central to transforming STEM education at the undergraduate level. These themes include 1) institutional supports and barriers for transformation; 2) understanding transformation through assessment; 3) faculty development for educational innovation; and 4) learning spaces, technology and infrastructure. Underpinning each thematic session is the aim for researchers to share and discuss the potential impact their experiences have at the local, national and international levels and furthermore, propose both programmatic and policy changes for undergraduate STEM education. Through this conference, we hope to gather a critical mass of innovation that will inform and even drive undergraduate STEM education worldwide.

This conference is made possible by the generous support and collaboration of our sponsors listed below. Our heartfelt thanks go to these sponsors who have partnered with the DLRC to encourage and support innovation and transformation in STEM education.

I wish you an enjoyable conference and encourage to you engage in and explore the diverse intellectual opportunities throughout the conference.

Sincerely,

Brenda M. Capobianco

Brenda M. Capobianco
Associate Professor, Science Education and Engineering Education (courtesy)
Interim Director, Discovery Learning Research Center
Co-Director, Science Learning through Engineering Design (SLED) Partnership

DLRC

IEEE Advancing Technology for Humanity

Discovery Lecture Series Purdue University

Purdue University Office of the Provost

Purdue Diversity and Inclusion

HermanMiller

Purdue Agriculture

Purdue Science

Paul Sturm and Chris Lamar

Dear Colleagues,

The conversation about transforming STEM higher education has been happening on a national and global scale for the better part of the last decade. Over the last several years, however, it has grown more urgent and has begun to result in plans for action at the highest levels, if not in the actual classrooms of our institutions. In 2010, the United States Congress passed the America Competes Reauthorization Act. That reauthorization resulted in the Federal STEM Education 5-Year Strategic Plan, announced by the National Science and Technology Council for the Executive Office of the President in May 2013. The strategic plan has subsequently been parlayed into a 3.7% increase in federal funding for STEM education in the FY15 budget, including for efforts in higher education and in educational research. In 2014, several think-tank meetings have been held across the United States to explore next steps in higher education STEM education related to the goals of this federal strategic plan.

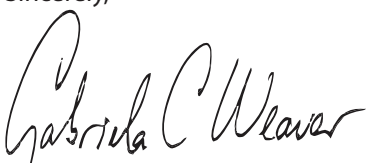
Simultaneous with these actions, and influenced by them though not directly tied to them, are a number of efforts that are converging to support implementation of educational best practices for STEM. For example, in 2011 the Association of American Universities (AAU) convened a council of experts to develop a framework for institutional transformation. Shortly after, this framework became the basis for its STEM Initiative and eight institutional grants issued as pilot sites for a much larger network of institutions working on institutional transformation of STEM education. It was the first time the AAU had involved itself on such a large scale in issues of education at its member institutions in over a decade. On a similar timeline with the AAU framework development, the National Science Foundation developed and issued the solicitation for its Widening Implementation and Demonstration of Evidence-Based Reforms (WIDER) program. At the heart of this solicitation was the growing concern that instructional innovations and educational research, which had been part of large government investments over decades, were not being translated into sustained and measurable action at the level of institutions.

As part of the response, we are beginning to see the formation of coalitions of groups nationally and internationally with the intention of enacting and supporting practices that run across institutions, in the hope that this will lead to greater generalizability, higher likelihoods of sustainability, and a deeper understanding of the transformation process itself. One example is the Bay View Alliance, formed in 2012 and involving several institutions from Canada and the United States; the alliance is organized around research-action clusters, putting in place reforms and studying the impacts across multiple institutions including those outside of the formal alliance. Another is the Coalition for Reform of Undergraduate STEM Education, which is a group of representatives from across agencies that fund and represent higher education, working on ways to address gap areas in STEM education research and funding efforts. And there is the newly emerging network of STEM education centers, committed to understanding and maximizing the impact of such centers on their campuses and across campuses.

The conversation is happening now, and action is beginning to occur. Those who are involved with the leadership of higher education institutions need to become part of that dialog in order for all of these efforts to have the greatest chance of success for the ultimate aim — educating the next generation of students who will enter the workforce of the information and innovation economy. We are fortunate to have many of the distinguished leaders and scholars of the efforts mentioned above at the 2014 Transforming Institutions conference. We will compile these presentations, as well as findings from the inaugural conference in 2011, into a published volume (Purdue University Press), due out in early 2015. We hope that this conference and the book will help to clarify the current thinking on the best ways to move forward and on those questions and issues that are likely to emerge as we explore new frontiers.

Welcome to *2014 Transforming Institutions: 21st Century Undergraduate STEM Education.*

Sincerely,



Gabriela C. Weaver
Conference Chair
Associate Provost, University of Massachusetts, Amherst
Director, Center for Teaching and Faculty Development

Introduction to the Discovery Learning Research Center

Society now exists within a knowledge economy that is highly technical and information-rich. Educating students to understand and excel within this system is one of today's greatest and most important challenges. The Discovery Learning Research Center strives to be in the vanguard in understanding and developing interdisciplinary learning and the educational methodologies that support it, and then translating these findings into teaching and learning practice in formal and informal environments at all levels.

The DLRC is one of the centers comprising Purdue's innovative Discovery Park, an interdisciplinary research enterprise committed to advancing science, engaging industry, enhancing educational and work environments, and improving the quality of life. Since its inception in March 2003, the Discovery Learning Research Center has fostered more than $80 million in funded research focused on identifying, developing and nurturing interdisciplinary teams and projects that integrate, synthesize and promote research aimed at transforming education, especially in science, technology, engineering and mathematics (STEM) and related disciplines. The Discovery Learning Research Center is a 22,000 square-foot state-of-the-art facility that features unique, flexible spaces designed for educational research unlike any available nationwide. The spaces also incorporate technologies and structural features that allow for collection of research data about the learning experience. DLRC staff provide expertise in research design and methodology, educational pedagogy, assessment and evaluation, project initiation and management.

The DLRC is strategically positioned to:

- catalyze large-scale, interdisciplinary research programs in teaching and learning, especially in STEM and STEM-related fields;
- promote articulation between the scholarship of teaching and learning and actual classroom practice at all levels; and
- provide leadership in influencing STEM public literacy and educational policy.

The DLRC, led by a faculty director, is comprised of13 staff members, including a managing director, operations manager, two assessment specialists, two project coordinators, an intern coordinator, media specialist, laboratory manager, two business office staff and two support staff. In addition, the center employs six to eight graduate assistants and three undergraduate assistants. Faculty fellows provide additional intellectual capital to the center on a rotating basis.

The center collaborates on educational research projects with every academic unit at Purdue and with many colleges and universities across the country and the world. Please contact us to discuss potential collaborations: **learningcenter@purdue.edu**.

Conference interactive online tools

The tools available for the conference and discussed here include:

- Wireless access
- Social media
- Discussion site and online resources: STEMEdhub.org

Free wireless access
During the Transforming Institutions conference, free wireless internet service is available in the Christine Grant Ballroom.

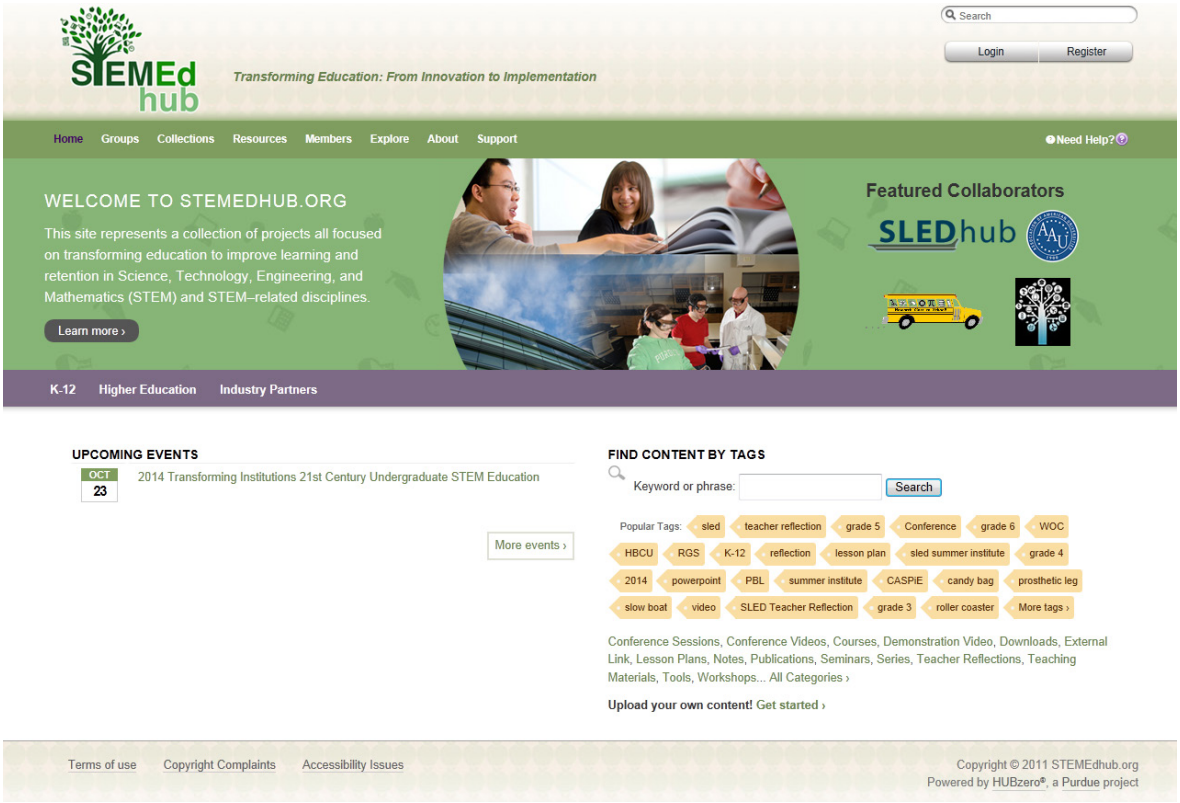
To access this service, search for the wireless network called: NCAA

Enter password: NCAAGuest (The password is case sensitive)

Social media
Twitter hashtag: #transformSTEM
Our Twitter handle: @DLRCPurdue
Facebook: Dlrc Purdue

Online conference discussion site: STEMEdhub.org
Introduction

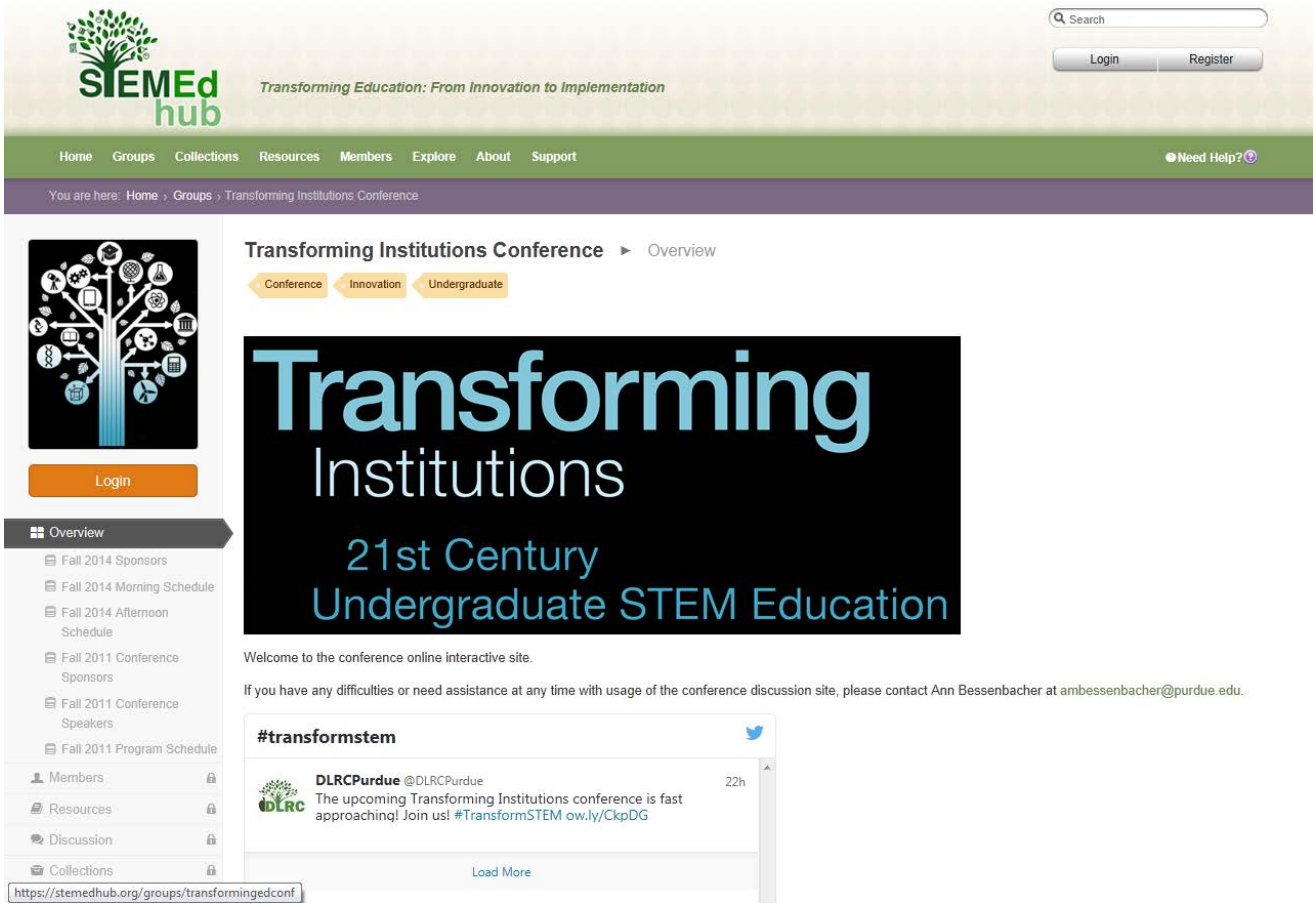
STEMEdhub.org is an online community of practice for university researchers, administrators, K-12 teachers and combinations of those groups. The site facilitates the hosting of interactive scientific tools, online presentations, wikis, or documents such as lesson plans and courses for downloading or interactive editing, complemented by document tagging to enable searching and a rating tool for commenting on shared resources.



Registration
If you do not already have an account on STEMEdhub please go to https://stemedhub.org/register to create an account. If you already have an account but do not remember your username or password you can go to the login page at https://stemedhub.org/login and click on either the 'Lost username?' button or the 'Forgot password?' button. If you have trouble with this process please email Ann Bessenbacher ambessenbacher@purdue.edu and she will help you reset your account.

Transforming Institutions Conference Group
You will find a link to the Transforming Institutions Group on the STEMEdhub.org home page in the set of Featured Collaborators' icons or at this link: https://stemedhub.org/groups/transformingedconf. If you are not already a member of the group, please click on the 'Request Group Membership' button to gain access to the group.

Once your membership is approved, you will have access to all of the group features and a screen shot is provided below. You will see the conference Twitter Feed on the right side of the page and a list of available features (Overview pages, Members, Resources, Discussion, Collections) on the left side of the page.



