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EHR Advisory Committee
Fall Meeting, 2014
Introductions, meeting overview, and EHR update

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Assistant Director, National Science Foundation
Education and Human Resources

Welcome

- EHR and NSF Updates
- FY 2014 Accomplishments
- The AC Report and EHR
  - What we have done
  - Where we are going
- Discussions with Program Officers
  - AC Report Comments
  - Current EHR Activities
  - Questions for the AC

Welcome to New EHR AC Members

- Dr. Rebecca Blank, Chancellor, University of Wisconsin, Madison
- Dr. Catherine Casserly, Strategist - Learning, Openness and Innovation
- Dr. Candace Thille, Graduate School of Education, Stanford University
- Dr. Rory Cooper, Director, Human Engineering Research Laboratories, University of Pittsburgh

NSF/EHR Initiatives

- Transparency and accountability
- NSF-wide interest in reproducibility and replication
- Congressional interest in NSF-funded projects
- Dear Colleague Letters:
  - I-Corps for Learning
  - Hispanic-Serving Institutions
  - Ebola

Government-Wide Activity

- NSTC Committee on STEM Education and Cross-Agency Priority Goal
  - Undergraduate Education: Susan Singer
  - Graduate Education: Val Wilson
    - Graduate Research Internship Program partners with FBI, DHS, EPA, Smithsonian, Office of Naval Research
  - Underrepresented Groups: Sylvia James
- College Opportunity Activity

FY 2014 Accomplishments: Highlights

- Outstanding execution of FY 2014 EHR budget
- Volunteered to pilot the “New IQ” for NSF
- Increased cross-division and cross-directorate collaborations
- New ideas and creative approaches
  - Conducted 1st all-virtual review of Graduate Research Fellowship Program (GRFP)
  - 13,000 applicants, 1,300 reviewers, 38 panels over 3 weeks

FY 2014 Accomplishments: Great work in EHR-funded projects

Meta-analysis of 225 studies on student performance in STEM classrooms show that:

- Active learning increased student by 6% on exam scores
- Students were 1.5x more likely to fail in lecture based classes at all sizes.

