**Meeting of the Advisory Committee for Education and Human Resources**
**May 19-20, 2015**

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

**Members Present:**

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| Bruce Alberts* | Rory Cooper | Beverly Tatum (5/19)* |
| Rebecca Blank (5/19)* | Paul Kim | Candace Thille* |
| Angel Cabrera | Karen Klomparens | Lee Todd* |
| Michele Cahill | Mark Lipsey | Lillian Wu |
| Gregory Camilli (5/19) | William McCallum | |
| Catherine Casserly* | Roy Pea* | * Virtual attendance |
| Muhammed Chaudry | Francisco Rodriguez, Chair | |

**MINUTES**

**Tuesday, May 19, 2015**

**8:30 AM – 8:45 AM - Welcoming Remarks**
Dr. Joan Ferrini-Mundy opens the AC Meeting

Dr. Lee Todd, President Emeritus, University of Kentucky, Outgoing EHR Advisory Committee Chair – reflects on the history of the EHR AC Meetings. Dr. Todd welcomed Dr. Rodriguez as the new AC Chair.

Dr. Francisco Rodriguez, Chancellor, Los Angeles Community College District, Incoming EHR Advisory Committee Chair – highlights measures he's looking forward to on the agenda.

**8:45 AM – 9:15 AM - Introductions, Meeting Overview, and EHR Updates**
Dr. Joan Ferrini-Mundy, Assistant Director, Directorate for Education and Human Resources – introduces the members of the AC Meeting.

Dr. Ferrini-Mundy provided an update of events that have happened since the fall meeting:

- New Steps to Enhance Transparency and Accountability at NSF
- NSB Meeting in February 2015, focus on investments in education research
- FY16 President's Budget Request; BRAIN Initiative, INFEWS, Risk/Resilience, INCLUDES
- CoSTEM Activities
- EHR FY16 Budget Request; Strengthen Research Initiatives
- AC Recommendations Addressed
- Shifts in education and human resources investments
- Building next generation research infrastructure for education research
- Comprehensive public access to research results

Dr. Ferrini-Mundy poses two questions for the AC Members to reflect during the meeting. The questions are on their tables.

**9:15 AM – 10:15 AM - Update of the EHR Core Research Program**
Moderated by Dr. Anthony Kelly, Senior Advisor, EHR – outlines the agenda for the panel and introduces the speakers.

Finbarr Sloane, Co-lead, EHR Core Research Program, EHR Division of Research on Learning in Formal and Informal Settings – provides an overview, history, snapshot and the goals of the ECR Program.

B. Jan Middendorf, Co-lead, EHR Evaluation and Monitoring Work Group, EHR Division of Graduate Education – provides an evaluation-based perspective and encourages engagement and feedback from the AC members.

Dr. Anthony Kelly poses discussion questions to the AC Members.

**Questions from AC Members:**
Dr. Roy Pea – wonders to what extent is EHR is collecting evidence and argumentation that will make changes in ECR's communities.

Finbarr Sloane explains the types of data that ECR is collecting and provides examples of how data can be impactful to the different communities.

Dr. Ferrini-Mundy asked Dr. Roy Pea to elaborate on his question.

Dr. Roy Pea references the four layers in the slide, and wants to know how these individuals are being influenced by the research; decision makers may have limited window in ability to interpret data results. New techniques are developing to address these problems and Dr. Roy Pea is curious of EHR research on how people approach these techniques.

Dr. Lilian Wu asks how EHR evaluates projects (internships, hackathons, transformative projects). Also how does EHR evaluate the work people have done in jobs/careers?

Susan Singer notes program on Core Based Research that EHR is evaluating in undergraduate work. Also, she notes that prior experience (micro credentialing) is an area EHR is interested in (Veterans). EHR may consider evaluation in more of its programs.

Rebecca Blank notes a "thin" literature on students with experience-based backgrounds.

Finbarr Sloane addresses idea on how EHR is and can incorporate these areas in programs.

Roy Pea notes there is not much research directly on standards and its effects on education.

**10:15 AM – 10:30 AM - Committee of Visitors Report Out: ADVANCE**
Moderated by Corby Hovis, EHR COV Coordinator – outlines the agenda for the panel and introduces the speakers.

Suzanne Ortega, Council of Graduate Schools, COV Chair –notes remarks will focus on three areas:
Recommendations of Review Process
Recommendations Management of Program:
Recommendations Portfolio

**Questions from AC Members:**
Greg Camilli stated that centralized budgeting seems to take away some form of freedom.

Suzanne Ortega stated that funding to support projects resides in the Directorates- when you balance a portfolio over years it gets difficult.

Lillian Wu asks how many ADVANCE projects have we done at NSF? Are we getting some feedback on what should be scaling out or is every institution is unique?

Jessie DeAro stated that we have done 45 or 47 projects that have been awarded.

**10:30 AM- 10:45 AM- Break**

**10:45 AM – 12:15 PM – Panel Discussion: Evolving Successful STEM Education Indicators**
Moderated by Mark Lipsey, Research Professor and Director of the Peabody Research Institute, Vanderbilt University, EHR AC Member – provided opening remark that there is a real difference between identifying indicators and implementing or operationalizing them.