Conference schedule

Thursday, Oct. 23, 2014

5-8 p.m. Registration
Opening reception

6:30 p.m. Keynote presentation in *Christine Grant Ballroom*
Speaker: Freeman Hrabowski III, Ph.D., President, University of Maryland, Baltimore County

Friday, Oct. 24, 2014

7:30-8:15 a.m. Breakfast in *Christine Grant Ballroom*

8:15-9:30 a.m. Featured speaker: Adrianna Kezar, Ph.D., Professor, Rossier School of Education and Co-Director, Pullias Center for Higher Education, University of Southern California

9:45-11:45 a.m. Concurrent sessions in *Jesse Owens Room, Pat Summit/John Wooden Room, Theodore Roosevelt Room, Auditorium, and Palmer Pierce Ballrooms 1 and 2*

12-1 p.m. Lunch in *Christine Grant Ballroom*

12:30-2 p.m. Panel of University Leaders
Ann E. Austin, Ph.D., Professor of Higher, Adult, and Lifelong Education, Michigan State University

Jack Friedlander, Ph.D., Executive Vice President, Educational Programs, Santa Barbara City College

Barbara Sawrey, Ph.D., Associate Vice Chancellor for Academic Affairs and Dean of Undergraduate Education, University of California, San Diego

Moisés Wasserman, Ph.D., Board Member of the UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC) and Former Rector and Professor Emeritus of the National University of Colombia

2:15-4:15 p.m. Concurrent sessions in *Jesse Owens Room, Pat Summit/John Wooden Room, Theodore Roosevelt Room, Auditorium and Palmer Pierce Ballrooms 1 and 2*

4:30-5:45 p.m. Reception in *Lobby/Atrium*

6-7 p.m. Dinner in *Christine Grant Ballroom*

7-8 p.m. Keynote presentations in *Christine Grant Ballroom*
Linda Slakey, Ph.D., Consultant, AAU STEM Initiative

Howard Gobstein, SMTI Co-Director and the Executive Vice President for Research, Innovation and STEM Education at APLU

8 p.m. Closing remarks
Brenda Capobianco, Ed.D., Interim Director, Discovery Learning Research Center

Thursday evening overview

5-6:30 p.m.	Registration in the *NCAA Conference Center* Opening Reception
6:30-7:30 p.m.	Keynote Presentation in *Christine Grant Ballroom*
	Opening Remarks Brenda Capobianco, Ed.D., Interim Director, Discovery Learning Research Center
	Introduction of Speaker Deba Dutta, Ph.D., Provost, Purdue University
	Keynote Speaker Freeman Hrabowski III, Ph.D., President, University of Maryland, Baltimore County

Thursday evening keynote speaker

Freeman A. Hrabowski III, Ph.D.
President, University of Maryland, Baltimore County

Freeman A. Hrabowski, who has served as president of University of Maryland, Baltimore County (UMBC) since 1992, is a consultant on science and math education to national agencies, universities, and school systems. He was recently named by President Obama to chair the newly created President's Advisory Commission on Educational Excellence for African Americans. He also chaired the National Academies' committee that produced the recent report, *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads.*

Hrabowski's research and publications focus on science and math education, with a special emphasis on minority participation and performance. Named one of the 100 Most Influential People in the World by *TIME* (2012) and one of America's Best Leaders by *U.S. News & World Report* (2008), he also received TIAA-CREF's Theodore M. Hesburgh Award for Leadership Excellence (2011), the Carnegie Corporation's Academic Leadership Award (2011) and the Heinz Award (2012) for contributions to improving the human condition.

UMBC has been recognized as a model for academic innovation and inclusive excellence by such publications as *U.S. News & World Report*, which the past five years has ranked UMBC as the No. 1 "Up and Coming" university in the nation.

Brenda Capobianco, Ed.D.
Interim Director of the Discovery Learning Research Center, Purdue University
Associate Professor in the Department of Curriculum and Instruction
Co-Director, Science Learning Through Engineering Design (SLED)

Brenda Capobianco is an associate professor in the Department of Curriculum and Instruction and holds a courtesy appointment in the School of Engineering Education and an affiliated appointment in Women's Studies at Purdue University. Capobianco is currently serving as interim director of the Discovery Learning Research Center and the co-director for the Science Learning through Engineering Design (SLED) Partnership, a multiyear Math and Science Partnership program at Purdue funded by the National Science Foundation.

She holds a B.S. in biology from the University of Alaska Fairbanks, an M.S. in general science from Connecticut Central State University, and an Ed.D. from the University of Massachusetts Amherst. Her research interests include girls' participation in science and engineering; teachers' engagement in action research; and science teachers' integration of the engineering design process to improve science learning. She received Purdue University's Outstanding Faculty Teaching Award in 2004 and was recognized as a University Faculty Scholar in 2010.

This year, Capobianco received the inaugural Christian J. Foster Award, named after the former Purdue first gentleman and given to a faculty member who has made transformational contributions to improving STEM teaching and learning in Indiana's K-12 schools. And she was just named the Outstanding Educator in Science, Technology or Engineering at the annual Women and Hi Tech's Leading Light Awards. The award honors Indiana's female leaders in recognition of their achievements in science, education and technology.

Debasish (Deba) Dutta, Ph.D.
Provost and Executive Vice President for Academic Affairs
Professor of Mechanical Engineering, Purdue University

Debasish (Deba) Dutta joined Purdue University in 2014 as provost and executive vice president for academic affairs, with a faculty appointment as a professor of mechanical engineering. He came to Purdue after five years as associate provost and dean of the Graduate College at the University of Illinois at Urbana-Champaign. During 1989-2009, Dutta was a professor of mechanical engineering at the University of Michigan. He is a scholar in residence at the National Academy of Engineering.

At Illinois, Dutta led efforts in defining standards and setting policies to enable excellence in graduate education, and established offices and improved procedures for external fellowships and postdoctoral affairs. He also served as interim vice chancellor for research; chaired the Board of Directors of Illinois at Singapore PTE, a multimillion-dollar research enterprise in Singapore; and chaired the steering committee for a university-wide reorganization process in an era of declining state appropriations.

During 2004-07, he served at the National Science Foundation as acting director of the Division of Graduate Education, as IGERT program director and as advisor in the Office of Assistant Director, Education and Human Resources. He chaired the Learning and Workforce Development subcommittee during the development of NSF's Cyberinfrastructure Strategy (Vision for 21st Century Discovery).

At University of Michigan, among other accomplishments, Dutta was the founding director of InterPro, an innovative interdisciplinary academic unit in the College of Engineering that catalyzed new interdisciplinary graduate programs.

Dutta received his Ph.D. from Purdue University in 1989 and is a fellow of the American Association for the Advancement of Science and a fellow of the American Society of Mechanical Engineers.

Friday morning overview

7:30-8:15 a.m. Breakfast in *Christine Grant Ballroom*

8:15-9:30 a.m. Introduction of Speaker
Jeff Vredevoogd, Director, Herman Miller Education

Featured Speaker
Adrianna Kezar, Ph.D., Professor, Rossier School of Education and Co-Director, Pullias Center for Higher Education, University of Southern California

9:45-11:45 a.m. Concurrent Sessions in *Jesse Owens Room, Pat Summit / John Wooden Room, Theodore Roosevelt Room, Auditorium and Palmer Pierce Ballrooms 1 and 2*

Friday morning featured speaker

Adrianna J. Kezar
Professor, Rossier School of Education and Co-Director, Pullias Center for Higher Education, University of Southern California

Adrianna Kezar is a professor in the Rossier School of Education and co-director of the Pullias Center for Higher Education at the University of Southern California. She has several years' administrative experience in higher education as well both in academic and student affairs. Her field of expertise consists of change and leadership in higher education, and her research agenda explores the change process in higher education institutions and the role of leadership in creating change.

Kezar is also a well-known qualitative researcher and has written several texts and articles about ways to improve qualitative research in education. She is well published with 14 books, over 75 journal articles, and over a hundred book chapters and reports. In 2011, she published two new books: *Recognizing and Serving Low Income Students* (Routledge, 2011) and *Enhancing Campus Capacity for Leadership* (Stanford Press, 2011). Other recent previous books include *Understanding the New Majority of Non-tenure Track Faculty* (Jossey Bass, 2010); *Organizing for Collaboration* (Jossey Bass, 2009); *Rethinking Leadership Practices in a Complex, Multicultural and Global World* (Stylus Press, 2009); *Rethinking the "L" Word in Higher Education: The Revolution of Research on Leadership* (Jossey Bass, 2006); and *Higher Education for the Public Good* (Jossey Bass, 2005). She has acquired over $5 million dollars in grant funding and has worked on grant-funded projects exceeding $12 million dollars on a variety of projects to fundamentally improve higher education.

Kezar has participated actively in national service, including being on the editorial boards for *The Journal of Higher education, The Journal of College Student Development, Change,* and *The ERIC Review* and serving as a reviewer for 17 journals in and outside higher education. She has played major leadership roles, serving on the AERA-Division J Council and Association for the Study of Higher Education Board, Publication Committee and Dissertation of the Year Committee. Kezar also has served on numerous national boards, including the American Association for Higher Education, Association of American Colleges and Universities' Peer Review and Knowledge Network, National TRIO Clearinghouse, and the American Council on Education's CIRP Research Cooperative. She volunteers for several national organizations, including the National Science Foundation, HERS/Bryn Mawr Summer Institute, Project Kaleidoscope, Pathways to College Network and the Kellogg Forum on Higher Education for the Public Good.

Kezar holds a Ph.D. (1996) and M.A. (1992) in higher education administration from the University of Michigan and a B.A. (1989) from the University of California, Los Angeles. She joined the faculty at USC in 2003. Kezar has received national awards for her editorial leadership of the ASHE-ERIC report series from ASHE, for developing a leadership development program for women in higher education from ACE, and for her commitment to service learning from the National Society for Experiential Learning.

Jeff Vredevoogd
Director, Herman Miller Education

As director of Herman Miller Education, Jeff Vredevoogd leads the effort to expand the understanding of evolving learning trends and the impacts on higher education environments.

His specific areas of contribution have included:

- maintaining a strong focus on researching changes in teaching and learning and how space can support this evolution;
- developing knowledge and insights to assist higher hducation leadership in shaping new approaches to campus learning spaces;
- working with clients to develop new approaches to campus learning spaces (including learning space strategy, observation, design criteria and change management); and
- assessment efforts that have helped leadership understand the impact that space can have on teaching and learning.

With over 30 years of industry experience, Vredevoogd works with higher education leadership to develop spaces that have a positive impact on teaching and learning.

Concurrent sessions, Friday morning

SESSION THEMES	Institutional Supports and Barriers for Transformation	Case Studies in Institutional Transformations in Engineering and Technology Education	Strategies	AAU Undergraduate STEM Education Initiative	Faculty Development for Educational Innovation	Understanding Transformation through Assessment
LOCATIONS	Jesse Owens Room	Pat Summit/John Wooden Room	Theodore Roosevelt Room	Auditorium	Palmer Pierce Ballroom 1	Palmer Pierce Ballroom 2
9:45 A.M.	A1: Applying the CACAO Change Facilitation Model to Promote Systemic Transformation	B1: Our Big Move in 1,000 Small Steps: A Lesson in Collaboration	C1: Sandbox. Learning. Space.	D1: The Role of Cultural Change in Large-scale STEM Reform: The Experience of the AAU Undergraduate STEM Education Initiative	E1: Faculty Learning Communities: A Model that Fosters Individual, Departmental, and Institutional Impact	F1: Evolution of STEM Faculty Perceptions of Concept Map Assessments
	Pat Pyke R. Eric Landrum Anthony Marker Amy Moll Tony Roark Susan Shadle Karen Viskupic	Robert Herrick Fatma Mili	Jeanne Narum Shirley Dugdale Nancy Sturm	Emily Miller James Fairweather	Katerina V. Thompson	Lindsay Owens Helen Meyer
10:15 A.M.	A2: From Grassroots to Institutional-ization: RIT's CASTLE	B2: T-shaped Support for T-shaped Graduates	C2: Balancing Pathfinding Innovation with Institutional Cultural and Constratins for a (Truly) Multidisciplinary Design Initiative	D2: Measuring Progress: The Value of Common Data for the AAU STEM	E2: Successful Model for Professional Development: Creating and Sustaining Faculty Learning Communities	F2: Creating a Coherent STEM Gateway for Teaching and Learning: An AAU STEM Initiative Project
	Scott Franklin	Gary Bertoline Fatma Mili	Brian E. Gilchrist Karen Batzli A. Harvey Bell Gail Hohner Daniel I. Johnson Brian Noble Albert Shih Max Shtein	James Fairweather Josh Trapani Karen Paulson	Ann C. Smith Gili Marbach-Ad Ann M. Stevens	Melanie M. Cooper Marcos D. Caballero Diane Ebert-May Cori L. Fata-Hartley Sarah E. Jardeleza Joseph S. Krajcik James T. Laverty Rebecca L. Matz Lynmarie A. Posey Sonia M. Underwood

Concurrent sessions, Friday morning

SESSION THEMES	Institutional Supports and Barriers for Transformation	Case Studies in Institutional Transformations in Engineering and Technology Education	Strategies	AAU Undergraduate STEM Education Initiative	Faculty Development for Educational Innovation	Understanding Transformation through Assessment
LOCATIONS	Jesse Owens Room	Pat Summit/John Wooden Room	Theodore Roosevelt Room	Auditorium	Palmer Pierce Ballroom 1	Palmer Pierce Ballroom 2
10:45 A.M.	A3: Achieving Large-scale STEM Education Improvement at a Research University	B3: Current Directions in Modern Undergraduate Engineering Education	C3: Can the Studio/Spiral Model of Technology Training for Theatre Inform Undergraduate STEM Curricula?	D3: Creating High Engagement Learning Environments in Large Introductory STEM Courses	E3: Culture, Policy and Technology: Barriers Reported by Faculty Implementing Course Reform	F3: A Social Constructivist Perspective of Teacher Knowledge: The PCK of Biology Faculty at Large Research Institutions
	Craig Ogilvie Charles Henderson	Anas Chalah Fawwaz Habbal David Hwang	Rich Dionne	Kelly A. Hogan	Loran C. Parker Omolola A. Adedokun Zaira R. Arvelo Alicea Sula Lee Rob Morris Gabriela Weaver	Kathleen Hill
11:15 A.M.	A4: Integration and Transformation: Steps toward Institutionalizing Undergraduate Research at Hunter College	B4: A Transformative Initiative: How iFoundry's Heroic Systems Course Reimagines STEM Education for the 21st Century	C4: The Vertically-Integrated Projects (VIP) Program – Leveraging Faculty Research Interests to Transform Undergraduate STEM Education	D4: University of Arizona	E4: A Disciplinary Teaching and Learning Center: Applying Pedagogical Content Knowledge to Faculty Development	F4: Supporting STEM Education: Reflections of the Central Indiana Talent Expansion Project
	Rachel B. Verni Annemarie Nicols-Grinenko	Diana E. Sheets	Edward J. Coyle Randal T. Abler Brian E. Gilchrist Amos Johnson James V. Krogmeier Stephen Marshall	Gail Burd Deb Tomanek	Gili Marbach-Ad Laura C. Egan Katerina V. Thompson	Jeffery X. Watt Lisa G. Bunu-Ncube Charles Feldhaus Andrew Gavrin Stephen Hundley Kathleen Marrs Howard Mzumara

SESSION: **A1**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***Applying the CACAO Change Facilitation Model to Promote Systemic Transformation***

PRESENTERS: **Pat Pyke,** *Boise State University;* **Susan Shadle, Ph.D.,** *Boise State University;* **Karen Viskupic, Ph.D.,** *Boise State University;* **Amy Moll, Ph.D.,** *Boise State University;* **Anthony Marker,** *Boise State University;* **R. Eric Landrum, Ph.D.,** *Boise State University;* **and Tony Roark, Ph.D.,** *Boise State University*

ABSTRACT:

Our goal as STEM educators is to apply the rich and deep body of research on effective instructional practices — everything from discipline specific strategies to optimized learning spaces — to transform student learning, persistence and degree attainment. To achieve this ambitious goal at our institution (around 3,500 undergrad STEM students), our team is applying a change facilitation model from the business world, Dormant's CACAO model, to systematically explore and address supports and barriers at all institutional levels. The CACAO model guides us in translating scholarly change theory into an actionable plan to propagate evidence-based instructional practices (EBIPs) throughout our STEM curricula.

As part of an NSF WIDER project begun in fall 2013, we facilitated data-gathering conversations with more than190 science, engineering and mathematics faculty to learn their perceptions of the proposed shift to student-centered, evidence-based teaching practices. Faculty were asked to identify factors in five categories (relative advantage, simplicity, compatibility, adaptability and social impact) that serve as either driving or restraining forces for change. We have also supported a team of faculty advocates to implement seven first-wave projects centered on EBIPs and conducted campus-wide surveys on teaching practices and instructional climate.

Results from the facilitated conversations, first-wave projects and surveys have enabled us to engage faculty with plans for pedagogical change and university leaders to address institutional supports and barriers such as classroom space planning, policies and resources. In this session, we will present how we are applying Dormant's CACAO model to support and overcome personal, departmental and institutional obstacles to widespread adoption of effective EBIPs. Our intention is to provide a model applicable and adaptable for institutions nationally.

SESSION: **A2**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***The Importance of Context: Departmental Variations in Factors Influencing Adoption of Educational Innovations***

PRESENTERS: **Travis J. Lund,** *Oregon Institute of Technology*, **and Marilyne Stains,** *University of Nebraska-Lincoln*

ABSTRACT:

Research at the secondary and post-secondary levels has clearly demonstrated the critical role of individual and contextual characteristics in instructor adoption of educational innovations. Although recent research has begun to shed light on factors influencing STEM faculty teaching practices, it is still not well understood how unique departmental environments impact faculty adoption of evidence-based instructional practices within the context of a single institution. In this study, we have sought to characterize the communication channels and external and internal factors that influence STEM faculty teaching practices at the departmental level.

Accordingly, we have collected survey and observational data from the majority of the chemistry, biology and physics faculty at a single large research-intensive university. In particular, faculty have reported the extent to which their teaching has been influenced (positively or negatively) by various external and internal factors, including departmental expectations, course or classroom constraints, resource availability and faculty attitudes. In this presentation, we will report on systematic similarities and differences between these three departments in terms of teaching influences and communication channel usage. In addition, we have identified the communication channels and internal and external teaching influences that are correlated with high or low adoption of evidence-based instructional practices. An understanding of these supports and barriers, including the consideration of individual, departmental and institutional characteristics, will aid stakeholders in the successful propagation of educational innovations.