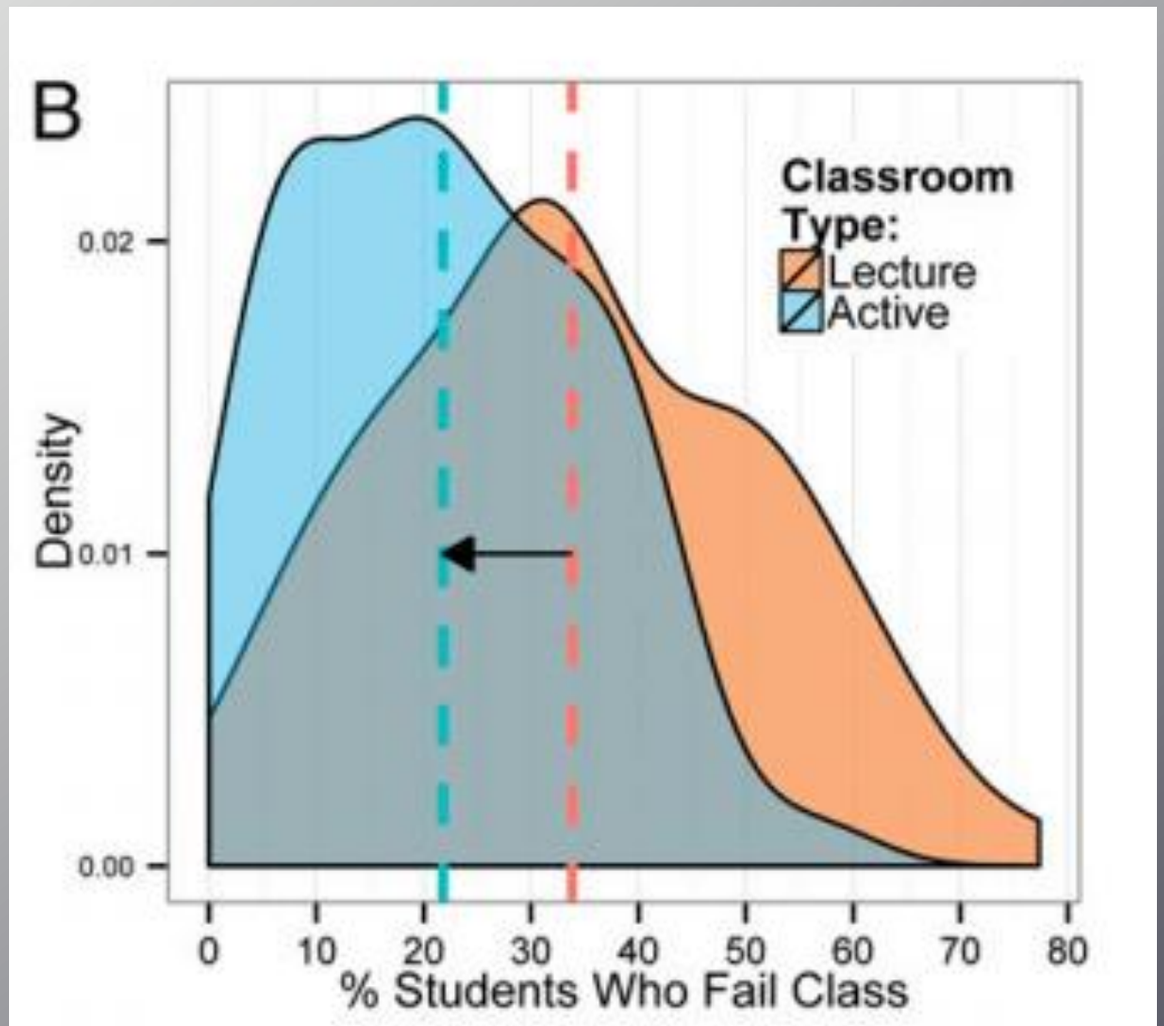

Figure: Changes in failure rates under active learning and under lecturing

REFERENCE

Source: *Active learning increases student performance in science, engineering, and mathematics*, Scott Freeman, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt, and Mary Pat Wenderoth, Proceedings of the National Academy of Sciences, April 15, 2014: http://www.pnas.org/content/111/23/8410.abstract

FY 2014 Accomplishments

Executed $831.57M during a 10-month period

- 701 Competitive Awards
- Conducted 316 panels with nearly 3,000 panelists completing ~10,000 reviews
- Hosted 10 PI meetings

Actions similar in volume to FY13, but in condensed period

Overview of Meeting

- *AC Report:* EHR staff processing so far
- *Five areas of focus:* where we are, questions for you
- *Action planning* (and lunch): around five areas of focus with staff
- *Deep dives*: in assessment, big data, and reproducibility (five areas of focus as a backdrop)
- *Conversations:* EHR program experts, EHR senior staff, all of you, visitors, and Dr. Córdova

CONGRATULATIONS AND THANK YOU!

EHR Advisory Committee. (May, 2013). *Strategic Re-envisioning for the Education and Human Resources Directorate.* Arlington, VA: National Science Foundation.

What have we done with "the AC report" since May?

- Wide dissemination (including Director, ADs, members of NSB), web site, NRC
- Deep discussion:
  - ✓ 2-day senior staff retreat
  - ✓ all-staff meeting
  - ✓ separate meetings in each division and OAD
- Developed several areas of focus from staff discussions, chose 5 for this meeting

What have we done with "the AC report" since May?

- External presentations (great interest from the community in engaging in dialogue)
- EHR senior staff are participating in this week's meetings to synthesize comments and actionable items for implementation in FY2015
- Senior staff retreat next month to refine and prioritize actionable items and an implementation timeline in January 2015
- Executive summary drafted
- Other dissemination ideas?

Five Areas of Focus
For Fall 2014 AC Meeting:

- PARTNERSHIPS
- CROSS-CUTTING RESEARCH THEMES
- APPROACHES TO SCALING
- BROADENING PARTICIPATION AS INTELLECTUAL MERIT
- EVALUATION AND RESEARCH USING BIG DATA

Partnerships

Comments from the AC Report

- Coordinated programs of research should include partnerships between NSF and sister federal and state agencies, universities, industry and the non-profit sector.
- Continue to build NSF-university-industry partnerships to leverage investments in research, development, and training for the STEM workforce
- Provide opportunities for the field to study learning and organization theory in university and industry partnerships to disseminate essential knowledge to foster best practices for STEM education and workforce development.

Partnerships in *Workforce Development* – Celeste Carter, DUE

- Partnerships with Industry
  - Industry – Education – Economic Development Agencies
  - Grades 7-12, 2-yr and 4-yr partnerships (career pathways)
- Across NSF
  - Engineering, Biology (Vision & Change)
- Across Agencies
  - Department of Defense, Department of Energy;
  - Department of Labor (Trade Adjustment Assistance Community College Career Training Grants Program);
  - US Economic Development Administration (Investing in Manufacturing Communities Partnership)

Partnerships in *Broadening Participation* – A. James Hicks, HRD

- **Louis Stokes Alliances for Minority Participation** uses the concept of alliances for broadening participation.
- To increase diversity and quality of the STEM workforce the LSAMP program emphasizes:
  - regional alliances of academic institutions (2- and 4-year degree-granting educational institutions)
  - school districts, and the private sector
  - local, state and federal governments
  - national, international research labs/field stations

Partnerships in *STEM Learning and Learning Environments* – Al DeSena, DRL

- **Science Learning** +: Partnership between EHR/Advancing Informal STEM Learning program (AISL) and Wellcome Trust (UK) – a two-phase initiative to stimulate international collaborations on research in informal STEM learning.
- **Partnerships of science museums and universities** – deepening the relationships and long-term commitments at the institutional and faculty/staff levels, addressing both Intellectual Merit and Broader Impact criteria.