The indicators are one way to try and answer the question of what successful STEM education practices are.

Barbara Means, Director of the Center for Technology in Learning, SRI International
The first report on STEM education (NRC 2011) provided recommendations that can be broadly grouped into 3 categories:

- The organizational structure of schools
- Teaching and learning processes
- District and state processes

The second report on STEM education (NRC 2013) focused on how translate the recommendations into items that are measurable on the large scale (to show progress towards providing successful STEM education). The idea is not only geared on outcomes but also on malleable variables. The indicators should a) be directly related to the recommendations, b) enhance understanding of whether equal opportunities are provided to all students, c) be considered as a means for continuous improvement.

The indicator system was not envisioned as part of the accountability system (that would be counterproductive). It is important to note that an improvement orientation is the driving force behind the indicator system.

The development of indicators is not a one-shot activity. It is a gradual process that improves and adapts over time, as an improvement cycle. Some research is needed on how to measure certain indicators. However the notion is not to wait for a perfect system, but to start with what is known and available then develop/improve as warranted.

It was stated that the emphasis on NSF's role going forward is not on dissemination but on the engagement process. The engagement with policy and practitioner groups is an important aspect of the recommendations from the STEM education reports.

**<u>Issues for indicators and the indicator system</u>:**

How best to measure them – additional research needed to have comparable measures over time.

Debate over cause and effect – How do we know what the effects are before discussing causes? What measures describe them well enough? Monitoring achievement is good, and then can try to backward map

onto the contexts (asking questions to map to effects rather than trying to get general indicators that hope to capture effects). There may be many obstacles and need a reality test to determine whether the indicator system approach would work out.

Complex relationships exist (we are dealing with a complicated system). Trying to disentangle variables or even to know what is being done in the schools or by teachers is like delving into a "black box," i.e., trying to understand what is going on behind the mechanism.

Should the indicators tell more about the national system and less on details of the cause/effect of trying to look within the black box? It is not an either/or proposition, both types of investigations are needed. The goal is to raise attention to the issue in a way that people can think about in meaningful ways.

A suggestion on trying to understand the "black box": Would a program or project cohesion ratio be a useful thing to consider? It would be a statistical probability to provide a numeric comparison indication. For example, if the cohesion ratio has a high value then the likelihood of leading to better outcomes, scale-up, etc. would be high.

Presuming the monitoring system will go forward (since it was a request from Congress), what is EHR's role, conceptually, in the process? Part of EHR's mission is a focus on outcomes. How can EHR connect investments to information that can be used by the policymakers who enact changes?

There is an absence of class size from list of indicators – is that intentional? There was not a strong research connection for class size effects for the first STEM education report (that provided recommendations) so it was not considered.

It was noted that the STEM acronym encompasses a wide array of disciplines, and that typically the different disciplines do not talk to each other. One might consider studies on whether systematically having science teachers incorporate examples from science, and vice versa, would have a beneficial effect. Try to fully capture the essence of the acronym as well as investigate among the science, technology, engineering, and mathematics for appropriate indicators.

Are there indicators of things that are happening that we would want to avoid?

Suggestion for indicator: a short Gallup poll of the population of parents (particularly those with young children) that can be done consistently over time.

Examine closely when schools do better than expected – along the lines of positive deviance and factors involved in this positive deviance.

**Wrap-up by Karen King:**

There are many tensions surrounding the use indicators as monitoring system or as an engine for improvement.

What is the role of EHR, within a research agency, to change/improve versus learn/understand? Is the NSF role as one to document/monitor, or as an engine of improvement, or both?

Need to keep some of the variables stable/consistent over time.

Some indicators are hard to measure (or no data collected in the area yet).

Are the indicators the "correct" ones? Will the indicators need to be reframed over time (e.g., to reflect the changing landscape of the STEM infusion process in the K-12 arena)?

What are the items to measure that really matter?

Some things that are supposed to be easy to measure turn out to be not so easily measureable in reality (e.g., measuring time spent on teaching). What level of precision is required?

How can we stimulate or prioritize proposals around important indicators?

**12:15 PM – 1:15PM - Lunch Conversation and Poster Session with EHR Program Officers**

**1:15 PM – 2:15 PM - Committee of Visitors Report Out: Division of Research on Learning in Formal and Informal Settings (DRl), IGERT, GK-12, and SFS**
Moderated by Corby Hovis, EHR COV Coordinator – outlines the agenda for the panel and introduces the speakers.

Greg Camilli, Professor, Graduate School of Education, Rutgers University, Co-chair for DRL COV – review panels are good for new individuals, but what about the applicants wo might be judged by less experience and therefore less experience in writing good reviews.

Karen Klomparens, Professor and Associate Provost and Dean of the Graduate School, Michigan State University, Chair for IGERT, GK-12 and SFS COV - discussed the IGERT and GK-12 Subpanel and SFS Subpanel and recognized the individuals that worked on them.

**Questions from AC Member:**
Carol van Hartesveldt stated that minority students must self-identify, they can't be identified by PIs them.

Lillian Wu – explain the SFS program within EHR?