SESSION: **A3**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***Achieving Large-Scale STEM Education Improvement at a Research University***
PRESENTERS: **Craig Ogilvie,** *Iowa State University,* **and Charles Henderson,** *Western Michigan University*

ABSTRACT:

We have implemented a large-scale education change at Iowa State University, with the main goal of engaging first and second-year students by having them do science within their courses. Groups of 80 faculty across all our science departments have worked in Faculty Learning Communities (FLCs) to adapt ideas to what works best with their disciplines. These FLCs have 1) added extended five- to six-week research projects into lab courses so that all science students conduct research; 2) changed all of our large-enrollment introductory labs from "cookbook" to inquiry; and 3) added active learning to large classes. We are now impacting over 10,000 students each year.

Our presentation incorporates two conference themes: institutional supports and barriers for transformation and faculty development for educational innovation. We will briefly describe the impact these changes have had on students, but spend more time on the process of change, especially how departments have been engaged in the reform. We will examine this through two lenses: the Eight-Stage Leadership Process described by John Kotter and Dan Cohen and the Complexity Leadership Theory described by Mary Uhl-Bien. By generalizing our results, we aim to help other universities utilize emergent change to achieve their education reforms.

SESSION: **A4**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***Integration and Transformation: Steps toward Institutionalizing Undergraduate Research at Hunter College***

PRESENTERS: **Rachel B. Verni,** *Hunter College* **and Annemarie Nicols-Grinenko,** *Hunter College*

ABSTRACT:

Addressing the theme of institutional supports and barriers for transformation, this presentation will highlight the steps that Hunter College has taken to institutionalize undergraduate research on its campus. Over the past several years, the Offices of the President, Provost and Vice President for Student Affairs have collaborated with faculty and students to advance a culture of undergraduate research that is completely aligned with, and supportive of, the two major planks of Hunter's strategic plan— to become a more research-oriented institution and to increase efforts to support student success.

Several initiatives that have contributed to this ongoing transformation will be discussed, starting with a presidential initiative in 2007 and including a five-year NSF grant to establish Hunter's-Science Mathematics Opportunities Network (SciMON), the implementation of an undergraduate research initiative to support student-faculty research in and beyond the sciences and the institutionalization of an annual undergraduate research conference to recognize and celebrate student-faculty research efforts. These activities — along with a new undergraduate research hub website that serves a centralized source of information and advice — both enhance awareness of research opportunities and provide support for Hunter's students and faculty. Other features of Hunter's effort, which are critical to creating a sustainable infrastructure that can accommodate growth and continuing innovation, will also be discussed.

SESSION: **B1**
SESSION TOPIC: **Case Studies in Institutional Transformations in Engineering and Technology Education**
TITLE: ***Our Big Move in 1,000 Small Steps: A Lesson in Collaboration***
PRESENTERS: **Robert Herrick,** *Purdue University* **and Fatma Mili,** *Purdue University*

ABSTRACT:

The Purdue Polytechnic Institute is a collective effort led by the College of Technology with strategic partners in the Colleges of Liberal Arts and Education. This project was approved by the Purdue president in 2013 with a goal to start with a pioneering class in 2014.

The Purdue Polytechnic aims to foster a learning environment that is engaging, empowering and relevant to the students' passions. Learning happens in an integrated way with no separation between the disciplines. In the Purdue Polytechnic, faculty are no longer sages on the stage but guides on the side, helping the students build individualized purposeful paths. In many ways, this is a complete departure from the way we are traditionally organized and the way we operate.

The long-term plan is to create a multi-disciplinary holistic degree in which all disciplines come together and collaborate to create this environment for the students. In the meantime, we have designed a first year that is consistent with the disciplinary knowledge that current majors require and consistent with the Purdue Polytechnic values. We started with a constraints-free environment letting the pioneering faculty design the ideal setting. Then, we worked with all stakeholders to align with current existing requirements and ensure that the students can enroll in their traditional degrees while learning in a polytechnic environment and culture. In this presentation, we will share our strategic approach in partnering with university constituents as well as the mechanics and the lessons learned in collaborating with all departments and administrative constituencies.

SESSION: **B2**
SESSION TOPIC: **Case Studies in Institutional Transformations in Engineering and Technology Education**
TITLE: ***T-Shaped Support for T-Shaped Graduates***
PRESENTERS: **Gary Bertoline,** *Purdue University* **and Fatma Mili,** *Purdue University*

ABSTRACT:

The Purdue Polytechnic Institute is an educational research and development initiative led by the College of Technology at Purdue and funded as one of the Purdue Moves supported by Purdue's president. Purdue Polytechnic is a response to changing needs of three key constituencies: we entered a thinking economy, different from the knowledge economy; students grew in a connected, collaborative world and are concerned about their collective future; and, as a consequence, the mission of higher education has also changed from its narrow focus on the elite to a necessity for all.

In the past decade, many educators, professional organizations and industries have recognized the urgency to close the gap between a traditional conservative institution and a rapidly evolving world. Many initiatives aiming to address this gap have emerged, some bottom up, some top down, some in small private institutions, others in large public ones. Each one of them presents unique challenges and learned lessons.

We share our experience in beginning to transform the way we educate. We describe the journey started months ago, examine the challenges encountered and the successes we have had so far. We emphasize in particular the importance of the comprehensive broad and deep support from all segments of the university. As we question and seek to transform, we discover the mechanics that have made this institution of higher education resilient and conservative. Having allies and collaborators from the full range of stakeholders at the same time coordinated by the top leadership is paramount to truly transformative actions.

SESSION: **B3**
SESSION TOPIC: **Case Studies in Institutional Transformations in Engineering and Technology Education**
TITLE: ***Current Directions in Modern Undergraduate Engineering Education***
PRESENTERS: **Anas Chalah,** *Harvard - SEAS***; David Hwang,** *Harvard - SEAS***; and Fawwaz Habbal,** *Harvard - SEAS*

ABSTRACT:

Engineering skills have become essential core knowledge for every broadly educated person — and indispensable for leaders. Concurrently, an explosion of knowledge and new technologies has transformed society and enabled new pedagogy, including online learning. With this in mind, an understanding of the role of the university and its impact on devising solutions to the world's most challenging problems is required. Large-scale challenges of unprecedented complexity demand cross-disciplinary learning and system-level solutions that are learned through different teaching tools. Technical expertise alone is not enough to be successful in analyzing and addressing large-scale social issues; deep understanding of the societal context of the problem at hand requires critical thinking skills derived from broad exposure to the arts, humanities, and social sciences. Thus, the leadership required to address today's most intractable challenges cannot emerge without a new and innovative curriculum.

At Harvard School of Engineering and Applied Sciences (SEAS), we are revamping our curriculum, reinventing engineering education and striving to create a new 21st century engineer. Our focus is on creating a curriculum that allows students to excel in engineering and applied sciences, and also have a broad knowledge of other disciplines.

Through research and scholarship, SEAS is creating collaborative bridges across Harvard and educating a generation of students with the drive to become global and innovative leaders. In this presentation, we will discuss successes and difficulties with our approaches. We will address the difficult case of balancing breadth and depth, as well as methods for providing soft-skills that ensure building on the strength of the individuals as well as team participation through exposing students to real-life environments where ethical decisions are critical, yet paradoxical. One cornerstone of our education is *design thinking* courses as well as a capstone design activity. These will be points for discussions as well.

Changes that have taken place over the past two years have been under evaluation and assessment. Our presentation will provide insights about the role of active learning, human support (preceptors and advisors), peer-to-peer education, online learning and international research experiences. We believe that all of these are critical elements in creating a required ecosystem for innovation and problem solving.

SESSION: **B4**
SESSION TOPIC: **Case Studies in Institutional Transformations in Engineering and Technology Education**
TITLE: ***A Transformative Initiative: How iFoundry's "Heroic Systems" Course Reimagines STEM Education for the 21st Century***

PRESENTERS: **Diana E. Sheets, Ph.D.,** *University of Illinois at Urbana-Champaign*

ABSTRACT:

The College of Engineering at the University of Illinois has the same challenge facing many educational institutions in the STEM disciplines. Our students are superbly trained by a top-tier school. Our engineers work at prestigious corporations, government agencies and academic institutions. They lead fulfilling careers. Many are great entrepreneurs who transform the socio-techno landscape.

Our biggest challenge is not technical but imaginative: How do we empower engineers to achieve not only outstanding professional accomplishments but also to become the global leaders of tomorrow? iFoundry believes it's not enough for our graduates to be the recognized experts in their fields. They must be movers and shakers in the corridors of power. That entails exposing students to big ideas and encouraging them to transgress the academic boundaries in pursuit of transformative solutions. We want to give them the confidence and vision to reinvent the world.

Our course, "Heroic Systems: Pushing the Boundaries of Greatness, Past, Present, & Future" defines heroic systems. It examines how heroic systems are conceived in buildings, infrastructures, telecommunications, water and city life, modes of transportation, sports analytics, space exploration, the electric grid and the pioneering frontiers of health and medicine. It's about enabling students to invent the "Next New Thing" while ensuring that they shape the political and institutional responses to these new systems and technologies. The course serves as a case study of how to reimagine engineering for the 21st century.

SESSION: **C1**
SESSION TOPIC: **Strategies**
TITLE: ***Sandbox. Learning. Space.***
PRESENTERS: **Jeanne Narum,** *Learning Spaces Collaboratory***; Nancy Sturm,** *The Sextant Group***; and Shirley Dugdale,** *Dugdale Strategy LLC*

ABSTRACT:

Sandbox is a metaphor for a space designated for exploring approaches to enhance learning that may not be common in a given institutional context. *Sandboxing* is a planning strategy intended to be a *learning* experience for a diverse set of stakeholders. If learning happens best by "practicing" doing, a sandbox affords faculty, students and many others extended opportunity to become comfortable with new pedagogies, technologies and settings that enable changing dynamics in the learning experience. It also provides research opportunities to test how space that accommodates a range of pedagogies can improve assessment in STEM education, to guide future space development.

In sandboxing, we are challenged to ask new questions about how and where learning happens: how can we leverage knowledge from the learning and cognitive sciences, and the work of pioneering agents of change within and beyond our campus? Administrators managing assessment, faculty and curriculum development, facilities and budgets are also learners. A sandbox is transparent in that all stakeholders become aware of how new approaches could work for their community — enhancing learning and institutional distinction.

A sandbox process starts by inviting design of new learning experiences: first engaging inventive faculty and students in envisioning future learning, and then defining pilot settings through rapid prototyping with iterative testing. The process also accelerates change by stimulating strategies to address: course redesign; reduced density and greater flexibility in classrooms; new scheduling systems for bookable-on-demand spaces; and development of the essential ecosystem of integrated support services needed to drive change.

SESSION: **C2**
SESSION TOPIC: **Strategies**
TITLE: ***Balancing Pathfinding Innovation with Institutional Culture and Constraints for a (Truly) Multidisciplinary Design Initiative***

PRESENTERS: **Brian E. Gilchrist,** *University of Michigan - Ann Arbor***; Alan Taub,** *University of Michigan - Ann Arbor***; Albert Shih,***University of Michigan - Ann Arbor***; Max Shtein,** *University of Michigan - Ann Arbor***; Gail Hohner,** *University of Michigan - Ann Arbor***; A. Harvey Bell,** *University of Michigan - Ann Arbor***; Karen Batzli,** *University of Michigan - Ann Arbor***; Daniel I. Johnson,** *University of Michigan - Ann Arbor***; and Brian Noble,** *University of Michigan - Ann Arbor*

ABSTRACT:

Through support from University of Michigan's Provost and College of Engineering, a college-level initiative was created to focus on expanding significant, multidisciplinary design experiential learning opportunities. This Multidisciplinary Design (MD) Program was intended to bring students together that not only came from all engineering departments, but also from other schools and colleges across the campus. Emphasis was given to projects that were real-world with a real customer or need and generated real, testable products or solutions.

As a college-level program, the MD Program has had the opportunity to innovate and pilot a variety of different initiatives, assess their impact and sustainability, and rapidly revise. This could be done without fully confronting the sometimes significant differences in culture and constraints between engineering departments or between schools/colleges. Yet, any sustainable initiative must ultimately address these differences in a way that keeps the core strengths of any innovative initiative while finding a way to simultaneously push change and respect the culture and constraints across many educational units.

In our presentation, we share our experiences and ideas, both those that have been successful and those that have been less so.

SESSION: **C3**
SESSION TOPIC: **Strategies**
TITLE: ***Can the Studio/Spiral Model of Technology Training for Theatre Inform Undergraduate STEM Curricula?***

PRESENTERS: **Rich Dionne,** *Purdue University*

ABSTRACT:

Technology training for theatre — which includes, among other concepts, structural design, mechanical design, construction management, control and automation systems, and computer networking — often follows a signature pedagogy (Schulman) comprised of studio-based project-based learning in a spiral curriculum (Cennamo and Brandt; Harden and Stamper). Successful learners in well-structured programs often become innovators in theatre technology, pushing the boundaries of what is possible on stage and in other live entertainment venues by combining existing technologies in new ways and by working with industrial partners to develop new technologies in STEM fields including networking, robotics, control systems, material science, structures and mechanical engineering.

While these learners rarely explore STEM fields through traditional STEM coursework, they are nevertheless innovators, knowledgeable in STEM fields who continue to expand that knowledge throughout their careers. This suggests there may be much for STEM educators to learn from the studio/spiral curricular approach these students experience, and about the growth mindset (Dweck) that this approach inspires. This paper will examine the studio/spiral curriculum common in theatre technology training as a signature pedagogy, and explore how that pedagogy might be applied to undergraduate STEM education, primarily as a resource for undergraduate instructors developing project-based-learning courses and/or developing new four-year curricular models.

SESSION: **C4**
SESSION TOPIC: **Strategies**
TITLE: ***The Vertically-Integrated Projects (VIP) Program – Leveraging Faculty Research Interests to Transform Undergraduate STEM Education***

PRESENTERS: **Edward J. Coyle,** *Georgia Institute of Technology - Main Campus*; **James V. Krogmeier,** *Purdue University*; **Randal T. Abler,** *Georgia Institute of Technology - Main Campus*; **Amos Johnson,** *Morehouse*; **Stephen Marshall,** *University of Strathclyde*; **and Brian Gilchrist,** *University of Michigan - Ann Arbor*

ABSTRACT:

The Vertically-Integrated Projects (VIP) Program is an education program that operates in a research and development context. Undergraduate students that join VIP teams earn academic credit for their participation in discovery and design efforts that assist faculty and graduate students with research and development issues in their areas of technical expertise. The teams are multidisciplinary, drawing students from across campus; vertically-integrated, maintaining a mix of sophomores through Ph.D. students each semester; and long-term, allowing each undergraduate student to participate in a project for up to three years. The continuity, technical depth and disciplinary breadth of these teams enable the completion of projects of significant benefit to faculty members' research programs.

We compare the implementations and success of VIP Programs at five different institutions by a variety of criteria, including origin and type of implementation strategy; number of disciplines involved; type of institution; implementation in the curriculum; resources and support available; growth of the program; grading/assessment strategy and tools; relationship with other discovery and design programs; software tools for program administration; and number of students and faculty involved. While programmatic variations and support have a marked effect on the success of VIP at each institution, its implementation in the curriculum and the ease of scheduling and timetabling teams stand out as two of the most important issues for every VIP site. The common slow pace of curricular change and the variability of curricular implementations across disciplines and institutions lead to specific recommendations and strategies for future growth and dissemination of the VIP Program.

SESSION: **D1**
SESSION TOPIC: **AAU Undergraduate STEM Education Initiative**
TITLE: ***The Role of Cultural Change in Large-scale STEM Reform: The Experience of the AAU Undergraduate STEM Education Initiative***

PRESENTER: **Emily Miller, Project Director,** *AAU Undergraduate STEM Education Initiative*
CO-AUTHOR **James Fairweather, Professor and Director,** *Center for Higher and Adult Education, Michigan State University*

ABSTRACT:

The Association of American Universities (AAU) is in the middle of a five-year initiative in collaboration with member institutions to improve undergraduate teaching and learning in STEM fields primarily in the first two years. The initiative offers an alternative to traditional STEM change efforts focused on individual faculty members, which, according to recent major reports by the National Academy of Sciences and PCAST on discipline-based educational research, largely have been ineffective. Instead, the initiative seeks larger and more permanent reform by influencing academic cultures to encourage STEM faculty to use teaching practices proven by research to be more effective in helping students learn.

