Workshop on Advancing Systemic Change in Undergraduate STEM Education Background Material

September 6-7, 2018
NAS Building

DRAFT as of August 14, 2018

Roundtable & Workshop Overview

Background Material Objectives: Provide workshop participants with an understanding of the workshop objectives, the Roundtable's purpose and goals, and additional information.

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Roundtable: Purpose

This roundtable is being convened to enable leaders from across the STEM policy, research, and implementation communities of higher education to:

- learn from each other's efforts,
- work more efficiently to address complex issues related to undergraduate STEM education, and
- make collective decisions about future policies and priorities as well as plan their own work based on deeper understanding of the perspectives of other stakeholders in the system.

The Roundtable will foster ongoing discussion of the challenges to and strategies for improving undergraduate STEM education among federal officials, the business community, policy makers, educators, and academic scientists, mathematicians, and engineers. It will provide major federal and national stakeholders with the foundational knowledge of the evidence base on systemic reform in higher education while fostering ongoing interdisciplinary discussions by gathering experts from the major stakeholder groups. Roundtable members will learn from each other and other invited experts about broad systemic issues such as policies and practices that can facilitate or impede reform, effective approaches to supporting students' learning and engagement, the needs of faculty members as such efforts move forward, how institutional leaders can encourage and support improvements, and strategies for identifying and generating resources to support reforms.

Roundtable: Goals

The major goals of the Roundtable are to:

- Make participating members aware of current evidence across multiple disciplines that can be used to guide systemic reforms in undergraduate STEM education.

- Provide a formal mechanism for ongoing collaboration and communication among stakeholders.

- Advance discussion among stakeholders about systemic changes which can improve undergraduate STEM education at the state and national levels including articulation of challenges; identification of leverage points; and identification of the appropriate roles for federal, state, local, private, and non-profit organizations and institutions.

- Develop mechanisms to scale the implementation and dissemination of key findings/recommendations emerging from the portfolio of consensus studies being led by the Board on Science Education (BOSE) and the Board on Higher Education and the Workforce (BHEW) in the area of STEM education.

Workshop Objectives: Key Take-Aways

The Roundtable looks forward to learning from your expertise and your perspective. The Roundtable co-chairs and staff have designed sessions with the following key take-aways in mind:

- Identify ideas for thinking broadly and systemically about improving student learning in undergraduate STEM education.

- Promote thinking on the interconnections between societal change and undergraduate STEM education.

- Advance strategies for change in undergraduate STEM education.

The workshop contains panels to share data, research, and broad perspectives to serve as shared context for conversation. The workshop also includes a number of active engagement sessions to allow all participants to share his or her knowledge, to advance the collaboration between stakeholder groups, and to build collective action for systemic change in undergraduate STEM education.

Workshop Objectives: Driving Questions

The Roundtable co-chairs and staff designed the sessions based on the following driving questions in three categories. These questions may serve as different lenses through which to view the panelists' remarks and general conversation:

Systems Issues:

- How can using systems thinking lead to new insights about improving learning for undergraduate STEM students?
- How can higher education leaders stay in touch with the broader changes in society impacting needs and delivery of undergraduate STEM education?

Key Factors:

- What are the critical changes that undergraduate STEM education must take into account?
- How can higher education meet the needs of STEM learners from diverse backgrounds and preparations?

Advancing Change:

- What do change leaders need to know and do?
- What is needed to support local and national change leaders?
- What are the national tasks and what are the campus level tasks?
- Are there ways to target strategies most appropriate to each local context or type of institutions?
- What does the broader higher education community need to know and do?

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Roundtable: Meeting 1 Summary (1/2)

December 20-21, 2017

Meeting 1 Objectives: Provide background information to the Roundtable members, identify shared vision for the Roundtable, and to identify unique actions the Roundtable and its members can take.

Discussion themes from Day 1 of the meeting:

- <u>Teaching and Learning</u>: Use what we know about teaching and learning, embed effective practices and scale them up so lectures are not the norm.
- <u>Curricular Issues</u>: Have students tackle big STEM problems with multiple dimensions during their undergraduate tenure.
- <u>Big Problems and Grand Challenges</u>: Better links between career technical education and baccalaureate education.
- <u>Students/Student Environment</u>: Greater collective responsibility, inclusion
- <u>Rethinking Success</u>: Couple definition to the needs of the workforce. Consider the need for flexibility and balance in work, and the importance of transferable skills.
- <u>Institutional practices</u>: Promote a sense of collective responsibility. Consider the role of departments, especially in the evaluation of teaching and preparing the next generation of faculty.
- <u>STEM undergraduate education:</u> Consider this as a public good and encourage all to work together to improve it across the nation. (Eliminate courses designed to weed out students.)

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Roundtable: Meeting 1 Summary (2/2)

December 20-21, 2017

Key themes from group discussion on Day 2 responding to the following question: *"Where can we imagine the roundtable going from here?"*

- Work across the system by increasing alignment and leveraging each participants' network.

- Workshop and proceedings on measuring teacher effectiveness; evaluation, tenure, and promotion; and/or how different stakeholders can contribute to improving undergraduate STEM education.

- Embed equity and inclusion in the goals of the Roundtable from day one.

- Develop evidence-based and measurable goals, including a communication and engagement strategy.

- Use, but not rely exclusively on, the Academies' convening power to cast a broad net beyond the usual suspects.

- Focus on scalability and sustainability of change in a system.

- Recognize the concerns that skeptics hold and seek opportunities to engage with them.