Partnerships: Questions for Conversations

- What advice do you have for fostering collaborative funding partnerships with other organizations, foundations or industry?
- How do you measure the success of partnerships with other organizations?
- How do we ensure the continued success of our current partnerships while staying current with new findings and practices?
- What is the particular role NSF-EHR can play to foster and advance partnerships that are a win-win for all involved?

Cross-Cutting Research Themes

***Comments from the AC Report*:**

- EHR should coordinate intensive research on key concepts and well-defined problems of practice in STEM teaching and learning that pose significant "stumbling blocks" for educating all students.
- A paradigm shift from a program/division focus to a portfolio focus is needed to develop high leverage collaborative research programs.
- Common priorities for cross division/directorate interdisciplinary investments in Science and Technology can spark collaborative research.

Cross-Cutting Research Themes in *STEM Learning and Learning Environments* – David Campbell, DRL

- Probabilistic reasoning – How is probabilistic and statistical reasoning featured in student learning? How does it factor into workforce development and especially the growth of data science professions and professionals? What challenges does probabilistic reasoning pose for growing STEM literacy across the workforce and in the citizenry at large?
- Visualization and multiple representations of STEM knowledge may support powerful learning across a range of content – how might this idea connect to communication and STEM literacy?
- Scale and proportional reasoning concepts cut across science disciplines (e.g., time scale in biology, scale in geography). How might they inform research across the Directorate?

Cross-Cutting Research Themes in *Workforce Development* – Earnestine Easter, DGE

- How can STEM knowledge-building interventions and curricula better align with industry expectations of necessary competencies and skills?
- How do we more fully understand and support successful early career transitions for STEM professionals?
- What effects do different STEM funding models have on graduate student career outcomes?
- How do we develop students' research skills?

Cross-Cutting Research Themes in *Broadening Participation* – Mark Leddy, HRD

- How are learning theories that relate to learning STEM advanced by studying the learning behaviors and characteristics of people with disabilities, both gender groups and diverse minority populations?
- In what ways do organizational and institutional policies, and the design of learning environments, foster the untapped potential and success of underrepresented groups in STEM education?
- What are the most effective ways to train STEM educators to employ culturally and socially responsive pedagogy to better engage the diverse learner and facilitate career development?

Cross-Cutting Research Themes: Questions for Conversations

- At your organizations, or in your disciplines, how have you identified productive cross-cutting themes?
- How have you coordinated intensive research on key topics at your organization?
- What advice do you have for NSF on how to develop a more coherent set of cross-cutting themes across the EHR directorate and the Foundation as a whole?
- What approaches would you recommend to elicit the best possible input from the field on powerful cross-cutting research themes?

Approaches to Scaling

***Comments from the AC Report*:**

- Provide support for replication of evidence-based programs that support STEM learning, and examine mechanisms to provide sustained implementation support where justified.
- Continue to exploit the potential of cyberinfrastructure to transform STEM learning within and across the formal and informal education sectors so that all American students can meet and exceed the expectations articulated in education standards and related policy documents.
- Provide opportunities for the field to study learning and organization theory in university and industry partnerships to disseminate essential knowledge to foster best practices for STEM workforce development.

Funding Approaches to Scaling – David Haury, DRL

- Across programs, EHR focuses on differentiated learning ecologies:
  - Formal education, Informal education, and Blended models
- Within programs different funding strands explore untested ideas and build on evidence of promise:
  - "Exploratory," "Pathways," or "Prototype" strands *versus* "SPrEaD" or "Full Design and Development" strands
- Different programs have different funding levels and scopes of work:
  - "Resources, Models, & Tools" versus "Systems"

Approaches to Scaling – Connie Della-Piana, DUE

We use a variety of iterative R&D focused on evidence-based instructional practices. For example:

- Innovation-Corps-Learning
- Institutional and Community Transformation
  - Institutional Level
  - Disciplinary Community Level

There is a growing focus on Community Colleges

- DCL - Two-Year Hispanic Serving Institutions

And Undergraduate Research Experiences

Approaches to Scaling – Sarah-Kay McDonald, DRL

Modern technologies and data analytics allow more creativity and flexibility in dealing with warrants for scaling.

There may be inherent limitations from using traditional models of scalability as a criterion for assessing impact in learning and educational research.