The primary culture of interest is the academic department, although the AAU effort also examines the cultures of the college, institution and disciplinary societies. In addition to fostering and assessing changes in faculty pedagogy and attitudes toward teaching, the initiative seeks to reform faculty reward systems to enhance the value of undergraduate teaching at research universities. Eight AAU institutions are currently implementing projects for the initiative. All 62 institutions have appointed a contact person for the initiative and most plan to join a larger AAU-related network in support of this effort.

SESSION: **D2**
SESSION TOPIC: **AAU Undergraduate STEM Education Initiative**
TITLE: ***The Roles of Data in Promoting Institutional Commitment to Undergraduate STEM Reform: The AAU STEM Initiative Experience***

PRESENTER: **James Fairweather, Professor and Director,** *Center for Higher and Adult Education, Michigan State University*
CO-AUTHORS: **Josh Trapani, Director of Policy Analysis,** *Association of American Universities; Karen Paulson (Co-author),* **Senior Associate,** *National Center for Higher Education Management Systems*

ABSTRACT:

Most literature on the utility of data in STEM education reform focuses on individual faculty members and the performance of their students in the classroom. This literature fails to address a much wider application of data to the reform process, which must take into account the departmental and institutional environments as well as the academic disciplines. We draw on two sources of information from the AAU Initiative to demonstrate how data can be used to influence institutional transformation.

The first source is qualitative information collected on visits to the eight AAU project sites, including examples of how student performance data has been used as evidence in departmental adoption of curricula reforms. The second source, quantitative in nature, is a cross-site instrument on faculty teaching practices and attitudes that was administered to faculty at both project and non-project AAU institutions. Obtaining faculty and institutional buy-in was vital in the development and administration of the instrument and required dialogue with faculty and administrators during the iterative development of the instrument. Communication of AAU's project goals and objectives, as well as explicitly limiting analyses to aggregate project use, was essential.

We discuss potential applications of both forms of data to institutional and departmental decision-making. Finally, we address the role, and limitations, of common instruments in expanding the AAU project to form a broader network of institutions interested in STEM reform.

SESSION: **D3**
SESSION TOPIC: **AAU Undergraduate STEM Education Initiative**
TITLE: ***Creating High Engagement Learning Environments in Large Introductory STEM Courses***

PRESENTER: **Kelly A. Hogan, Director of Instructional Innovation for the College of Arts and Sciences,** *University of North Carolina, Chapel Hill*
CO-AUTHOR **Jennifer Krumper, Lecturer in Chemistry,** *University of North Carolina, Chapel Hill;* **Michael T. Crimmins; Mary Ann Smith, Distinguished Professor,** *University of North Carolina, Chapel Hill;* **Laurie E. McNeil, Bernard Gray Distinguished Professor,** *University of North Carolina, Chapel Hill*

ABSTRACT:

This presentation addresses the need for **faculty development** in educational innovation by increasing the **support** for faculty to change their teaching and lowering the **barriers** that inhibit needed change. At UNC, three departments (Biology, Chemistry, and Physics and Astronomy) are working together to bring evidence-based teaching practices to the introductory courses that have been traditionally taught by lecture methods.

We will describe how we are using a mentor-apprentice model to transfer effective techniques from instructors experienced in evidence-based techniques to their less experienced (but perhaps senior!) peers. In this way, we build on progress already achieved and thereby reduce the developmental phase (a barrier) for tenure-track and tenured faculty. A mentor and a course release provide support for faculty who are learning to teach with new techniques. Interdisciplinary faculty learning communities bring instructors from the three departments together routinely to solve common problems and share best practices.

Our presentation will share some initial data we have collected from interviews with faculty, some involved and some not directly involved in the project. We'll also present challenges faced and our current view of best practices for replicating this model at another institution. Our long-term goals are to have 11 transformed courses that touch the majority of STEM majors, to have trained between 15-20 tenure and tenure-track faculty in evidence-based methods, and to observe those methods in continued use in semesters after the training. Besides affecting the culture of teaching, our goals include measuring changes in student outcomes related to attitudes, retention and learning gains for students in these courses.

SESSION: **D4**
SESSION TOPIC: **AAU Undergraduate STEM Education Initiative**
TITLE: ***Developing Departmental Cultures for Evidence-Based Teaching Practices in STEM***

PRESENTER: **Debra Tomanek, Associate Vice Provost for Instruction and Assessment, Professor of Molecular & Cellular Biology,** *University of Arizona*
CO-AUTHOR: **Gail D. Burd, Senior Vice Provost for Academic Affairs, Distinguished Professor of Molecular & Cellular Biology,** *University of Arizona*

ABSTRACT:

This presentation will address the themes of understanding transformation through assessment and supports and barriers for transformation. The UA project is built on the assumption that a departmental culture of teaching is more likely to undergo transformation to more evidence-based approaches when faculty members within the culture initiate the changes. In order to grow our project's potential for influencing transformation at the departmental level, we collect assessment of teaching data through surveys, classroom observations, and interviews and data on students' academic performance.

We will describe, with the use of an example from Physics, how the data are used to first understand the current state of teaching and learning in individual courses and then to participate in departmental level discussions about possible changes suggested by the data. We will also discuss how our project is addressing barriers to the transformation process at the departmental culture level by (1) supporting faculty members who are already interested in change as participants in project-centric Faculty Learning Communities (FLC), and (2) supporting FLC members and key project leaders in their efforts to advocate for reformed teaching in their own departments. We have recently begun data collection to understand how one of our project departments (Chemistry and Biochemistry) is transforming all sections of general chemistry by supporting faculty teaching the reformed curriculum with active learning pedagogies.

Our long-term project goals are to (1) support the transformation of STEM departmental cultures to practice and sustain evidence-based, active learning instruction in their classes, and (2) redesign at least five introductory STEM courses in alignment with the first goal.

SESSION: **E1**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Faculty Learning Communities: A Model that Fosters Individual, Departmental and Institutional Impact***

PRESENTERS: **Katerina V. Thompson,** *University of Maryland - College Park***; Gili Marbach-Ad,** *University of Maryland - College Park***; Laura C. Egan,** *University of Maryland - College Park***; and Ann Smith,** *University of Maryland - College Park*

ABSTRACT:

Despite prominent calls to improve undergraduate science education, bringing about this change has proven difficult. Faculty learning communities (FLCs) are emerging as a powerful model for fostering STEM reform in higher education. FLCs can be characterized as groups of faculty members who meet on a regular basis to share activities, knowledge and practices, which collectively constitute a joint enterprise. Our university has multiple FLCs whose joint enterprise is to improve undergraduate STEM education. Some of these FLCs are active for a specific academic year, while others are longstanding. Our FLCs focus variously on (a) gateway introductory courses; (b) the interface between related disciplines, such as biology and physics; (c) courses related to a shared research area; and (d) non-tenure track faculty members.

In this presentation, we will characterize the STEM-related FLCs in our institution, share our experiences with creating and supporting FLCs, and present evidence from surveys and student assessments that demonstrates that FLC members use more evidence-based teaching approaches than non-FLC members. We will discuss the benefits of FLCs at the individual, departmental and institutional levels. At the individual level, FLC participants become more comfortable with their teaching role, learn important teaching skills, implement more evidence-based teaching approaches and feel more collegial as well as more recognized for their work. At the departmental and institutional levels, FLCs provide opportunities for faculty mentorship, allow for the development of large-scale projects, facilitate grant funding and offer opportunities for the development of curriculum and assessment for a program of study.

SESSION: **E2**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Successful Model for Professional Development: Creating and Sustaining Faculty Learning Communities***

PRESENTERS: **Ann C. Smith,** *University of Maryland - College Park*; **Ann M. Stevens,** *Virginia Polytechnic Institute and State University*; **and Gili Marbach-Ad,** *University of Maryland - College Park*

ABSTRACT:

Faculty learning communities (FLCs) are one of the most effective ways to provide faculty with professional development in teaching and learning. FLCs engage faculty members that might otherwise be reluctant to participate in pedagogical activities by providing them with a supportive environment to explore and experiment with teaching approaches.

The Host-Pathogens Interaction (HPI) FLC at the University of Maryland has a successful working model for developing such an FLC. The HPI FLC brings together 20 faculty members with a shared research interest in HPI who are collectively responsible for nine undergraduate courses that cover HPI topics. They have met monthly since 2004 to discuss topics related to teaching and learning. Over the past ten years, the HPI FLC members created a validated two-tiered concept inventory (HPI-CI), consisting of multiple-choice questions with open-ended explanations. Based on the rich data collected, the group made curriculum and pedagogical changes in their courses. The multiple publications that resulted from the group's work draw the attention of many science educators who ask permission to use the HPI CI in their courses.

More significantly, the process for developing an effective community has now been successfully transported to the Microbiology Group at Virginia Tech. Work at both institutions focuses on using the HPI CI as an assessment tool to engage faculty members in discussions about student learning, especially commonly held student alternative conceptions that set a barrier to instruction. We will share the process of creating inter-institutional collaborations between FLCs, including challenges faced and solutions found.

SESSION: **E3**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Culture, Policy and Technology: Barriers Reported by Faculty Implementing Course Reform***

PRESENTERS: **Loran C. Parker,** *Purdue University*; **Omolola A. Adedokun,** *Purdue University*; **Zaira R. Arvelo Alicea,** *Purdue University*; **Sula Lee,** *Purdue University*; **Rob Morris,** *Purdue University*; **and Gabriela Weaver,** *Purdue University*

ABSTRACT:

This work reports on research exploring the transformation process at the intersection of faculty and institutional levels and addresses supports and barriers to institutional transformation. The long-term goal of this research effort is the description of institutional best practices surrounding the transformation of undergraduate teaching and learning process. The project under study selects and supports cohorts of faculty (approximately 60 per year) at a large Midwestern research university through the process of course transformation. To examine perceived barriers to successful and sustained transformation, participating faculty and instructors are surveyed and interviewed periodically beginning with their entrance to the program and continuing yearly after they have first implemented their redesign.

We report on data collected from multiple cohorts who have implemented their redesigned courses. Descriptive and thematic analysis, triangulated across cohorts and between quantitative and qualitative data sources reveal that faculty and instructors encounter several types of barriers including student resistance, resistance from fellow faculty, lack of resources (e.g., instructional space, teaching assistants, and time), and difficulties with technology. The proposed presentation will further describe and categorize these barriers and spur discussion of possible solutions. For example, our results suggest that, in addition to faculty development, outreach to students and non-participating faculty by university administrators may be important for reducing cultural barriers (e.g., due to prevalent norms and expectations of college teaching and learning) to course reform in higher education.

SESSION: **E4**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***A Disciplinary Teaching and Learning Center: Applying Pedagogical Content Knowledge to Faculty Development***

PRESENTERS: **Gili Marbach-Ad,** *University of Maryland - College Park***; Laura C. Egan,** *University of Maryland - College Park***; and Katerina V. Thompson,** *University of Maryland - College Park*

ABSTRACT:

Undergraduate education is in the midst of a major transformation to improve its quality and relevance. Accordingly, institutions of higher education have placed increasing emphasis on professional development in teaching. At the University of Maryland, we have taken a discipline-specific approach through the creation of the Teaching and Learning Center (TLC), which supports chemistry and biology faculty members, postdocs and graduate students. Our program is deeply integrated into the missions of the departments, and our emphasis on pedagogical content knowledge makes our activities highly relevant to the community we serve. This is demonstrated by our high participation rates and growing evidence of change in our undergraduate instruction.

The TLC has three overarching goals: to provide opportunities to collaborate with science education experts, to incorporate training in teaching science into the standard graduate program, and to support faculty learning communities (FLCs). To accomplish these goals, we provide a wide variety of resources: consultation, seminars/workshops, acculturation activities for new faculty, and teaching preparatory courses as well as a certificate program for graduate students.

We conduct ongoing program evaluation to enhance our transformative impact on undergraduate education using a holistic evaluation model to assess short- and long-term outcomes. This evaluation includes surveys, interviews and observations to measure participants' awareness and implementation of evidence-based teaching practices, as well as surveys and exams to assess the impact on student learning. We will provide an overview of our programming and evaluation process, evidence of the effectiveness of the TLC model and suggestions for replicating this model.

SESSION: **F1**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Evolution of STEM Faculty Perceptions of Concept Map Assessments***

PRESENTERS: **Lindsay Owens,** *University of Cincinnati - Main Campus***; Chad Huelsman,** *University of Cincinnati - Main Campus***; and Helen Meyer,** *University of Cincinnati - Main Campus*

ABSTRACT:

This interpretive mixed methods research study revealed how four university STEM faculty members reflected upon the transformation of student learning using concept map assessments. Semi-structured interviews were used to integrate reflective discourse with the quantitative and qualitative results of the concept map assessments. This integration led to favorable changes in the beliefs, attitudes and values of using pre- and post-assessments within the faculty's own classrooms. One such change included the practitioners elaborating on how they could utilize concept maps as a part of their curriculum and instruction in future STEM courses at the undergraduate level, despite having not used concept maps in the past.

The study also uncovered how the faculty, with varying degrees of concept map experience, interpreted student learning progressions through the quantitative and qualitative results of the pre- and post-concept map assessments. Specifically, the faculty believed that the qualitative results provided insight to the mental connections students were making within the content of their course. This study benefits educators interested in using concept mapping to interpret students' prior knowledge with a pre-concept map and student learning progressions by interpreting the shift from pre- to post-concept map. The long term goal of this study is to assist educators through reflective discourse to see concept maps as an alternative to the traditional assessments which focus predominantly on output instead of organization of knowledge, and to see shifts in students' pre- and post-concept maps as a model of student learning.

SESSION: **F2**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Creating a Coherent STEM Gateway for Teaching and Learning: An AAU STEM Initiative Project***

PRESENTERS: **Melanie M. Cooper,** *Michigan State University*; **Joseph S. Krajcik,** *Michigan State University*; **Diane Ebert-May,** *Michigan State University*; **Marcos D. Caballero,** *Michigan State University*; **Sonia M. Underwood,** *Michigan State University*; **James T. Laverty,** *Michigan State University*; **Sarah E. Jardeleza,** *Michigan State University*; **Rebecca L. Matz,** *Michigan State University*; **Cori L. Fata-Hartley,** *Michigan State University*; **and Lynmarie A. Posey,** *Michigan State University*

ABSTRACT:

The President's Council of Advisors on Science and Technology noted in 2012 that "the first two years of college are the most critical to the retention and recruitment of STEM majors." Researchers and faculty at Michigan State University have responded to this call from PCAST by initiating transformation of the gateway biology, physics and chemistry courses.

The MSU transformation process engages disciplinary faculty in conversations to determine the core ideas of the discipline and how students should be able to use those ideas combined with scientific practices and crosscutting concepts to explain phenomena and solve problems, or 3-Dimensional Learning. The emphasis on 3-Dimensional learning means that transformed instructional and assessment practices must be developed, implemented and evaluated. Our long-term goal is to transform the gateway courses so that students learn to engage with the disciplinary core ideas, scientific practices and crosscutting concepts in the same way that scientists do. The outcomes of these discussions will be examined in multiple ways, including investigating how faculties integrate 3-Dimensional learning into course instruction and assessments. A suite of instruments to assess changes over time in the content, instructional practices and assessments used in the gateway courses is currently in development and will be discussed.

SESSION: **F3**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***A Social Constructivist Perspective of Teacher Knowledge: The PCK of Biology Faculty at Large Research Institutions***

PRESENTERS: **Kathleen Hill,** *Bethany College - Bethany*

ABSTRACT:

Research and policy continue to call for improvements in undergraduate STEM education, including reforms to undergraduate teaching. To implement effective reforms, it is important to characterize the knowledge for teaching that postsecondary level teachers possess as well as understand the social experiences that influence this knowledge. Pedagogical content knowledge (PCK) is a framework used to explore and assess the various types of knowledge that teachers possess, use, and develop for teaching. Only a limited number of studies have explored the PCK of science teachers at the postsecondary level.

This study of postsecondary STEM teachers had two foci: (1) to characterize the PCK of biology faculty at large research institutions, and (2) to investigate the social experiences that contributed to their PCK. Data included semi-structured interviews and classroom observations along with faculty-generated documents and instructional artifacts. A qualitative inquiry was designed to conduct an in-depth investigation involving six biology instructors who were actively engaged in teaching large introductory courses.

The findings revealed that the PCK of the biology faculty included eight domains of knowledge. Based upon the variations of knowledge within these domains, three categories of faculty PCK emerged: (1) PCK as an expert explainer, (2) PCK as an instructional architect and (3) a transitional PCK, which fell between the two prior categories. A comparison the participants between the three groups, the faculty had varied social experiences that influenced their PCK. This research serves to inform faculty and administrators seeking to design faculty development programs to improve undergraduate science teaching.