Dr. Ferrini-Mundy stated it's a very specialized program aimed on training students for cybersecurity within the Federal Government (primarily). The program was first done in DUE, and then switched to DGE – so it has been managed in both divisions.

**2:15 PM – 2:30 PM – Break**

**2:30 PM – 4:00 PM - Panel Discussion: Developing New Measures for Non-cognitive**
Moderated by Angel Cabrera, President, George Mason University – outlines the agenda and introduces the speakers.

Art Graesser, Professor, Department of Psychology and the Institute of Intelligent Systems, University of Memphis -

**3 Projects:**

1) Work with two computer agents interacting with a human.
2) Track What Emotions People are Facing During Learning and Problem Solving
3) Work with PISA - Collaborative Problem Solving – How people solve problems and act in teams.

Rory Cooper, Director Human Engineering Research Laboratories and Distinguished Professor, Department of Rehabilitation Science and Technology, University of Pittsburgh

Engineering Perspective – Non-cognitive skills – we use to call them soft skills. Skills necessary for success be able to collaborate, communication skills (both written and oral) and project management skills.

Lost in engineering in the last 40 years are professional/practical skills. Started to diminish the role of laboratories and project.

Students never fabricate anything of any significant. So when they become engineers that don't have any experience.

**Questions/Discussion from AC Member:**

Angel Caberea asks how we scale such collaborative efforts.

Art Gresser stated that technology will play a role – where people use computers. Sensor devices try to pick up if people are engaged. Try ways to change boredom things to more engaging – by increasing the interest in value in some way. (Example: students don't know the value of courses they are taking – they are told to take them, but they really don't know the value). There is no curriculum, currently for Collaborative problem solving. Will employ didactic training.

Angel Caberea asks are there any additional thoughts on measuring these non-cognitive skills?

Evan Heit stated that different people have different language for (perseverance for example). These are some challenges the precede some of the measuring endeavors. Even if you've measure for one purpose does not mean it will be applicable to others.

Angel Caberea asks is there any particular set of non-cognitive skills that we should be paying attention to with people with disabilities?

Roy Cooper answered – a lot of times children with disabilities do not receive the same level of learning socialization or able to participate in school sports. Disability people are known for note takers, most chemistry or engineering laboratories are not set up for people to fully participate in activities. People with disabilities learn great time management skills because it takes them more time. On the same line you need resilience. Also people with disabilities have more access to technology.

Angel Cabrera stated on the measurement side, it appears that grades are better predictors of future performance as opposed to standardized tests. How do we go back to looking at the outcomes of learning on grades?

Evan Heit answered there is no measure that will get you a free peak of cognitive ability. Part of what is needed is when we look at different STEM disciplines work needs to be conducted to determine non-cognitive measures.

Art Gresser wanted to draw attention to PISA and PEAP research. Look at 16 year olds, some of the predictors of success in later life is math and personality. Look at studies comparing PEAP and PISA.

Bruce Alberts stated we are trying to get active problem solving in all first year college class rooms. Interaction with graduate students have shown a robust need to experience the competence at all levels to be successful in some problem solving areas. Rather than having a new course, try to build on what is already being done. Could we create synergy with science education to active inquiry group actions?

Rory Cooper stated that often times the formal curriculum doesn't keep pace with student desire and needs. Student are looking for these opportunities and if not found in the classroom then they're found in other ways.

Mark Lipsy asks where do the members of the panel think we are in terms of correlations of cognitive vs non-cognitive skills?

Art Gresser answered that self- regulation and metacognitive skills are modest at best and no curriculum exists. One thing we've learned is that an hour of didactic intervention doesn't help, it has to be more like 20 hours to see affect. Some feel that stealthy methods should be employed. Stealth assessment where people don't realize that they're being assessed.

Rebecca Blank: What do we know of the correlation between high cognitive skills vs low cognitive skills?

Evan Heit stated that there are some challenges measuring these skills. I wouldn't assume malleability. To the extent that there is research, to a degree children will be more malleable than adults etc. yet this could be due to selective evidence. Evan Heit mentioned the great work by Jane Heckman (Univ. of Chicago), done work on cognitive measures and predictability on future success. Some educational outcomes will not support a viable trade off due to educational constraints such as GED which doesn't test non-cognitive ability.

Art Gressler stated that putting 4 students in a team often does not accomplish much without some guidance. It’s his understanding that a few teachers do not know what the guidance is. Art Gressler stated that he is not sure if teachers get this information through professional development.

Francisco Rodriguez - first generation students vs. other generation students. First generation student has a disadvantage when they didn’t have anyone else in their family attend college. I think they thirst to learn or succeed is more powerful then third or fourth generation students.

Finbarr Sloane stated yes work has been done by Carlos Castillo Chaves at ASU mathematics department, looking at cross generational shifts.

Greg Camilli asks what is known now, that changes a better springboard into this unchartered territory?

Art Graesser stated there are a series of handbooks that have been published that would be a start. The challenge is having a trickle-down effect to teachers and what assessments there are through k-12 to college.

Discussant: Gul Kramer, Program Director, EHR Division of Undergraduate Education summarized the main points, questions and answers that were discussed.