May 14-15, 2018

Meeting Goals:

- Present the Roundtable mission statement
- Analyze the context more deeply and examine implications for Undergraduate STEM Education
- Develop agenda items for the Roundtable
- Develop goals and priorities for the September workshop

Day 1: Fireside Chat with Salim Ismail, Singularity University:

- Cultural and social disruption is happening with greater frequency and across more domains than ever before. Higher education institutions need to acknowledge:
  - Students today are motivated to learn when material is linked to a sense of purpose;
  - The emergence of micro-credentialing, peer ratings, and entrepreneurship as educational "currency" in hiring processes;
  - The increasing importance of a learner's "agency"- their ability to access knowledge on their own and create their own educational experience.
- Discussion around the concept of "students" vs. "learners
  - Students: Instructors push content knowledge on the recipient, and the student receives the content knowledge directly from the instructor
  - Learners: One who interacts directly with the content and seeks connections across various content areas

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May 14-15, 2018

Roundtable members broke into small groups and developed the following questions, centered around how changes in the conduct of research, society, the labor market, and the economy affect undergraduate STEM education, for the panelists on Day 2:

- When there are successful innovations, why don't they spread?
- How to design instruction to take account of diversity and the role of motivation, identity, etc. in learning?
- How do we ensure that organizational changes are intentional and include all institutions?
- How do we implement large scale indicators that authentically measure student improvement given the differences in institutional missions?
- How do we intentionally and explicitly infuse transferrable skills in undergraduate STEM education and support faculty in implementation and assessment?
- How do we implement large scale indicators that authentically measure student improvement given the differences in institutional missions?
- How do we intentionally and explicitly infuse transferrable skills in undergraduate STEM education and support faculty in implementation and assessment?
- How do we ensure that the future faculty is representative of the changing population of the country?

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Roundtable: Meeting 2 Summary (3/4)

May 14-15, 2018

Using the Day 1 discussions and a morning panel on the Implications for undergraduate STEM education of changes in societal context as a foundation, the Roundtable members broke into smaller groups and developed pitches for future Roundtable activities. The following ideas were created to generate discussion and identify potential next steps:

Pitch 1:Converging on STEM Competencies for the Future Workforce

- Identifying and mapping partnerships between industry and undergraduate STEM programs that can serve as guides and examples of highly effective models and can inform the work of the Roundtable in determining ways to deploy this knowledge across regional networks.

Pitch 2: Establishing Collaboratories to Develop and Build Change Agency

- Going "beyond the choir" to support and develop new change agents, to foster innovative, collective change in a context-specific manner, and to identify ongoing efforts that inform the work of the Roundtable in determining what are the factors for change, and what change readiness looks like.

Pitch 3: Systems View for Change: The Canary in the Coal Mine

- Creating a learning system to build the capacity of the Roundtable by establishing our understanding of systems thinking and its application to undergraduate STEM education through case studies around key issues, listening tours, research and coordinated messaging, and engaging and dialoguing with audiences and stakeholders around the value of higher education, and how we measure this.

Roundtable: Meeting 2 Summary (4/4)

May 14-15, 2018

Pitch 4: Bringing Incubated Projects into Larger Environments while Preserving Unique Factors
- Helping institutions bring what is working well to scale, while maintaining the integrity, by hosting a series of workshops that convene those who have had success and those who haven't-using case models to ground the conversation with the goal of looking at internal, institutional scaling and establishing ways to move successful initiatives across institutions.

Pitch 5: Project Being Explicit and Intentional about Transferable Skills (BIETS)
- Equipping students with the desired skillset(s) for workforce employment by considering the "DNA" of our institutions and how this influences the teaching of these skills to students via faculty mentors, and by pulling together successful models to assess the value proposition inherent to these models that can potentially be incorporated into classes and explicitly linked back to the workforce.

Pitch 6: Democratizing Access and Transformative Models
- Establishing a learning environment for training that concretely supports multicultural competencies and displaces negative elements (e.g., bias, stereotype threat, micro/macro aggression) with inclusiveness, access, affirmation, respect and dignity, which potentially have greater implications for student retention and the relevance of higher education in the future than the quality of the curriculum.

Roundtable: Members

- Ann Austin (Co-Chair), Michigan State University
- Mark Rosenberg (Co-Chair), Florida International University
- Andrea Beach, Western Michigan University
- Kamau Bobb, Georgia Institute of Technology
- Erin Dolan, University of Georgia
- Levon Esters, Purdue University
- Mica Estrada, University of California, San Francisco
- Noah Finkelstein, University of Colorado, Boulder
- Jeff Gold, California State University Office of the Chancellor
- Junius Gonzales, University System of North Carolina
- Cassandra Horii, California Institute of Technology
- Collins Jones, Montgomery College
- Patty Lopez, Intel Corporation
- Cordelia Ontiveros, California State Polytechnic University, Pomona

- Annette Parker, South Central College
- Ann Quiroz Gates, University of Texas, El Paso
- Chris Rasmussen, San Diego State University
- Barbara Schaal, Washington University in St. Louis
- Susan Singer, Rollins College
- Kyle Swanson, Metropolitan State University
- Jim Swartz, Grinnell College

Ex-Officio Members
- Howard Gobstein, Association of Public Land Grant Universities
- Mary Heiss, American Association of Community Colleges
- Lynn Pasquerella, Association of American Colleges and Universities
- Toby Smith, Association of American Universities
- Robin Wright, National Science Foundation

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Roundtable: Additional Information

- [Roundtable Website](#)
- Meeting I, December 20-21, 2017: [Meeting Agenda](#)
- Meeting II, May 14-15, 2018: [Meeting Agenda](#)
- Sponsor: The Keck Foundation
- Staff Director: Kerry Brenner, Senior Program Officer, Board on Science Education (BOSE), kbrenner@nas.edu
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  - Heidi Schweingruber, Director, BOSE, hschweingruber@nas.edu
  - Tiffany Taylor, Research Associate, BOSE, tetaylor@nas.edu