SESSION: **F4**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Supporting STEM Education: Reflections of the Central Indiana Talent Expansion Project***

PRESENTERS: **Jeffery X. Watt,** *Indiana University-Purdue University Indianapolis***; Charles Feldhaus,** *Indiana University-Purdue University Indianapolis***; Howard Mzumara,** *Indiana University-Purdue University Indianapolis***; Stephen Hundley,** *Indiana University-Purdue University Indianapolis***; Kathleen Marrs,** *Indiana University-Purdue University Indianapolis***; Andrew Gavrin,** *Indiana University-Purdue University Indianapolis***; and Lisa G. Bunu-Ncube,** *A.T. Still University of Health Sciences*

ABSTRACT:

This presentation will describe how Central Indiana STEM Talent Expansion Program (CI-STEP) has impacted student learning outcomes and transformed teaching and learning in STEM courses through several mini-projects. The purpose of CI-STEP is to increase the number of students in central Indiana obtaining STEM degrees. CI-STEP targets undergraduate STEM programs in the Schools of Science and Engineering and Technology. In addition, the CI-STEP is collaborating with Ivy Tech Community College Central Indiana.

The greatest impact and most successful initiatives in the CI-STEP has been the Mini-Grant program developed by the CI-STEP team. This move toward planned, revolutionary change involved recruiting STEM faculty from schools across the IUPUI campus to participate in meaningful change that resulted in measurable progress and success for STEM students. A request for proposals to all faculty explicitly stated that each proposal include work that was above and beyond the normal requirements of the position, that successful achievement of the objectives or outcomes would promote retention and persistence in STEM and clear, concise methods of assessment and evaluation be included in all proposals. Awards ranging from $5,000-$25,000, involvement of collaborators, immediate impact on a broad range of students and demonstrated innovativeness, effectiveness and inclusiveness were also prerequisites for successful awards.

CI-STEP attributes much of its impact to date on the increase of STEM graduates to the successfully funded mini-grants and their dedication to the mission of STEP, ultimately taking a step toward institutional and cultural change on our campus. The goal of this presentation is to demonstrate strategies for effectively increasing the numbers of students of all demographic groups who:

(1) pursue STEM academic and career pathways;

(2) participate in STEM research, industry internships, and honors activities;

(3) graduate with an undergraduate degree in STEM fields; and

(4) transition into industry, graduate and professional programs.

Friday afternoon overview

12-1 p.m. Lunch in *Christine Grant Ballroom*

12:30-2 p.m. Panel of University Leaders

Introduction of Panelists
Deba Dutta, Ph.D., Provost, Purdue University

Panel Moderator
Gabriela Weaver, Ph.D., Conference Chair
Associate Provost for Faculty Development and Director of the Center for Teaching and Faculty Development, University of Massachusetts Amherst

Panelists
Ann E. Austin, Ph.D., Professor of Higher, Adult and Lifelong Education, Michigan State University

Jack Friedlander, Ph.D., Executive Vice President, Educational Programs, Santa Barbara City College

Barbara Sawrey, Ph.D., Associate Vice Chancellor for Academic Affairs and Dean of Undergraduate Education, University of California, San Diego

Moisés Wasserman, Ph.D., Board Member of the UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC) and Former Rector and Professor Emeritus of the National University of Colombia

2:15-4:15 p.m. Concurrent Sessions in *Jesse Owens Room, Pat Summit/John Wooden Room, Theodore Roosevelt Room, Auditorium and Palmer Pierce Ballrooms 1 and 2*

4:30-5:45 p.m. Reception in *Atrium*

Panel of University Leaders

Ann E. Austin, Ph.D.
Professor of Higher, Adult and Lifelong Education
Michigan State University

Ann E. Austin is a professor of higher, adult and lifelong education at Michigan State University, where she holds the Mildred B. Erickson Distinguished Chair. Her research concerns faculty careers and professional development, teaching and learning in higher education, the academic workplace, organizational change and doctoral education. She is a fellow of the American Educational Research Association (AERA), past president of the Association for the Study of Higher Education (ASHE), and was a Fulbright Fellow in South Africa (1998).

Austin also is co-PI of the Center for the Integration of Research, Teaching and Learning (CIRTL), funded by the National Science Foundation, and the PI of an NSF-funded ADVANCE PAID grant to study organizational change strategies that support the success of women scholars in STEM fields. Her work is widely published, including *Rethinking Faculty Work: Higher Education's Strategic Imperative* (2007) and *Educating Integrated Professionals: Theory and Practice on Preparation for the Professoriate* (2008), as well as other books, articles, chapters and monographs concerning higher education issues in the United States and in international contexts.

In 2011, Austin wrote a commissioned paper for the Board on Science Education of the National Research Council entitled "Promoting Evidence-Based Change in Undergraduate Science Education." She has worked with colleagues at the national and institutional levels on higher education issues in a number of countries, including Australia, China, Egypt, Finland, Malaysia, Oman, Thailand, the Philippines, South Africa, the United Arab Emirates and Vietnam.

Panel of University Leaders

Jack Friedlander, Ph.D.
Executive Vice President, Educational Programs
Santa Barbara City College, Santa Barbara, Calif.

Jack Friedlander is the executive vice president of educational programs at Santa Barbara City College (SBCC), where he is responsible for the college's credit and non-credit academic and student support programs and services as well as its Center for Lifelong Learning, a self-supporting enterprise for providing community services offerings. The college has been recognized at the state and national levels for its innovative programs that contribute to the success of its students, including being selected as the co-winner of the prestigious 2012 Aspen Institute Prize for Community College Excellence.

Friedlander has been actively involved in professional organizations and activities at the local, state and national levels. These include serving on the boards for the Santa Barbara City College Foundation and the South Coast Business and Industry Technologies Awards sponsored by the Scholarship Foundation of Santa Barbara. At the state level, Friedlander is involved in the Chief Instructional Officers Association for the California Community Colleges, the Chief Student Services Officers Association for California Community Colleges, the California Community Colleges Association for Occupational Education Association, the Center for Student Success, the California League for Community College's Legislative Advisory Committee, the Chancellor's Office Legislative Advisory Committee, the Statewide Matriculation Advisory Committee, and the advisory committee for the New Directions for Community Colleges quarterly book series published by Jossey-Bass in conjunction with the Eric Clearinghouse for Community Colleges.

Friedlander's many accomplishments include authoring over 80 published articles, monographs, books and newspaper articles, giving more than 200 presentations at state and national conferences and writing grant proposals that have generated well over $30 million, including ones funded by the National Science Foundation. Along with C. Robert Pace, Friedlander co-authored the Community Colleges Student Experiences Questionnaire, which formed the basis for the development of the Community College Student Engagement Survey, which has been used by numerous community colleges throughout the nation. He also has conducted research studies that have resulted in the development of the methodology used by the California Community College System for tracking the post-college employment and wages for students that participated in career and technologies courses and programs.

Panel of University Leaders

Barbara Sawrey, Ph.D.
Associate Vice Chancellor for Academic Affairs and Dean of Undergraduate Education
University of California, San Diego

Barbara Sawrey serves as the associate vice chancellor for academic affairs/dean of undergraduate education (AVCDUE). Working with faculty, the academic senate, the colleges, administration, associated students leadership, and colleagues throughout the campus and UC system, the AVCDUE is a strong voice and advocate for undergraduate education.

Sawrey leads the Council on Undergraduate Education and the Undergraduate Academic Advising Council, and she oversees the Office for Students with Disabilities, the Office of Academic Integrity and Institutional Research. She chairs or serves on a wide variety of other campus and system-wide committees, task forces and work-groups to promote excellence in undergraduate education. In her role as the campus accreditation liaison officer, she is responsible for leading campus-wide reaffirmation of accreditation reviews, initiatives and activities. Sawrey also is a member of the executive vice chancellor's management team.

She serves on the board of directors of the American Chemical Society, the Gemological Institute of America, the San Diego Foundation and the National Center for Conflict Resolution.

Panel of University Leaders

Moisés Wasserman, Ph.D.
Board Member of the UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC)
Former Rector and Professor Emeritus of the National University of Colombia

Moisés Wasserman is a board member of the UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC) and former rector and professor emeritus of the National University of Colombia (the largest among Colombian universities). He taught at the university for 33 years.

From 1995-1998, he was general director of the Colombian National Institute of Health, where he was the head of the biochemistry laboratory and a researcher for 15 years. He was president of the Colombian Academy of Exact, Physical and Natural Sciences from 2002-2006, and is also a member of the Latin-American Academy of Sciences. For six years, he was a member of ICSU's (International Council of Science) Committee for Freedom and Responsibility in Science, and serves in numerous boards of academic Colombian institutions.

Wasserman holds a Ph.D. in biochemistry from the Hebrew University of Jerusalem and was a post-doctoral fellow at the State University of New York. He has written over 100 indexed scientific publications, most of them on biochemistry and molecular biology of the parasites Plasmodium falciparum and Giardia intestinalis, and more than 90 essays and popular papers on science and society. He writes a bimonthly column on education and science in the newspaper *El Tiempo*.

Wasserman has been honored with several distinctions, including the Alejandro Angel Escobar National Science Prize of Colombia (1984), the Exceptional Teaching Award from the National University of Colombia (1995), the National Prize for Scientific Merit of the Colombian Association for the Advance of Science (1996) and the Medal for Scientific Merits (2001). He has a doctorate honoris causa from the Universidad de Antioquia (2009) and was elected as one of the 10 outstanding leaders of Colombia (Semana and Leadership Foundation, 2010). He also received the Life Achievement Award of the Colombian Association for Advancement of Science (2012) and was distinguished as a National Emeritus Senior Researcher (Semana, Colciencias, 2014).

Panel Moderator

Gabriela Weaver, Ph.D.
Conference Chair
Associate Provost for Faculty Development and Director of the Center for Teaching and Faculty Development and Professor of Chemistry at the University of Massachusetts, Amherst

Gabriela Weaver is associate provost for faculty development and director of the Center for Teaching and Faculty Development and professor of chemistry at the University of Massachusetts, Amherst. In her role as associate provost and director, Weaver oversees initiatives across the CTFD and represents both the CTFD and the broader university on issues of teaching, learning and faculty development.

Prior to joining UMass Amherst, Weaver served as the Jerry and Rosie Semler Director of the Discovery Learning Research (DLRC) and professor of chemistry and science education at Purdue University. The DLRC was founded in 2004 with a mission to advance STEM education, at all academic levels, through research and innovation. Working in collaboration with partners across all schools and colleges at Purdue, the DLRC managed and is an active participant in approximately 20 externally funded research projects in any given year. Those grants have brought over $118 million in funding to Purdue since 2004.

Among Weaver's accomplishments at Purdue was envisioning and organizing the first Transforming Education conference, an international meeting on the subject of transforming STEM undergraduate education by applying research-based findings to actual classroom practice. She also led the design of professional development workshops and assessment activities for IMPACT (Instruction Matters: Purdue Academic Course Transformation), an initiative to provide support, faculty development and infrastructure for changing teaching at Purdue to be more student-centered and research-based. In two and a half years, the project engaged approximately 60 faculty members from across the university and resulted in the implementation of revised teaching approaches in courses impacting almost 13,000 students.

Weaver's other educational redesign efforts have included her research as part of the CASPiE project (Center for Authentic Science Practice in Education), funded by the National Science Foundation. A model for undergraduate chemistry laboratory instruction that engages first- and second-year students in actual scientific research by including them as participants in research projects, CASPiE is a multi-institutional collaboration that has been used as a model of best practice in teaching in a publication by the Board on Science Education of the National Academy of Science.

Prior to Weaver's appointment to lead the DLRC, she served as the associate head of the Department of Chemistry at Purdue. She also was a member of the faculty at the University of Colorado, Denver, and received her doctorate in chemical physics from the University of Colorado, Boulder.

Concurrent sessions, Friday afternoon

SESSION THEMES	Opportunities and Challenges for Institutional Transformation in College Mathematics	Faculty Development for Educational Innovation, continued	Understanding Transformation through Assessment, continued	Institutional Supports and Barriers for Transformation, continued	STEM Initiatives	Case Studies - General
LOCATIONS	Jesse Owens Room	Pat Summit/John Wooden Room	Theodore Roosevelt Room	Auditorium	Palmer Pierce Ballroom 1	Palmer Pierce Ballroom 2
2:15 P.M.	G1: Features Of Successful Calculus Programs At Five Doctoral Degree Granting Institutions	H1: One Evidence-Based Educational Innovation at a Time: The Effect of an On-Site, Semester-Long Faculty Development Workshop on Classroom Practices	J1: Closing the Loop! Linking Formative and Summative Assessment to Promote Self-Regulated Learning	K1: Planning Transformation of STEM Education in a Research University	L1: Building a Model of Change: Outcomes from Eight Years of Educational Transformation at the Science Education Initiative	M1: Transforming the Teaching of College Math across an Entire University System
	Chris Rasmussen Jessica Ellis	Trisha Vickrey Travis J. Lund Marilyne Stains	Gwen A. Lawrie	Gerry G. Meisels Jennifer Lewis Richard Pollenz Robert L. Potter Peter Stiling Kevin Yee	Stephanie Chasteen Katherine K. Perkins Carl E. Wieman	Charles Kutal Kris Biesinger Myk Garn
2:45 P.M.	G2: Characteristics of Successful Programs in College Calculus at Four Two-Year Colleges	H2: Promoting the Teaching Identities of New Chemistry Assistant Professors Through a National Workshop Focused on Research-Based Instructional Practices	J2: Clickers in the Wild: A Campus-Wide Study of Student Response Systems and their Impact	K2: The Role of Social Capital in the Retention of First-Generation Undergraduate Women in STEM	L2: Towards a Model of Systemic Change in University STEM Education	M2: A Research-Based Transformation of Purdue's Calculus-Based Introductory Physics Sequence
	Vilma Mesa	Matthew Pilarz Andrew Feig Marilyne Stains Rory Waterman Jodi Wesemann	Lynn C. Reimer Tutrang Nguyen Katerina Schenke Domina Thurston Mark Warschauer	Deborah A. Tully	Joel C. Corbo Melissa H. Dancy Stanley Deetz Noah Finkelstein Daniel L. Reinholz	Rebecca Lindell Andrew Hirsch

SESSION THEMES	Opportunities and Challenges for Institutional Transformation in College Mathematics	Faculty Development for Educational Innovation, continued	Understanding Transformation through Assessment, continued	Institutional Supports and Barriers for Transformation, continued	STEM Initiatives	Case Studies — General
LOCATIONS	Jesse Owens Room	Pat Summit/John Wooden Room	Theodore Roosevelt Room	Auditorium	Palmer Pierce Ballroom 1	Palmer Pierce Ballroom 2
3:15 P.M.	G3: Supporting Mathematics Instructors' Adoption of Inquiry-Based Learning (IBL): Lessons from Professional Development Workshops	H3: Teaching to Increase Diversity and Equity in STEM (TIDES): A Faculty Professional Development Initiative of AAC&U Project Kaleidoscope	J3: Social Constructivism in Cyberspace	K3: The Importance of Context: Departmental Variations in Factors Influencing Adoption of Educational Innovations	L3: Creating Conversations: Engaging Biology Faculty in Transformation of the Gateway Curriculum	M3: FIRE: The First-Year Innovation & Research Experience
	Charles Hayward	Kelly M. Mack Kate Winter	Sarah B. Wilson Pratibha Varma-Nelson	Travis J. Lund Marilyne Stains	Cori L. Fata-Hartley Marcos D. Caballero Melanie M. Cooper Diane Ebert-May Sarah E. Jardeleza Joseph S. Krajcik James T. Laverty Rebecca L. Matz Lynmarie A. Posey Sonia M. Underwood	Patrick Killion
3:45 P.M.	G4: Experiments in Educational Transformation: Departmental Contexts and Strategies for Implementing Inquiry-Based Learning in College Mathematics	H4: Faculty Professional Development as a Mechanism for Cross-Institutional Reform in STEM Teaching and Learning		K4: Measuring Postsecondary Teaching Practices and Departmental Climate: The Development of Two New Surveys		M4: The Gemstone Program: Maximizing STEM Education through Team-Based Interdisciplinary Research
	Sandra Laursen	Jude K. Apple Emily Borda Ed Geary		Emily M. Walter Andrea L. Beach Charles Henderson Emily M. Walter Cody T. Williams		Kristan C. Skendall Frank J. Coale Leah K. Tobin

SESSION: **G1**
SESSION TOPIC: **Opportunities and Challenges for Institutional Transformation in College Mathematics**
TITLE: ***Features of Successful Calculus Programs at Five Doctoral Degree Granting Institutions***
PRESENTERS: **Chris Rasmussen,** *San Diego State University*

ABSTRACT:

Calculus is typically the first undergraduate mathematics course for science, technology, engineering and mathematics (STEM) majors. Indeed, each fall approximately 300,000 college or university students, most of them in their first post-secondary year, take a course in differential calculus (Blair, Kirkman, & Maxwell, 2012). This course is also a well-known bottleneck, blocking large numbers of students from continuing to pursue their interest in a STEM major. The role of calculus in disengaging students from a STEM related major are complex, but include lectures that are uninspiring or unimaginative and an over-stuffed curriculum taught at too fast a pace (Seymour & Hewitt, 1997). While reasons that students give for disengaging from a STEM major are fairly well documented (e.g., Kuh et al., 2008), characteristics of calculus programs that are more successful in keeping students engaged in their STEM-related major are less well understood. In this presentation, I report on findings from a large scale, five-year, national study of Calculus I programs that addresses the pressing need to better understand characteristics of successful calculus programs.