**4:00 PM – 5:00 PM - Conversation with Dr. Richard O. Buckius, NSF Chief Operating Officer**

Dr. Francisco Rodriguez introduced Dr. Richard Buckius

Dr. Richard Buckius stated that the Vote at the House on the HR Bill is taking place tomorrow, May 20th.

Dr. Richard Buckius stated that EHR is important to the Foundation.

Greg Camilli – provided a brief summary of what was discussed this morning during the Update on the EHR Core Research Program

Mark Lipsey – provided a brief summary of what was discussed this morning during the Evolving Successful STEM Education Indicators - explored different ways of contrast of indicators of professional development of teachers and how teaching is done on a K-12 level. If you take the results of indicators, there are a lot of work EHR can do to address the indicators in STEM education.

Question for Dr. Richard Buckius: How far do you want to go and what can EHR do to tackle STEM education?

Dr. Richard Buckius stated that we need to look at the outcome and not just the data for the Indicators.

Dr. Ferrini-Mundy explained the project started 3 years ago by Wolfe. Today's discussion was "what's next" and Mark Lipsey is right in reference to what can EHR do to address what's next.

Art Graesser – provided a brief summary of what was discussed this morning during the panel discussion: Developing New Measures for Non-cognitive skills. – Art Graesser stated that the ability to tackle issues that relate to interpersonal skills that doesn't just deal with a person's ability to be creative and teach but their skills in teaching effectively in a school setting and connecting with people.

Question for Dr. Richard Buckius: How do we measure them and see if they have been effective?

Dr. Richard Buckius stated that they had an argument recently about whether or not measurements will be effective and it was said that if environment wasn't considered, it may not be effective.

Lilian Wu stated that she found today discussion interesting. Also, mentioned that at her organization they have post-docs intern there to see if they fit into the environment before hiring them. It allows them to see whether the person/student needs support outside of cognitive skills. This is allows them to build portfolio so that they have multiple experiences.

Question for Dr. Richard Buckius: How do you evaluate what they have actually learned in the real world…the courses and tasks in addition to the real world?

Richard Buckius stated that we have approx. 600 Academic Institutions – are we building operable graduate students.

Lilian Wu stated students get experience and first hand ones from building apps and finding success from building apps that help people or doing things that impact others.

Rebecca Blank fears that the President's number for EHR budget will not be correct (whether up or down).

EHR Budget: This is raw information.
Richard Buckius think that it's going to be a battle and not going to see an outcome for a while. He is hoping that it will be a plus.

Greg Camilli asked have you heard any criticism of EHR portfolio on Capitol Hill -
Richard Buckius answer was no. Dr. Ferrini-Mundy stated that she hear a lot of ideas of what EHR could be doing. Dr. Ferrini-Mundy has been listening for Research Direction, but not been hearing anything significant. It has been positive but neutral, depending on who you are talking to.

Greg Camilli asked when thinking about ECR, what is the research architecture of EHR? How do we change the culture of the division? How do you communicate it to people, what are the challenges, are we missing anything? How can we show its impact?

Dr. Richard Buckius stated that is that the impact that we want to see. We are about assisting in people learning? Has it not been illustrated the way people want it to be, like yourself?

Greg Camilli stated that it's not properly there. It should be in an open and transparent way that is producing and increasing common good in EHR. Is it available to stakeholders and other people interested in this division?

Greg Camilli assumes that the job of being on the advisory committee was to speed along the process of things in EHR and increase the means of production.

What is your sense of relationship on the Congressional Side – Dr. Richard Buckius stated that Science and Engineering did not have a half empty feeling back in 1998 when he was here, but now unfortunately that is the feeling of the country. Richard Buckius stated that this is the feeling of the country unfortunately. Buckius stated that Dr. Cordova has invested a lot of time on the Hill more than any other Director.

Brain Science – how can EHR investigate in this initiative? – Richard Buckius stated that this is a great initiate it impacts everything that goes on in the Foundation. EHR has to play an essential role on this initiative. Dr. Ferrini-Mundy – 1) Research on Learning on STEM 2) Partnership with other Directorates 3) significant investment in training and education and how it can further in this field.

Bruce Alberts stated that he think we need a major training program on how to write abstracts. Also, he stated that NSF used to assist in STEM curriculum in which you had to go through certain logistics to utilize them. He thinks there should be a way to utilize materials and make them accessible on the web or by another party.

Dr. Ferrini-Mundy stated that they have a pilot working on this for 2015 that can both be studied and do-able that can go back to initial materials used in the beginning to not do anything illegally. Question:

“How does a teacher find material”? “How do teachers select which material to use and which material not to use”?

Catherine Casserly stated her experience in going back and looking at copyright issues and being that there are new laws and copyright issues that are attached to those things. One thing is that a copyright license should be easiest especially with NSF so that he can have access to these materials. Another question was how will NSF stay ahead of the curve in reference to teachers using content especially with the merging of other materials.

Bruce Alberts does not want people to lose their grounding in EHR. During a panel discussion, he stated that a comment of “Persistence might be different in math than in any level" and EHR should look at that.

Dr. Richard Buckius stated that you have to have strengths in the discipline. We do expect for there to be an increase from the 10% we have but we do think we need to handle interdisciplinary issues.