Leveraging opportunities to work ***at scale***:

- Conducting research (e.g., big data, data science, embedded experiments)
- Mass customization (e.g., personalized learning)

Approaches to Scaling: Questions for Conversations

- In your experience, what incentives are successful to support adoption of an intervention?
- What information do you use to justify continued investments in scaled interventions?
- What does "bringing to scale" mean in the context of "non-cognitive" skills that will vary in nature and relevance across learning contexts, and the same outcomes will not be expected from all participants?
- What alternatives to traditional "scale-up" models can we use to more appropriately gauge the contributions of EHR-supported research and returns on EHR investments?

Broadening Participation as Intellectual Merit

***Comments from the AC Report*:**

- Support conversations on the need for a common, working definition of broadening participation that respects traditional formulations but is forward-looking, ensures access, and powerfully engages all Americans in the STEM enterprise
- Broadening participation as a means of providing an intellectual context that may enrich perspectives on research on STEM practices.
- Broadening the set of methods and metrics for program evaluation.

Broadening Participation as Intellectual Merit – Jessie DeAro, HRD

Broadening Participation Research:

- Broadening participation research tracks across EHR programs
- Partnering with the Directorate for Social, Behavioral and Economic Sciences to create a *Science of Broadening Participation* (SBP) research area and community
- Broadening participation is one of the EHR core research areas in EHR *Core Research program*

Broadening Participation as Intellectual Merit – Robert Russell, DRL

Examples of EHR Research Concerning Broadening Participation in Informal and Out-of-School Environments

- *Examining Contextual Factors Influencing the Implementation of a Citizen Science Project* – Implementation research of a citizen science project in five culturally diverse communities
- *Engaging Girls in Computation Electronic Design* – Development of a Community of Practice of STEM practitioners engaged in supporting Equity, Diversity and Inclusion
  - Design of model strategies to engage urban and minority girls in learning coding, electronics, engineering and computer design through designing e-textiles
  - Research on topics, narrative, and social support influencing learning, skill development and STEM identity

Broadening Participation as Intellectual Merit: Questions for Conversations

- In your experience, what are some effective practices to *transform* organizational cultures for broader participation?
- In your organizations, how do you identify broadening participation strategies to invest in?
- What strategies or incentives may help ensure researchers and evaluators take broadening participation into consideration when they:
  - formulate their research designs and
  - formulate their evaluation designs?

Expanding and Supporting New Methods for Evaluation and Research Using Data Analytics

***Comments from the AC Report*:**

- Support the development of multi-modal **learning analytics** and related **data-intensive methods** to advance a range of educational questions
- Engage communities of researchers in exploring the **emerging concerns for human subjects' protections in rapidly changing, data-intensive**, STEM learning environments
- **Develop knowledge bases … and knowledge management tools and techniques** to improve internal and external knowledge synthesis, evaluation, and communication
- **Broadening the set of methods and metrics for program evaluation**. Evaluation studies should take advantage of **new methods and analytical strategies** … made possible by improved methodologies related to **"big data"** approaches to learning and other applications

Expanding and Supporting New Methods for Evaluation and Research Using Data Analytics – John Cherniavsky, DRL

Example programs:

- Building Community and Capacity in Data Intensive Research in SBE and EHR
- Data Infrastructure Building Blocks
- Software Infrastructure for Sustained Innovation

Example projects:

- Leveraging Matched Administrative Datasets to Improve Educational Practice and Long Run Life Outcomes: Toward Building a National Interdisciplinary Network
- Playdata Consortium (PDC): A Consortium for Digital Analytics and Techniques for Assessment with Learning Games
- Building a Scalable Infrastructure for Data-Driven Discovery and Innovation in Education
- Adding Research Accounts to the ASSISTments' Platform: Helping Researchers Do Randomized Controlled Studies with Thousands of Students

Expanding and Supporting New Methods for Evaluation and Research Using Data Analytics – Tasha Inniss, HRD

Other EHR Efforts:

- Infusing Data-Enabled Active Learning in Mathematics and Statistics Courses
- Learning Theory and Analytics as Guides to Improve Undergraduate STEM Education
- Knowing What Students Know: Using Educational Data Mining to Predict Robust STEM Learning
- Using data-mining to enable early interventions in introductory engineering courses

Expanding and Supporting New Methods for Evaluation and Research Using Data Analytics: Questions for Conversations

- What role can data analytics play to advance educational research?
- How does big data shift the research paradigm across learning platforms, and social systems?
- In your organization what strategies have you implemented to address issues with privacy and data security?
- How can work in data analytics support broadening participation?
- To prepare the next generation of researchers and data scientists, what do you feel are the necessary skills in data analytics and big data for STEM education, research, and careers?

Break Out Sessions

Partnerships – Room 880
Approaches to Scaling – Room 805
Broadening Participation as Intellectual Merit – Room 855
Research Challenges and New Methods for Evaluation and Research Using Data Analytics – Room 375

Please return to room 375 for the panel discussion starting at 2:15