The goals of this five-year project include to improve our understanding of the demographics of students who enroll in calculus, to measure the impact of the various characteristics of calculus classes that are believed to influence student success, and to conduct explanatory case study analyses of exemplary programs to identify why and how these programs succeed. The project was conducted in two phases. In Phase 1, surveys were sent to a stratified random sample of students and their instructors at the beginning and the end of Calculus I. The surveys were restricted to the calculus course designed to prepare students for the study of engineering or the mathematical or physical sciences. Surveys were designed to gain an overview of the various calculus programs nationwide, and to determine which institutions had more successful calculus programs. Success was defined by a combination of student variables measured in the student and instructor surveys: persistence in calculus as marked by stated intention to take Calculus II (a proxy for persistence in a STEM major); affective changes, including enjoyment of math, confidence in mathematical ability, interest to continue studying math; and passing rates. In Phase 2 of the project, we conducted explanatory case studies at 18 different post-secondary institutions, including community colleges through research universities.

In this report, I present findings from our case study analyses at the five research universities that were identified in Phase 1 as having more successful calculus programs. Understanding the features that characterize exemplary calculus programs at research universities is particularly important because these institutions produce the majority of STEM graduates. The five selected research institutions included two large public universities, one large private university, one public technical institute and one private technical institute. At each of these five institutions, we conducted three-day site visits to learn about contextual aspects related to *why* and *how* these institutions are producing students who are successful in calculus. During these site visits, we conducted over 90 hour-long interviews with students, instructors and administrators; we observed classes; and we collected exams, course materials and homework.

Cross-case analysis of the five selected research institutions led to the identification of following seven features that contribute to the success of their calculus program: (1) Coordination of Calculus I, (2) Attending to local data, (3) Substantive graduate teaching assistant training programs, (4) Active learning, (5) Rigorous courses, (6) Well-run learning centers, and (7) Thoughtful placement systems.

In the presentation, I will briefly describe each of the seven features and then provide more detail on one of the more unexpected features, namely the coordination of Calculus I. The fact that all five of the more successful calculus programs at doctoral degree-granting institutions had someone whose official job included coordinating the different calculus sections was surprising and particularly noteworthy. In the presentation, I will articulate the role that the calculus coordinator played in creating and sustaining a community of practice (Wenger, 1998) around the joint enterprise of teaching and learning calculus. In addition to helping to foster a community of practice, the calculus coordinator functioned as a "choice architect" (Thaler & Sunstein, 2000). The notion of a choice architect is adapted from economics to illuminate the unique and influential role that a calculus coordinator can have in creating and sustaining a successful calculus program. In totality, these seven common features of successful calculus programs offer a model for other institutions that want to improve the success of their calculus program.

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SESSION: G2
SESSION TOPIC: **Opportunities and Challenges for Institutional Transformation in College Mathematics**
TITLE: ***Characteristics of Successful Programs in College Calculus at Four Two-Year Colleges***
PRESENTERS: **Vilma Mesa,** *University of MIchigan*

ABSTRACT:

Calculus I is a gateway course for students interested in science, technology, engineering and math [STEM] fields. Thus, retaining students in Calculus I and improving the teaching-learning environment becomes an issue of national importance. Public two-year colleges, also known as community colleges, play a key role, accounting for 46% of total U.S. mathematics enrollments and 20% of all Calculus I enrollments in 2010 (Blair, Kirkman & Maxwell, 2013).

As part of the NSF-supported *Characteristics of Successful Programs in College Calculus* research project (MAA, 2013) we studied four two-year public colleges, which were identified from a national survey as having successful Calculus I programs. Success was defined by a combination of student variables: persistence in calculus as marked by stated intention to take Calculus II (a proxy for persistence in a STEM major); affective changes, including enjoyment of math, confidence in mathematical ability, interest to continue studying math; and passing rates. The four selected institutions include two small colleges (enrollment <5,000) (one rural one, located in a city), a midsize urban college, and a large suburban college (enrollment > 10000). We conducted nearly 40 interviews with faculty, students, administrators and staff; 10 classroom observations; and focus groups with over 150 students. In addition we collected syllabi, homework assignments, quizzes, exams and projects used by the calculus instructors.

In this presentation, I address the following question: "What are the features that participants identify as being directly associated with the success of their calculus program at the selected two-year institutions identified as successful?" We identified seven themes with our analyses: (1) High Quality Instructors, (2) Faculty Autonomy and Administrative Trust in the teaching of calculus, (3) Attention to Placement, (4) Support for students' social and academic well-being, (5) Transfer Policies, (6) Informal Instructional Support, (7) Assessment and Data Collection. In the presentation I will discuss each of these themes. Here I highlight the first theme, High Quality Instructors, and the third theme, Attention to Placement.

Instructors at these institutions were described as caring, knowledgeable, available and approachable, and as having high expectations for developing conceptual understanding in addition to procedural competency. Such appraisal was also confirmed through our analysis of exams they gave their students and of tasks they used for teaching and through our analysis of the national survey data collected prior to the visits to the colleges. The teachers in these institutions assign more complex exams than what was observed in an analysis of exams of 150 institutions (of all types) in the national survey. In classrooms, instructors used challenging tasks and continuously asked students to participate in the resolution of the problems.

These institutions were also very intentional in their process for establishing adequate placement. They implemented student-oriented rather than institution-oriented policies. That is, they took many steps to ensure that their students were in the correct course: in-house-designed placement tests, commercially available tests, in-class tests on the first day of class, and administrative overrides of registration to switch students who need to change classes. In addition, both administrators and faculty were closely engaged in placing the students in the adequate course. Moreover, in two of the institutions, faculty were proud of the preparatory courses offered at the college and made sure that their students took those courses rather than placing directly from outside.

These themes, collectively, reveal elements that are in place to assist students in integrating socially and academically in these campuses. Such integration influences students' choice to stay in college (Kuh et al, 2008; Tinto, 1975, 1988). These institutions have intentional processes to make sure that students stay: from validating students as learners in the classrooms (Rendon, 2006), to making sure that placement and transfer policies are

clear, to offering spaces for them to study and to connect to faculty. When instructors ask challenging questions in class and in exams, and give students confidence that they can master the material, they give students a strong basis to pursue further work. By encouraging students to take the preparatory courses in the college, the departments can create common experiences, foster use of rigorous language, set up expectations and create a community of learners ready for calculus. Such a community fosters social and academic integration.

The implications we derive from this work relate to the role of mathematics instruction in fostering academic and social integration, and the ways in which placement can support students in their goals.

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SESSION: G3
SESSION TOPIC: Opportunities and Challenges for Institutional Transformation in College Mathematics
TITLE: ***Supporting Mathematics Instructors' Adoption of Inquiry-Based Learning (IBL): Lessons from Professional Development Workshops***
PRESENTERS: **Charles Hayward,** *University of Colorado at Boulder*

ABSTRACT:

Mathematics is essential for success in STEM fields. Studies have linked students' persistence in STEM majors to differences in instructional methods (Seymour & Hewitt, 1997; Freeman, et al., 2014), specifically for their Calculus courses (Ellis, Kelton, & Rasmussen, 2014). However, relatively few students experience high-impact educational practices that require students to interact with each other about substantive content (Kuh, 2008). Any effort to transform undergraduate STEM education and increase the use of research-based high-impact practices hinges on individual instructors changing and adopting these strategies. Professional development workshops can help support individuals in making these transitions.

This report discusses how faculty development workshops have helped instructors adopt Inquiry-Based Learning (IBL) methods in college mathematics. IBL is a spectrum of teaching methods that share the spirit of student inquiry through deep engagement with mathematics and collaboration with peers (Yoshinobu & Jones, 2013). Students learn through analyzing ill-defined problems and constructing and evaluating arguments (Prince & Felder, 2007; Savin-Baden & Major, 2004). IBL strategies in college mathematics courses are associated with affective gains and greater persistence with math majors for female students, and improved grades low-performing students. (Laursen, Hassi, Kogan, & Weston, 2014).

I focus on survey and interview findings from a series of annual, week-long workshops featuring invited talks, collaborative work time, and panel discussions designed to support instructors in implementing IBL in their own classrooms. The workshops served 167 instructors from various institutions around the U.S. and Canada. Each year, participants were invited to complete pre-workshop, post-workshop, and one-year follow-up surveys. I use survey findings from 139 participants for which follow-up data are currently available, and interviews from a subset of 16 participants from the first two workshops, to identify professional development practices that have been effective in shifting mathematics instructors toward IBL pedagogies. These practices include communication of inclusive definitions of IBL, supports for implementation, frequent follow-up and inclusion in the broader IBL community. These components have contributed to successful workshops; so far, 58% or participants have reported implementing IBL methods in their classrooms in the first year following the workshop.

I frame these components with a three-stage theory of change in human systems (Lewin, 1947), as adapted by Paulsen and Feldman (1995) to model instructor change. In the first stage, *unfreezing,* instructors become motivated to make a change. I will argue that communicating broad, inclusive definitions of IBL helps instructors with the "safety" criterion of the first stage, as they allow instructors to "envision ways to change that will produce results that reestablish his or her positive self-image without feeling any loss of integrity or identity" (Paulsen & Feldman, 1995, p. 12). Interview participants commented on the "spectrum of IBL" and one described how this "was kind of a big moment for me because it made it seem less scary."

The workshops, to varying degrees, have also helped support participants with the second stage, *changing,* when they implement their new learning. We observed that workshops provided participants with how-to knowledge about implementing IBL in their own classrooms, and participants reported increased knowledge and skills following the workshops. While there were common elements across the workshops, each one featured its own blend of invited talks, panel discussion, video observations, discussions of readings and collaborative work time with colleagues. Based on participants' comments, workshop features that appear to have particularly

supported participants' learning include discussions with experienced IBL implementers, modeling of IBL teaching methods, and informal interactions and networking with other participants.

The third stage, *refreezing*, helps to reconfirm new behaviors and sustain the change. Our data suggest that this is supported by two components of the workshops, frequent follow-up and inclusion in the broader IBL community. For the third workshop, organizers engaged participants in frequent email mentoring through a group email list and individual messages. Many of the participants (62%) have been active on the list, and have used it to provide encouragement and address challenges they faced. Participants in this workshop reported significantly higher implementation rates than the first two cohorts. Participants from all three workshops were encouraged to join the broader IBL mathematics community through IBL-focused conferences and networking with other IBL instructors, and some reported doing so. These two components provide opportunities for colleagues to help reinforce and confirm the instructor's decision to implement IBL methods.

While these findings do not directly address institutional and national contexts, they do provide insight into ways to support individual instructors in incorporating new research-based teaching strategies. This is an important, and necessary, component of broader institutional transformation efforts.

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SESSION: G4
SESSION TOPIC: **Opportunities and Challenges for Institutional Transformation in College Mathematics**
TITLE: ***Experiments in Educational Transformation: Departmental Contexts and Strategies for Implementing Inquiry-Based Learning in College Mathematics***
PRESENTERS: **Sandra Laursen,** *University of Colorado Boulder*

ABSTRACT:

Ample research evidence supports the use of student-centered teaching approaches to improve student educational outcomes in science, technology, engineering and mathematics (STEM) disciplines. The bottleneck in actually making these improvements on a national scale is not a lack of well-developed classroom approaches from which to choose; rather, slow faculty uptake of proven teaching methods limits large-scale implementation and institutional commitment to these approaches. That is, "The problem in STEM education lies less in not knowing what works and more in getting people to use proven techniques" (Fairweather, 2008, p. 28).

Most studies of this issue have focused on challenges to faculty uptake: the internal and external barriers to pedagogical change among STEM instructors (e.g., Henderson & Dancy, 2007). Early socialization in their discipline develops a values hierarchy that privileges research over teaching; structural issues such as class size and room configuration complicate practical classroom logistics; and instructors fear real or perceived skepticism of students, colleagues, or chairs. Most studies have also focused on individual instructors, for example, their knowledge and choices about instruction (e.g., Walczyk, Ramsey & Zha, 2007). This is logical if we view teacher decision-making as individualized. But STEM instructors are embedded in social systems that influence their thinking in positive and negative ways, especially their discipline and department, and thus we must also understand instructors' working contexts. In this presentation, we examine departmental activities and contexts that influence the spread and sustainability of pedagogical change within university mathematics departments.

To examine this issue, we draw upon a study of the implementation of inquiry-based learning in four research mathematics departments with privately funded IBL Mathematics Centers established "to further develop, study, promote and disseminate the use of inquiry-based learning (IBL) approaches in the teaching of mathematics by fostering IBL activities at … prestigious national universities" (EAF, 2007). These leading research departments were expected to have high visibility and influence in their discipline, and were selected in part for their history of engagement in mathematics education. As a group, they present interesting case examples of efforts at institutional transformation, especially given the crucial role of mathematics courses as a gateway to STEM majors and jobs.

These universities are part of a larger mathematics education community surrounding a version of inquiry-based learning that stems from collegially shared traditions of Socratic teaching based on the practices of late mathematician R. L. Moore, rather than on the research literature in the learning sciences. However, their teaching practices as observed are largely consistent with modern, research-based approaches to active and collaborative learning. Each campus independently selected and developed its own set of IBL courses, yielding a range of courses targeted to audiences from first-year to senior level, and to mathematics majors, mixed STEM majors, or pre-service K-12 teachers. While the IBL teaching practices used in these courses are broadly consistent across the four campuses, the campuses also show variation in local cultures of how IBL is conceived and executed in the classroom.

This presentation will examine some of the strategies developed by these departments to support IBL instructors and engage colleagues, including formal and informal mentoring, team-teaching, and collegial gatherings, as well as some strategies used to inform colleagues not actively involved in IBL teaching. Interestingly, no department used all of these strategies. A comparative analysis suggests ways in which these strategies may have helped or hindered the spread and sustainability of departmental IBL programs.

In addition to their engagement with regular faculty, some departments involved numerous graduate students as teaching assistants in inquiry-based courses, while others worked with postdoctoral scholars as IBL instructors. Working as instructors in IBL courses proved to be a powerful form of professional development for early-career instructors, many of whom moved on to teaching roles at other institutions, carrying reshaped teaching philosophies and expertise with them, and remaining active in the larger IBL mathematics community. I will briefly describe outcomes for early-career instructors and suggest how this aspect of the Centers' work offers another potential avenue for transformation of teaching and learning in college mathematics.

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SESSION: **H1**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***One Evidence-Based Educational Innovation at a Time: The Effect of an On-Site, Semester-Long Faculty Development Workshop on Classroom Practices***

PRESENTERS: **Trisha Vickrey,** *University of Nebraska-Lincoln***; Travis Lund,** *University of Nebraska-Lincoln***; and Marilyne Stains,** *University of Nebraska-Lincoln*

ABSTRACT:

A wide variety of instructional practices have been shown to enhance student learning outcomes in STEM fields, yet evidence suggests that propagation of these teaching strategies to STEM faculty has proven challenging. To increase faculty awareness and adoption of evidence-based instructional practices, a series of on-site, semester-long, NSF-funded faculty development workshops were developed and implemented at a research-intensive institution. Each workshop series targets one evidence-based educational innovation (Just-in-Time Teaching and Peer Instruction).

This study thoroughly characterizes the effectiveness of these workshop series through a quasi-experimental research design study. Data collected include pre-post surveys and week-long classroom observations from workshop participants and non-participants. Survey data are intended to demonstrate the extent of the impact of the workshop series on faculty's thinking about teaching and their adoption of educational innovations. Classroom observations were analyzed through the Reformed Teaching Observation Protocol (RTOP), the Classroom Observation Protocol for Undergraduate STEM (COPUS), and a validated rubric measuring fidelity of implementation of Peer Instruction. In this presentation, we will provide a short description of the workshop series and share preliminary findings. These results will aid others in the implementation of successful faculty development workshop series.