**SYNTHESIS OF THE DAY**
Muhammed Chaudhry gave the synthesis of the day and reiterated the main points.

**Wednesday, May 20, 2015**

**8:30 AM – 8:45 AM - Reflection on Previous Day’s Discussion**
Dr. Francisco Rodriguez and Dr. Joan Ferrini-Mundy reflected on yesterday’s discussion.

William McCallum stated that we have not had any discussion about programs in EHR.
Dr. Ferrini-Mundy referred to the handout that was shared and listed several programs.

Mark Lipsey – changing or consolidating programs, lots of overlap and redundancy.
Dr. Ferrini-Mundy stated that if there was a push from the community on what is really needed and the stake holders.

Dr. Francisco Rodriguez would like to stay engaged throughout the year, need an avenue to communicate with one another throughout the year.

**8:45 AM – 10:30 AM - Panel Discussion: Putting Improvement Science into STEM**
Moderated by Paul Kim, Assistant Dean for Information Technology and CTO, Stanford University School of Education, EHR AC Member - outlines the agenda for the panel and introduce the speakers.

Anthony S. Bryk, President, Carnegie Foundation for the Advancement of Teaching – stated that he would argue that schools have been improving for some time. We cannot solve our education problems by continuing to do what we have always done.

Ann Austin, Co-lead, EHR Evaluation and Monitoring Work Group, EHR Division of Undergraduate Education – discussed Six Core Principles of Improvement

- Be Problem Focused – what specific problem we’re trying to solve
- Attend to Variability - even for rigorous research or eval, we know it can work: the effect size. If we want to achieve quality outcomes for all students at scale, then the variability

in performance is the problem to solve. It's not that something can work, but how to achieve improved outcomes for subgroups, teachers, and contexts in which learning occurs. It's a learning to improve problems.

- See the system: what's actually producing the outcomes that are occurring now. How do systems actually work? Needs data at a timely fashion. Policy support. Have to work on all supports and how they integrate in context.
- Embrace measurement: are we truly improving anything? Move beyond confirmation bias.

> Key drivers for community college: "starting strong" students disengage in the first few weeks; direct interventions, classroom routines, explicate value to topics—each change idea is research based. But how do we know if the ensemble is working? Surveys weekly, etc.

- Learn through disciplined inquiry: hunches to change at scale; 1 in 4 people die from infections they got in the hospital; start small scale
- Organize as networks: our schools are so complex, we need coordinated collective efforts to make improvements; break down the silos; if we organized ourselves, across expertise…

Improvement – joins the discipline of improvement science and networked communities. Taking together is the work we now call Learning Improvement of Science.

Julie Palais, Program Director (on detail from the Division of Polar Programs), EHR Division of Graduate Education – titled her talk – "Putting improvement Science into STEM" - What can be learned from how we manage other programs around NSF – found quotes that can help with this from Albert Einstein.

Some tools can be applied from the type of work we do in discipline science that can be applied to education:

- Strategic Planning
- Project Management
- Total Quality Management
- Six Signa
- Logic Models

Julie Palais stated that there is not a one size fit all approach to improve Science.

Discussant: Ann Austin, Co-lead, EHR Evaluation and Monitoring Work Group, EHR Division of Undergraduate Education – shared that she had the opportunity to attend the Improvement Science Meeting with Evan Heit in California.

Ann Austin highlighted the project CIRTL. CIRTL is a network of 22 Universities.

**Core Ideas of CIRTL:**

- Teaching as-Research
- Learning Community –needs to be collaborative environment
- Learning through Diversity – preparing our future faculty to how to use diversity

How does CIRTL illustrate some aspects of Improvement Science – CIRTL is problem specific; systems approach; variation; commitment to measurement; disciplined inquiry (regular reporting) and networked community.

**Tasks and Related Research – Questions: Challenges for this network**

- How to create a culture of collegiality;
- Defining and developing leadership (we learned that different kinds of leadership may be needed at different times);
- Establishing support mechanisms (what do you actually need in the center, what kind of intentional spaces are needed);
- balancing fidelity and flexibility (knowing the goal moves a bit ; how do we have flexibility and fidelity at the same time);
- addressing outcomes and dissemination (what is the appropriate measurement of this type of data; what outcomes should be shared and what outcomes are appropriate to share)

**Questions/Discussion from AC Members:**

Mark Lipsey - role of systematic intervention approach: randomized control approach; problems are idiosyncratic problems requiring specialized responses; when are issues generalized enough to work…

Anthony Bryk stated that he does not think about this as an even or. We tend to like to put things in competition. Community College – students mindset about learning math – good experiment studies about this concept – experiment science is like a building block.

William McCallum – having a good problem to solve is a way to build a community – this will help to get people to work together.

Candace Thille stated that situating our research in Pasture's quadrant; rather than having researchers come up with projects, having practitioners and researchers co-create the interventions as the same time we are refining our fundamental understanding of learning; For EHR, give preference to researchers and practitioners working together.

Roy Pea - So, for the record, I will add these remarks: To underscore Tony's prediction about the complexity of The individualization of instruction, what we called personalized learning in the US National Technology Plan, and which we have worked on for several years with the Learning Analytics Workgroup (LAW: lytics.stanford.edu/law-report/) focused on how to get to 'personalized learning at scale'. In particular, we need to be mindful on long-time recognized issues Howard Becker surfaced in his vital work on 'stigma' and 'labelling theory' in his Chicago school of sociology research and writing... the labeling risks of learners as 'slow', 'visual' or other depictions are already surfacing in educational settings where so many attributes of learning for a learner are made visible in newly online learning interactions and performances. This issue foregrounds the importance of looking at problematic ways of speaking about learners among participants in an education system, with concerns about the negative effects of labeling talk about learners on their self-concept and systemic ability to succeed.

Roy Pea brought up three points:

- Agency initiative – who has the authority and power to do so
- Adaptively, Resilience and Recovery – when initiative like this is underway they will drift, connections will drop
- Establishing a sense of belonging – Bias; blame for the problems that surfaces and taking credit for final solutions

Anthony Bryk stated that we have two mechanisms:

- Team at foundation
- You have an existing network – investing and building a social connection –

Anthony Bryk stated that this work has a technical quality to it. What is the actual measure that people are going to use to provide the feedback?

Muhammed Chaudhry discussed the Eastside Alliance. Is when someone neutral from the outside who brings them together.

Discussant: Ann Austin

1. A few observations
    a. Relevance of experimental approaches—productive relationship. It's not an either or. Experimental science helps us understand what may work.
    b. How does what we know can work play out in various contexts? How do we build a knowledge base about practice?
    c. Education and other sectors: examples from everywhere
    d. Challenges: belonging, initiation, participation, time, turnover, governance, and more
2. Suggest some issues and questions for EHR and AC
    a. Are there particular issues within EHR's priorities would be particularly amenable to Improvement science:
        i. Examples: institutional change in IUSE; rural education
3. Suggest concrete directions for HER
    a. Relationship between experimental and improvement science: how do we articulate this with our constituencies? What is the presentation of this work? How do we frame this conversation with this work
    b. How do we assess the quality of the proposals using this approach? Leadership? What challenge's for proposal to acknowledge? Intentions?
    c. Failure can be as important as success: how accommodate learning
    d. What are some of the products: case studies, evaluation instruments
    e. Concrete: what are some activities: conversations; convening to link practitioners and researchers about first generation students; link some of the projects into networks, eg ADVANCE community…; networks of networks—learn across networks; how build an explicit research agenda—challenges brought up here, relevant for PRIME

Ann Austin stated in closing that she thinks this is a very fruitful area within our work in EHR.

**10:30 AM – 10:45 AM – Break**

**10:45 AM - 11:45 AM - Panel Discussion: New Directions for Broadening Participation with INCLUDES (Inclusion Across the Nation of Communities of Learners That Have Been Underrepresented for Diversity in Engineering and Science)**

Joan Ferrini-Mundy, Assistant Director for Education and Human Resources – introduced the agenda of the panel and the speakers.

Joan Ferrini-Mundy - INCLUDES is a new initiative for FY16

Wanda Ward, Head of the Office of Integrative Activities - wants to communicate desire to optimize leadership role at NSF on this front- NSF could be worse off than it is, and the nation at large needs to improve, there is a lot of work to do. About a year ago, a Congressional Report to Congress was disseminated and galvanized leadership at NSF to reinvigorate the broadening participation group.

In the context of EHR, the R&D approach on this issue (as well as other issues) is important. Evaluation is also taking on an important role NSF-wide. FY16 budget has descriptions of evaluation plans for INCLDUES and NSF-wide. Evaluation of broadening participation, broader impacts, and other topics of interest.

The issue is full optimization of talent in science.

Drivers/challenges taken into account include under-representation in terms of under-preparation, under-resourcing, and decreased productivity.

Scalability (investing in networks, integrated activities) &Sustainability are important

Pramod Khargonekar, Assistant Director of Engineering - Engineering suffers from under-representation more than other disciplines. The Engineering community has been working on this problem for a long time but the results are not where they should be. This is a social innovation problem- entrenched in society, an innovation is needed to save it.

There are examples of local success that do not translate to national progress though they are still valuable
What is needed:

- Collective Impact Approach- NSF alone cannot solve this problem. Any solution has to leverage and bring together parties with shared interests. Q to AC: Are there opportunities where NSF plays a role to bring different groups to the table.
- Systems Thinking- you can think of small parts of the problem but a systems approach is needed. This type of thinking comes naturally to an engineer. Research and Learning (EHR focus) can be leveraged into system
- Analog of Disruptive Innovation- Major changes occur when people make major disruptions to the existing system, creating a completely new way of doing things. Q: How can this be applied to this situation?

James Olds, Assistant Director of BIO - sees this as a scalability issue and a how to measure the effects
Scalability: Knows of examples of smaller scale projects but need to find a way to have a larger impact. Broadening participation in Bio requires help of other agencies- NIH , DOE, etc. Need to work together for maximum effect.

Measuring Effects: Getting large amounts of data into a machine-readable format is challenging. But we cannot innovate without being able to measure what we are doing.