SESSION: **H2**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Promoting the Teaching Identities of New Chemistry Assistant Professors through a National Workshop Focused on Research-based Instructional Practices***

PRESENTERS: **Matthew Pilarz,** *University of Nebraska-Lincoln*; **Marilyne Stains,** *University of Nebraska-Lincoln*; **Rory Waterman,***University of Vermont*; **Andrew Feig,** *Wayne State University*; **and Jodi Wesemann,** *American Chemical Society*

ABSTRACT:

Chemistry graduate programs typically do little to prepare faculty to teach. As a result, assistant professors have a limited knowledge of the research on how people learn and develop their teaching skills and approaches on the job. Initiatives in physics and biology have demonstrated that short, national workshops for new faculty can significantly raise their knowledge of research-based instructional practices. Members of the Cottrell Scholars Collaborative initiated the New Faculty Workshop (CSC NFW) in order to provide a similar opportunity to chemistry assistant professors at research-intensive universities. Along with the implementation of the workshop, a longitudinal, quasi-experimental design study was undertaken to evaluate the extent of its impact.

The long-term goal of the CSC NFW is to promote the teaching identity of academic chemists, who mostly identify themselves as researchers. Connecting national disciplinary events such as this workshop with local pedagogical support is critical to achieve this goal. Therefore, the project is being expanded to help participants connect with teaching resources, such as teaching and learning centers, at their home institutions. In this presentation, we will provide a description of the workshop and efforts developed to support participants beyond the workshop. Evidence of the effectiveness of the workshop on raising participants' awareness of the research-based instructional methods and adoptions of these methods in their courses, as well as barriers they encounter, will also be shared. This presentation will provide an example of a successful initiative related to faculty development for educational innovation, one of the major conference themes.

SESSION: **H3**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Teaching to Increase Diversity and Equity in STEM (TIDES): A Faculty Professional Development Initiative of AAC&U Project Kaleidoscope***

PRESENTERS: **Kelly M. Mack,** *Association of American Colleges and Universities* **and Kate Winter,** *City University of Seattle*

ABSTRACT:

Recent data have identified that the most advanced mechanism for broadening the participation of underrepresented groups in STEM is not just pedagogical reform [1], but pedagogical reform that is evidence-based and culturally sensitive to the lived experiences of these populations [2]. However, mastery of new pedagogy commonly poses a substantial challenge for STEM faculty who oftentimes are experts in their disciplines, but not in teaching [3].

To prepare STEM faculty for advanced pedagogical reform, the Association of American Colleges and Universities (AAC&U) launched an initiative, TIDES—Teaching to Increase Diversity and Equity in STEM, funded by the Helmsley Charitable Trust to increase the self-efficacy of faculty in implementing culturally competent pedagogy in STEM, particularly the computer/information sciences. This initiative is designed to maximize the likelihood of sustained behavioral change in teaching by focusing on knowledge acquisition in concert with opportunities to practice new skills in a non-threatening environment [4]–[6]. Specifically, TIDES is a three-year curriculum and faculty development project that will engage 20 diverse and competitively selected campuses working to develop models for broad institutional change to advance evidence-based and culturally competent teaching. By focusing on faculty self-efficacy and institutional cultural change, TIDES intends to positively impact STEM student learning and mitigate deficient coping behavior that can arise in the face of institutional barriers [7]–[14].

We will provide an overview of the competition, summer institute, preliminary data from our Faculty Self-Efficacy instrument developed for assessing TIDES, and the project logic model detailing intended short- and long-term outcomes.

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SESSION: **H4**
SESSION TOPIC: **Faculty Development for Educational Innovation**
TITLE: ***Faculty Professional Development as a Mechanism for Cross-Institutional Reform in STEM Teaching and Learning***

PRESENTERS: **Jude K. Apple,** *Western Washington University***; Emily Borda,** *Western Washington University***; and Ed Geary,** *Western Washington University*

ABSTRACT:

Approaches to STEM teaching and learning at many undergraduate institutions rely on expert-centered, content-based practices that provide minimal opportunity for student-centered inquiry. This culture of teaching and learning is reinforced by expectations at many grain-sizes, including students, faculty, departments, administrators and institutional leaders. Our presentation will describe results from a multi-disciplinary, inter-institutional project designed to transform undergraduate STEM education at three interlinked undergraduate institutions (Western Washington University, Whatcom Community College and Skagit Valley College). Titled "Change at the Core: A Collaborative Model for Undergraduate STEM Education Reform," this project seeks to improve student engagement, learning and success by creating a critical mass of STEM faculty at each institution who understand and regularly use evidence-based teaching and learning practices.

To this end, we have developed a model of how faculty professional development, professional learning communities and partnerships both within and among institutions can be used to transform the culture and practice of STEM education and to create a more inclusive learning environment by promoting the success of all students. Faculty professional development activities are built around collaboration, partnerships, strategies for addressing diversity and a foundational knowledge of evidenced-based pedagogies. Initial evidence indicates that our efforts have already instigated change in undergraduate teaching and learning. Evaluation and assessment results will be shared to provide more detailed insight into factors that promote and challenge reform, how these may manifest at different levels of institutional organization, and how reform might be achieved at other institutions.

SESSION: **J1**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Closing the Loop! Linking Formative and Summative Assessment to Promote Self-regulated Learning***

PRESENTERS: **Gwen A. Lawrie,** *The University of Queensland*

ABSTRACT:

Large, first year general chemistry courses represent a diverse cohort of students in terms of their engagement and assessment for learning. Instructors aim to encourage student to become more self-aware of their own thinking and to develop their independence through self-regulated study strategies. While potentially achievable delivering a combination of formative assessment with individual, personalized feedback, this represents a challenge for instructors on such a large scale.

As part of a two-year nationally funded project, 11 academics who lead first-year chemistry programs in five Australian institutions across three states have collaborated to develop a combination of diagnostic tools, formative feedback options and a range of strategies for delivering face-to-face or self-regulated online study modules. The aim was to transform instructional and assessment practices for these diverse STEM cohorts. Insights into the nature of alternate or missing conceptions, timing and delivery of formative feedback and engagement with online resources have been collected through an extensive evaluation process. Evaluation strategies included development of a validated concept inventory instrument, application of analytics to explore engagement in online learning activities and student perception data (both quantitative scales and qualitative student interview data). In this presentation, a case study from one institution will be presented to illustrate the combined elements that have been successful in engaging students in self-regulated, independent study across several institutions.

SESSION: **J2**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Clickers in the Wild: A Campus-Wide Study of Student Response Systems and their Impact***

PRESENTERS: **Lynn C. Reimer,** *University of California - Irvine*; **Thurston Domina Ph.D.,** *University of California - Irvine*; **Mark Warschauer Ph.D.,** *University of California - Irvine*; **Katerina Schenke,** *University of California - Irvine*; **and Tutrang Nguyen,** *University of California - Irvine*

ABSTRACT:

Student response systems (e.g., clickers) are a tool for making lectures more interactive. Several studies indicate that SRSs have positive effects on student achievement and course attendance in college and university lecture courses. However, these studies generally involve small-scale experiments between a few classes in one discipline.

In contrast, our study takes a broad naturalistic, population approach to examine the use of SRSs in all STEM disciplines in a major university. Over the course of a year, we observed and videotaped 95% of large introductory STEM courses across seven departments near the beginning and end of each course. Using a carefully designed and validated observation protocol, we took detailed notes on whether SRSs were used, the frequency and types of uses, the relationship of SRS use to other teaching practices, and, at defined intervals, the behavior of individual students. We also surveyed students during the first and last week of the course to measure attitudes toward the course and STEM careers, as well as to gather information about weekly study habits and practices. Institutional data were collected on all students as well, including high school GPA, SAT scores, financial aid eligibility, gender, ethnicity, university GPA, grade in course, enrollment and grades in subsequent STEM courses. Our study uses these data to analyze the broad patterns of SRS usage on campus and the impact of use on student attitudes, academic performance and persistence in STEM.

SESSION: **J3**
SESSION TOPIC: **Understanding Transformation through Assessment**
TITLE: ***Social Constructivism in Cyberspace***

PRESENTERS: **Sarah B. Wilson,** *Indiana University-Purdue University Indianapolis* **and Pratibha Varma-Nelson,** *Indiana University-Purdue University Indianapolis*

ABSTRACT:

As the proportion of online education options grows, both students and faculty need guidance on ways to assess the academic rigor of online classes as well as systematic comparisons of online or hybrid courses to the face-to-face versions of classes. This presentation will share the findings of one such study: the transition of Peer-Led Team Learning (PLTL), an educational intervention in which students work collaboratively in small groups to develop problem-solving and critical thinking skills under the guidance of undergraduate peer facilitators, at a large Midwestern U.S. research university to a synchronous online version, dubbed cyber Peer-Led Team Learning (cPLTL).

In this study, discourse analysis of general chemistry students' interactions and dialogue from both online and face-to-face PLTL workshop sections were systematically evaluated to determine (1) if this social constructivist pedagogy was viable in a synchronous online setting and (2) compare and contrast the students' interactions in the two settings. The findings of this study inform curriculum changes for institutions both nationally as well as internationally. Frequencies of deep student learning and conclusions from the analysis will be shared, in addition to implications for faculty and students.

SESSION: **K1**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***Planning Transformation of STEM Education in a Research University***

PRESENTERS: **Gerry G. Meisels Ph.D.,** *University of South Florida*; **Robert L. Potter Ph.D.,** *University of South Florida*; **Peter Stiling Ph.D.,** *University of South Florida*; **Jennifer Lewis Ph.D.,** *University of South Florida*; **Catherine Beneteau Ph.D.,** *University of South Florida*; **Kevin Yee Ph.D.,** *University of South Florida*; **and Richard Pollenz Ph.D.,** *University of South Florida*

ABSTRACT:

Attraction and retention of STEM majors, especially those from underrepresented groups, requires a comprehensive approach. Factors and practices that shape outcomes are identified and shared through a process that relies on a planning team that is broadly constituted from STEM and Education faculty, department chairs, and college administrators. Six key steps include 1. Developing a data base on students who leave the STEM major, including an analysis of their fates; 2. Establishing Planning Team understanding of how to achieve institutional change, identify and implement effective practices; 3. Institutional policies that encourage or inhibit success and proposing changes to reduce the latter; 4. Designing an action plan that recognizes the continuum of student experience from high school or community college to the university; 5. Analyze separately resources needed to initiate and to sustain the planned program of interventions; and 6. Establish and secure broadly-based institutional support and commitment to a long-term program.

The opportunity for success of this approach is enhanced by recent institutional priorities on student success, the alignment of resource allocations with this objective, and by the declaration of Discipline Based Education Research as a priority of the College of Arts and Sciences.

SESSION: **K2**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***The Role of Social Capital in the Retention of First-Generation Undergraduate Women in STEM***

PRESENTERS: **Deborah A. Tully,** *University of Sydney*

ABSTRACT:

First-generation college students are twice as likely to exit STEM and leave college altogether than their peers whose parents completed college. Their personal backgrounds and academic preparation place them at increased risk for attrition. More often than not, first-generation college students come from minority and lower socio-economic groups. This study focuses on first-generation undergraduate women who have completed at least two years in their STEM major and looks at those factors that have contributed to their persistence. Drawing on a theoretical framework of social capital, the purpose of this study is to gain a better understanding of how social networks may provide agency that affects the retention of first-generation women in STEM.

As private colleges have exhibited higher retention rates for students in STEM than do public universities, this research was undertaken at three different private liberal arts colleges (two women's colleges, one coeducational college). Although first-generation women in STEM at each of these colleges had lower GPAs ($p<.05$) than their female peers whose parents had graduated college, they were four times more likely to be involved in a formal or professional mentoring relationship. The results of this study highlight how first-generation women in STEM may appropriate new sources of cultural capital through resource-rich relationships with faculty and peers that in turn positively affect academic outcomes. Exploring the sources of both cultural and social capital in these academic settings may illuminate how future university policies and practices can be shaped to further promote successful gains for first-generation women in STEM.

SESSION: **K3**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***From Grassroots to Institutionalization: RIT's CASTLE***
PRESENTERS: **Scott Franklin,** *Rochester Institute of Technology*

ABSTRACT:

Overcoming institutional barriers to a culture of transformative STEM education requires a concentrated strategic effort. Critical hurdles at RIT included faculty skepticism toward classroom transformation, concern for impact on tenure and promotion, and defining the place of education research within a technologically-oriented institution.

In 2010, five STEM faculty from three College of Science departments came together to form the Science and Mathematics Education Research Collaborative (SMERC) devoted to rigorous discipline-based education research (DBER). At the same time, the group made a conscious effort to bring about broad culture change. SMERC faculty created a community of practice among other STEM faculty and a learning lssistant program to support course transformation. As a result, the 2013 College of Science strategic plan explicitly cited SMERC as a model interdisciplinary research group and incorporated SMERC goals into the college's strategic plan. The group now includes 10 faculty (five departments, three colleges) and enjoys recognition and support across the College.

At the institute-level, these efforts were framed as lying at the intersection of important institutional strategic priorities. DBER simultaneously advances basic research and discovery while driving pedagogical change and assessments that result in improved student learning and retention. Recognition of these synergies led RIT to create the Center for Advancing Science/Math Teaching, Learning & Evaluation (CASTLE) to integrate the many programs originally developed by SMERC. By highlighting the complementary nature of institute priorities, CASTLE has carved a unique position as broadly interdisciplinary, rigorous in research and pedagogy, and embedded in institute culture.

SESSION: **K4**
SESSION TOPIC: **Institutional Supports and Barriers for Transformation**
TITLE: ***Measuring Postsecondary Teaching Practices and Departmental Climate: The Development of Two New Surveys***

PRESENTERS: **Emily M. Walter PhD,** *Western Michigan University***; Andrea L. Beach PhD,** *Western Michigan University***; Charles Henderson PhD,** *Western Michigan University***; and Cody T. Williams,** *Western Michigan University*

ABSTRACT:

This paper will discuss the measurement of institutional supports and barriers for transformation related to postsecondary teaching practices in Science, Technology, Engineering and Mathematics (STEM) [Priority 1].

Although most faculty have knowledge of evidence-based teaching practices and have access to resources to employ them, efforts to transform postsecondary instruction have had only modest success (e.g. Dancy & Henderson, 2007; MacDonald, Manduca, Mogk, & Tewksbury, 2005; Prince, Borrego, Henderson, Cutler, Froyd, 2013). One of the reasons for this may be underlying institutional environments and structures, such as the climate for teaching in a department (Beach, Henderson, & Finkelstein, 2012; Henderson, Beach, & Finkelstein, 2011).

The purpose of our study was to develop and validate two research-based surveys to measure (a) departmental climate for teaching improvement and (b) postsecondary instructional practices. We also trained faculty observers on the Teaching Dimensions Observational Protocol (TDOP; Hora, Oleson, & Ferrare, 2012) to triangulate the results of the teaching practices instrument. Our pilot process has involved 19 departments our institution as well as cohorts of STEM departments at three other institutions.

The goals for this presentation are to share our research tools (two newly developed surveys and the TDOP observational protocol) and preliminary results, explain our development process, provide suggestions for use of the instruments and note future directions of our work. We know that many department- and institution-level change initiatives struggle with measurement of relevant aspects of the local environment. Thus, we expect the paper to be of wide interest to the *Transforming Institutions* audience.

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SESSION: **L1**
SESSION TOPIC: **STEM Education Initiatives**
TITLE: ***Building a Model of Change: Outcomes from Eight Years of Educational Transformation at the Science Education Initiative***

PRESENTERS: **Stephanie Chasteen,** *University of Colorado Boulder***; Katherine K. Perkins,** *University of Colorado Boulder***; and Carl E. Wieman,** *Stanford University*

ABSTRACT:

We will provide a broad, summative perspective on the Science Education Initiative (SEI) at the University of Colorado Boulder as well as results from its sister program at the University of British Columbia. The SEI served to inform the AAU Undergraduate STEM Education Initiative, and is a multi-million dollar university-funded program aimed at improving undergraduate education, and the program at Colorado is coming to a close. Departments receive SEI funding through a proposal process, resulting in 7 funded departments at each institution. A key element of the program is its departmental focus; postdoctoral fellows work within SEI-funded departments, partnering with faculty to transform courses using the principles of backwards design, including written learning goals, assessment of student learning and research-based instructional practices. Thus, the SEI incorporates research in the design of its programmatic structure (educational change, principles of learning), as well as in its implementation (student learning, program outcomes).

The SEI aims to improve student learning by supporting widespread, effective use of research-based instructional practices both locally and nationally, through development of instructional resources and faculty expertise, as well as through testing of this model of change at two institutions. This talk will identify the key outcomes of the initiative at the faculty, course, departmental and programmatic level, and indicate what aspects of the initiative supported those outcomes. We will examine what we have learned from this educational experiment, through both successful and less-successful aspects of the initiative, including the proposal process, the role of the postdoctoral fellows, departmental culture and sustainability.