Joan Ferrini-Mundy - in preparation for FY 16 in FY15, we are starting activities like conversations with the community. Dr. Cordova is directly interested in the issue of broadening participation in STEM.
We are hearing commitments from many people but how t owe leverage this commitment into action.
Sizable investment in broadening participation programs already- this is the foundation for INCLUDES which will amplify this work. Make sure when knowledge is gained, it is shared.
The education system itself is a system like Pramod mentioned. How can this network be included?

**Questions/Discussion from the AC Members:**
Mark Lipsey - How organized is the current knowledge base (particular resulting from EHR initiatives) as a platform for this? Has there been a synthesis of relevant research? How have EHR-funded projects been canvased to find successful work?

Joan Ferrini-Mundy - The amount of work done is mixed. Some programs have reports from evaluations that compile best practices. Program staff has much knowledge about success and failures that has not been synthesized. Joan agrees this information needs to be codified.

Wanda Ward - EHR and other directorates have worked hard to improve collaboration for the transfer of best practices. Evaluation and assessment is key. Agrees about the importance of synthesis and also gap analysis.

Joan Ferrini-Mundy - Are there examples of rapid social change or systems thinking that can be helpful?

Roy Pea - The concept of and platforms for crowd-sourcing as a way for funding new initiatives. We may want to consider how crowd-sourcing platforms and social dynamics such as incentive structures can be applied to this problem.

Francisco Rodriguez - He is not sure everyone realizes this is a national crisis in the American consciousness, which impacts national competiveness and the survival of the planet. Getting messaging out is important. A solution must include community colleges, which are the most egalitarian institutions in the country. They serve veterans, students with disabilities, students of low income, etc.
The convening power of NSF is very powerful.

Wanda Ward - Agrees that we need to bring the NSF full force behind this. Also emphasizing the community college role is on point. This is a critical system. In response to the perception nationwide of the crisis, agrees that may be true but it still is a national crisis. It does not get the attention it deserves ("silent crisis").

Pramod Khargonekar- Impact of demographic changes, combined with evidence that we lose skills early will cause this problem to come to forefront soon. Perhaps a forum is needed to show how acute this issue is.

James Olds - There are problems known as "wicked problems" the solutions for which require work on the edge of a discipline and interdisciplinary work. Not enough force is put behind them to solve it, for example Alzheimers, that is necessary to make a difference.

Roy Pea - Interest and Identity: concepts that were lacking in the first iteration of the Next Generation Science Standards. Need to foster disciplinary identities and sense of belonging. More can be done to advance these

William McCallum - This is a problem existing in a complex system with many communities. "Crisis talk" is very common in the policy community. Should "crisis talk" always be used to push forward an agenda. "Crisis talk" works well in the policy world but not the academic one.
What he found engaged his colleague's interest was to move to their particular interest, in this case making sure hiring procedures paid attention to women candidates. Unconscious bias research immediately causes self-reflection. Need to consider what sort of approach will work with which communities.

Wanda Ward - Most NSF investments in this issue reside in academic settings.
NSF has been talking about diversity and inclusion as an asset. "Crisis talk" may not be effective. But this is an opportune time to pay more serious attention to this issue, during this time of demographic shifting.

Roy Pea - A specific example full of ideas for INCLUDES: Stanford university CS department just had 50th anniversary. Accomplished creating a dual major of CS plus a liberal arts field (Computer Science + X). Brings in broader field of students. CS is now the number one major at Stanford. Over 50% of CS majors are women.

**Opening discussion up to EHR staff:**
Claudia Rankins - Had an opportunity to have many discussions at a recent conference. Particular interest in student empowering aspect of INCLUDES. How can empowerment occur at K-12 with its emphasis on testing. Also problem solved based learning, computer literacy.

Julie Johnson - Examples of projects that have been scaled- City Year, Teach for America have come from the social entrepreneurship milieu. Ashoka foundation sponsors social innovation fellows.

Sylvia James - Thinking about networks, they have at their disposal networks in their research and resource centers. Think about these structures for disseminating knowledge.

Lilian Wu - The types of problems IBM is dealing with- connectivity, using knowledge as a base- more women are coming to the forefront. Women have the skills to listen across many ways. Dealing with large amount of data, having diverse views are skills now needed. She can help share ways IBM has built genuine diversity.

Mark Lipsey - What kind of thinking is going on in alternative channels? Ex. Boy/girl scouts, big brothers/sisters have extracurricular activities that inner city youth find interesting.

Joan Ferrini-Mundy - EHR has connections to informal/afterschool communities. Good to have his comment to pay attention to this.

**11:45 AM - Committee of Visitors Report Out: Noyce and S-STEM COV**
Moderated by: Corby Hovis, EHR COV Coordinator – outline the agenda and introduced the speaker

Lillian Lowery, Maryland State Superintendent of Schools, COV Chair – discussed the NOYCE COV Findings/Recommendations and S-STEM COV Findings

**Questions/Discussion from AC Members:**

William McCallum – ask for clarification in the difference between inter and multi-disciplinary research.

Corby Hovis asks Rodriguez for votes on COV 7 reports. The members voted to approved the motion - Approved (7) COV Reports.