SESSION: **L2**
SESSION TOPIC: **STEM Education Initiatives**
TITLE: ***Towards a Model of Systemic Change in University STEM Education***

PRESENTERS: **Joel C. Corbo,** *University of Colorado at Boulder*; **Melissa H. Dancy,** *University of Colorado at Boulder*; **Stanley Deetz,***University of Colorado at Boulder*; **Noah Finkelstein,** *University of Colorado at Boulder*; **and Daniel L. Reinholz,** *University of Colorado at Boulder*

ABSTRACT:

Despite numerous calls for the transformation of undergraduate STEM education, there is still a lack of successful models for creating large-scale, systemic cultural changes in STEM departments. To date, change efforts have generally focused on one of three areas: developing reflective teachers, disseminating curricula and pedagogy, or enacting institutional policy. These efforts illustrate many of the challenges of departmental change; in particular, they highlight the need for a holistic approach that integrates across all three of these levels: individual faculty, whole departments and university policymakers. To address these challenges, as part of our campus-wide AAU-sponsored effort in STEM education transformation, we import and integrate models of change from multiple perspectives. We draw from models in organizational change, from departmental and disciplinary change in STEM education, and from efforts to support individual efforts such as the development and dissemination model. As a result, our departmental cultural change efforts are an attempt at holistic reform. We will discuss our theoretical underpinnings and report on the impact of our efforts to date.

SESSION: **L3**
SESSION TOPIC: **STEM Education Initiatives**
TITLE: ***Creating Conversations: Engaging Biology Faculty in Transformation of the Gateway Curriculum***

PRESENTERS: **Cori L. Fata-Hartley,** *Michigan State University*; **Sarah E. Jardeleza,** *Michigan State University*; **Rebecca L. Matz,** *Michigan State University*; **Melanie M. Cooper,** *Michigan State University*; **Joseph S. Krajcik,** *Michigan State University*; **Diane Ebert-May,** *Michigan State University*; **Marcos D. Caballero,** *Michigan State University*; **James T. Laverty,** *Michigan State University*; **Sonia M. Underwood,** *Michigan State University*; **and Lynmarie A. Posey,** *Michigan State University*

ABSTRACT:

The Michigan State University AAU STEM Initiative Project, *Creating a Coherent STEM Gateway for Teaching and Learning,* is focused on transforming gateway biology, chemistry, and physics courses. A diverse group of faculty from MSU's five biology-related departments participated in the effort to transform the large enrollment, multi-section Introductory Cell and Molecular Biology course. The conversations were structured to develop a shared vision of the course that emphasizes three-dimensional learning—using disciplinary core ideas, crosscutting concepts, and scientific practices to explain biological phenomena and solve problems.

Early results suggest this model may facilitate meaningful and sustainable change by circumventing previously reported obstacles, including skepticism about education research and perceptions that education research is dogmatic. Facilitators deflected these concerns by focusing on *what* we teach and assess, not on *how* we teach. The faculty were particularly receptive to reforming formative (e.g., in-class activities, homework) and summative (e.g., exam questions) assessments. As a result, the group identified a set of disciplinary core ideas, scientific practices and crosscutting concepts that will be used to develop assessments centered on explaining phenomena. The conversations also encouraged transformative reflection as faculty considered how to cover content in the context of disciplinary core ideas and addressed situational factors that hinder reform of large enrollment courses. A recent survey revealed that all the course instructors plan to make substantive changes in their courses. The instruments being developed for MSU's AAU STEM Initiative Project will be used to both facilitate and evaluate these changes.

SESSION: **M1**
SESSION TOPIC: **Case Studies – General**
TITLE: ***Transforming the Teaching of College Math across an Entire University System***
PRESENTERS: **Charles Kutal,** *University of Georgia*; **Kris Biesinger,** *University of Georgia*; **and Myk Garn,** *University System of Georgia*

ABSTRACT:

A common stumbling block for students considering a STEM major has been introductory math courses. The University System of Georgia (USG) is addressing this problem by supporting the development of an online multi-institutional pre-calculus course. This course combines lessons learned from the Math Emporium model with elements of massive open online course (MOOC) delivery to create a highly interactive and support-rich online learning experience.

The online Pre-calculus Emporium course is a prototype that extends the proven Emporium model of active student learning to a virtual environment in which content delivery, individualized and group support provided by an instructional team, and formative and summative assessments are delivered entirely online. Students have access to and interaction with a wide variety of materials and activities, including text and video instruction, intensive practice, online discussion and expert support, quizzes and proctored exams. The course was built within the Coursera learning management system utilizing content from Cengage Learning and assessment support from WebAssign. High-stakes exams utilized an online proctoring model.

The goals of the online Pre-calculus Emporium project are to (1) increase access to a high-quality pre-calculus course by providing an option that is broadly available and highly scalable, (2) reduce the percentage of students receiving grades of D, F, or W (withdrawal), (3) increase student success in subsequent math and science courses, and (4) inform affordability options and models for online courses. When fully implemented, the course will be available to students at all 31 institutions within the USG.

SESSION: **M2**
SESSION TOPIC: **Case Studies – General**
TITLE: ***A Research-Based Transformation of Purdue's Calculus-Based Introductory Physics Sequence***

PRESENTERS: **Rebecca Lindell,** *Purdue University* **and Andrew Hirsch,** *Purdue University*

ABSTRACT:

Purdue's introductory calculus-based physics sequence utilizes the two volumes of the Matter and Interaction curriculum developed by Chabay and Sherwood (Chabay and Sherwood, **http://matterandinteractions.org/**). Incorporating the results of 20th century physics, this text presents an alternative approach to presenting the introductory physics content, specifically utilizing a few fundamental principles to explain physics phenomena. In addition, students learn how to visualize physics using computational modeling. The first semester focuses on modern mechanics through the study of the fundamental principles of momentum, energy and angular momentum, as well as the properties of statistical mechanics. The second semester builds on the first volume in the study of the field mechanism, Maxwell's equation and role of electrons in conductors and insulators.

Purdue has utilized this approach for over 10 years for most of its calculus-based physics courses servicing nearly 3500 students each year. With funding from Purdue's Instruction Matters: Purdue Academic Transformation, we have spent the last 3 years transforming how we teach this course by utilizing many of the approaches developed by Physics Education Research (PER). A specific focus of this redesign is making this course more interactive and integrated. In this talk, we will present the learning theory behind our research-based model for this transformed course, the materials we have developed/adapted for use with this course redesign, as well as the results of our evaluations. In addition, we will present our solutions to the four key issues that must be addressed by any transformed course: Development, Implementation, Evaluation and Sustainability.

SESSION: **M3**
SESSION TOPIC: **Case Studies – General**
TITLE: ***FIRE: The First-Year Innovation & Research Experience***
PRESENTERS: **Patrick Killion,** *University of Maryland*

ABSTRACT:

Adapting the proven Freshman Research Initiative (FRI) developed at the University of Texas at Austin (UT), the University of Maryland, College Park (UMD) is extending the UT FRI model to integrate a broad spectrum of STEM disciplines including the natural, animal and computer sciences and engineering with the arts and humanities, business, social sciences and public health. The UMD First-Year Innovation and Research Experience (FIRE) will facilitate multidisciplinary inquiry-based experiences for first-year students through participation in STEM-focused innovation and research streams that integrate and leverage non-STEM expertise and perspectives. Students will earn degree credit while engaged with faculty and a peer cohort in the yearlong development of skill sets in authentic inquiry, critical thinking, innovation and experimental design, problem solving, leadership and scholarly communication. The program is designed to better unite the twin research and educational missions of the institution while driving gains in student persistence, retention, degree completion, academic accomplishment and acceptance into professional education programs. The FIRE mission will include focused attention on undeclared, non-honors and transfer student populations in order to reduce academic achievement gaps, expose students to less traditionally considered academic units and accelerate student integration into departments. The program seeks to contribute to national STEM recruitment and retention goals through increased student satisfaction, confidence and capacity while simultaneously expanding the scientific literacy and productivity of non-STEM student populations.

SESSION: **M4**
SESSION TOPIC: **Case Studies – General**
TITLE: ***The Gemstone Program: Maximizing STEM Education through Team-based Interdisciplinary Research***

PRESENTERS: **Kristan C. Skendall,** *University of Maryland - College Park***; Frank J. Coale,** *University of Maryland - College Park***; and Leah K. Tobin,** *University of Maryland - College Park*

ABSTRACT:

Founded in 1996, the University of Maryland Honors College's Gemstone Program is an interdisciplinary undergraduate research program in which teams of 8 to 14 students work with a faculty mentor and professional staff over four years to create, develop, conduct and publish original research. Teams work on research projects exploring a wide array of technological and social issues employing a variety of methodological approaches. On average, there are 12 teams per cohort, equating to a total of 36 teams and approximately 550 total students. For information on current teams, visit **www.gemstone.umd.edu**.

Over the course of four years, each Gemstone student takes a sequentially developed curriculum to maximize his or her learning experience. In addition to the formal curriculum, students also serve as undergraduate teaching assistants, participate in shared governance, and serve in leadership positions within the program. Further, most Gemstone freshmen live together in one residence hall in which the program's central offices are housed, this facilitates strong faculty-student interaction from the start of the program. The Gemstone Program is a highly successful, unique approach to STEM education at a large, land-grant university.

Our program assessments show that our approach to STEM education through teamwork and research results in valuable knowledge application and provides Gemstone graduates with the ability to apply what they are learning in the classroom to a real world setting and prepares them well for graduate/professional school and their careers.

Friday evening overview

4:30-5:45 p.m.	Reception in *Atrium*
6-7 p.m.	Dinner in *Christine Grant Ballroom*
7-8 p.m.	Introduction of Speakers Gabriela Weaver, Ph.D., Conference Chair, Associate Provost for Faculty Development and Director of the Center for Teaching and Faculty Development, University of Massachusetts Amherst Keynote Speakers Linda Slakey, Ph.D., Consultant, AAU STEM Initiative Howard Gobstein, SMTI Co-Director and the Executive Vice President for Research, Innovation and STEM Education at APLU
8 p.m.	Closing Remarks Brenda Capobianco, Ed.D. Interim Director of the Discovery Learning Research Center, Purdue University Associate Professor in the Department of Curriculum and Instruction Co-Director, Science Learning Through Engineering Design (SLED)

Friday evening featured speaker

Howard Gobstein
Co-Director of the Science and Mathematics Teacher Imperative (SMTI) and Executive Vice President for Research, Innovation and STEM Education at the APLU

Howard Gobstein is co-director of the Science and Mathematics Teacher Imperative (SMTI) and executive vice president for research, innovation and STEM education at the Association of Public and Land-grant Universities (APLU). He initiated SMTI and is responsible for university policy efforts and improvements pertaining to research, education and economic development. He also co-directs the affiliated Mathematics Teacher Education Partnership and is responsible for university policy efforts pertaining to research, education and economic development. His past positions include associate vice president for governmental affairs and director of federal relations at Michigan State University, senior policy analyst in the Office of Science and Technology in the Executive Office of the President, and vice president and senior program officer at the Association of American Universities (AAU).

Gobstein spent the first 11 years of his career designing and leading evaluations of government science programs and policies with the U.S. Government Accountability Office. He holds a master's degree in science, technology and public policy from George Washington University and a bachelor's in interdisciplinary engineering from Purdue University. He is a fellow of the American Association for the Advancement of Science (AAAS) and was named a distinguished alumnus of 2010 by the Purdue School of Engineering Education. As executive vice president of APLU, Gobstein works closely with the APLU president and vice-president/chief academic officer, thus ensuring feedback and drawing on their expertise and respective communities of presidents and provosts.

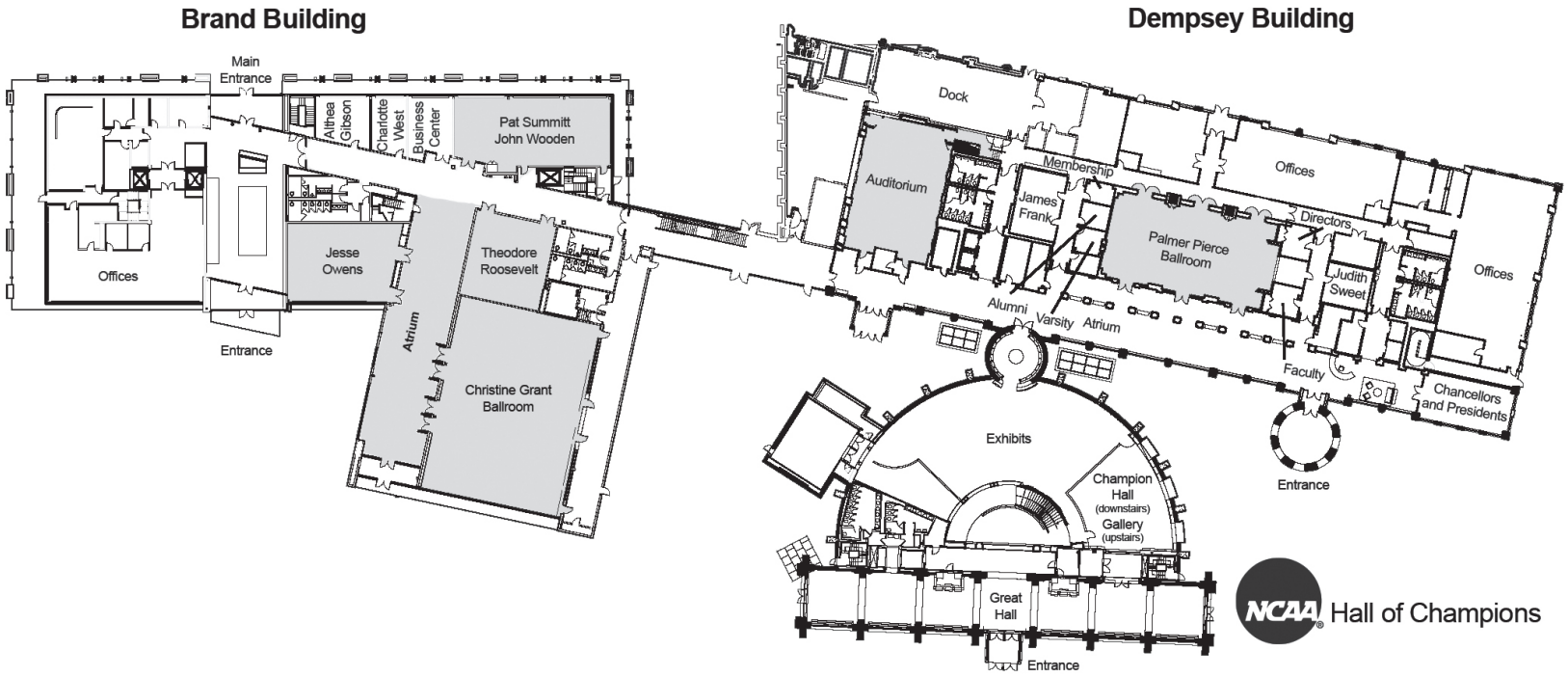
Friday evening featured speaker

Linda Slakey, Ph.D.
Consultant, AAU, STEM Initiative

Linda Slakey was appointed to the faculty of the Department of Biochemistry at the University of Massachusetts Amherst in 1973 and served in various administrative roles during her time there. From 2006-2011, she was director of the Division of Undergraduate Education at the National Science Foundation. At present, she has a consulting practice in Washington D.C., with appointments as senior advisor at both AAU and AAC&U.

Slakey is a graduate of Siena Heights College (B.S. in chemistry), and the University of Michigan (Ph.D. in biochemistry.) She was appointed to the faculty of the Department of Biochemistry at the University of Massachusetts Amherst in 1973. She was head of the Department of Biochemistry from 1986-1991 and dean of the College of Natural Sciences and Mathematics (NSM) from 1993-2000. From 2000-2006, she was dean of Commonwealth College, the honors college of the University of Massachusetts Amherst. As dean of NSM and of Commonwealth College, she was active in supporting teaching and learning initiatives throughout the university, with particular attention to engaging undergraduate students in research, to faculty development activities that promote the transition from lecturing to more engaged pedagogies, and to the support of research on how students learn.

During her time as director of the Division of Undergraduate Education at the National Science Foundation, Slakey came to view the challenge of bringing about good pedagogy as national and cultural in scope, and also came to know many of the people working on the agenda. As a consultant, she is focused on bringing about a shift in the culture of undergraduate teaching from one in which lecture is an acceptable norm toward one characterized by personal and institutional expectations of more student-centered teaching practices.


Brand Building
Main Entrance
Offices
Entrance
Jesse Owens
Althea Gibson
Charlotte West
Business Center
Pat Summitt John Wooden
Theodore Roosevelt
Atrium
Christine Grant Ballroom
Dempsey Building
Dock
Auditorium
Membership
James Frank
Palmer Pierce Ballroom
Offices
Directors
Judith Sweet
Offices
Alumni
Varsity
Atrium
Faculty
Chancellors and Presidents
Entrance
Exhibits
Champion Hall (downstairs)
Gallery (upstairs)
Great Hall
Entrance
NCAA Hall of Champions

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