**12:15 PM – 12:30 PM – Break**

**12:30 PM – 2:15 PM - Working Lunch Plenary Panel: Researching the Future of Graduate Education**

Moderated by: Sarah-Kay McDonald, Expert, EHR Division of Research on Learning in Formal and Informal Settings

Matt Wilson, Science and Engineering Policy Analyst, National Science Board Office - Revisiting the STEM Workforce NSB report. Definitions for "STEM workforce" vary widely, meaning there is no consensus. NSB avoided generalizations when referring to the STEM workforce.
STEM knowledge and skills are valuable in both STEM and non-STEM jobs. A STEM degree doesn't necessarily lead to a STEM job as shown by data presented. Instead of asking how many STEM jobs we need, ask what skills STEM majors need to maximize their career potential.

Nirmala Kannankutty, Senior Advisor, National Center for Science and Engineering Statistics -on NCSES and graduate education data. Data collected based on 4 questions: (1) Number of people, (2) demographics, (3) short-term and long-term trends, (4) how performance at one stage affects performance at the next stage.
No single pathway to describe education --> career
55M College grads and 4.9M with S&E grad degree
NCES collects census and sample data on students. NCSES collects workforce data from Census Bureau and professional societies. Survey of Doctorate Recipients gathers data on where PhDs end up and how they get there. Lack information and details about why students leave degree programs.
Can we make better use of available data? Do we need more or different data?
Themes: degrees vs skills, degree-based education vs other types, teaching methods and knowledge acquisition.

Sally Rockey, Deputy Director for Extramural Research and Director of the Office of Extramural Research, National Institutes of Health - on biomedical research training at NIH. NIH has research training programs for both individuals and institutions. Biomedical science PhD numbers continue to rise quickly relative to other disciplines. One goal is to minimize time to degree. Average age of first NIH grant has increased steadily over the past 30 years. Age distribution of NIH awardees has shifted to older ages.
NIH Initiatives: every awardee of any kind (RAs, post docs, etc) must have an IDP; BEST prepares grad students for variety of careers in and around biomedical research.

Julia Kent, Director of Communications, Advancement and Best Practices, Council of Graduate Schools - on CGS research. CGS is about 500 grad schools which award 91% of PhDs in the US. Current funding models support PI research, but lack in mentorship and professional development. Lack of long-term data about where STEM alumni work. Graduate deans have the power to influence policy and make changes, so they must be involved in changes made.

Understanding PhD Career Pathways project funded by Sloan and Mellon foundations. Goal of designing a survey and framework for data collection for 15 years post-graduation including all STEM and humanities fields.

Graduate Student Professional Development & the STEM Workforce project (NSF 1413827). Focus on funding structure, professional skills, and program structure. Will develop an online repository of professional development programs.

**Discussant: Richard Boone**, Acting Deputy Division Director, EHR Division for Graduate Education - on DGE activities and problems in graduate education. Graduate education is not aligned with workforce priorities. The job market and workforce priorities change rapidly. Graduate education focuses on research activities, but only 12% of graduates work in those areas. Pathways differ by discipline. Need

more data on career outcomes. GRIP and GROW programs in DGE help to give students practical experiences on the job and work worldwide. NRT is similar to NIH's BEST program preparing students for jobs outside of academia.
Research assistantships are unregulated, should they be? What is EHR's role in catalyzing changes in grad education?

**Questions/Discussion from AC Members:**
Roy Pea - question for Matt and Nirmala. Existing and emerging tech. Competencies that people seem to need a priori are not the actual skills needed for jobs. Can you imagine us doing a better job of us sensing the emerging STEM jobs and their competencies? Is it possible to predict needed competencies and how to train for this? Sally - tech is exploding so fast that it changes substantially over the course of one's graduate education. Should affect development of curricula and research. Need flexibility and open platforms. Matt - NSB made the point that the role of education is not to train for a specific job, but about core competencies. For people to meet demands, it requires education institutions, government, and also industry to provide training opportunities throughout one's career. Institutions and industry must share the role of these trainings. Industry often complains about lack of non-STEM skills (work ethic, timeliness, etc). Nirmala - skill measurement and competency measurement is difficult to do. A long term trend: over 20 years, PhDs don't lead to faculty positions. Communication, teamwork, writing, management are things PhDs were not well prepared in. With STEM training, you get analytical skills, research skills, and disciplinary skills. Other skills are needed to be successful in a variety of pathways. We need to make this easier.

Lilian Wu - are there distinctions between fellowships, post docs, and traineeships? Sally - move people from research grants to traineeships and fellowships could improve outcomes. Professional assistants to research could be a focus of grad education. Richard - often students are on all 3 types throughout their grad education. Lillian - IBM has more post docs recently. We want more than just a brilliant thesis or research to fit into industry. It's a good way to test the waters to see if industry is a better fit over academia, but it increases training time. Maybe it's better to do this during graduate school so more time isn't needed.

Karen Klomparens - each PhD student is their own program. They each need different skills and we can't design a set of skills for N pathways. Bigger problem than funding misalignment, it's a misalignment of faculty and university rewards systems. We have a lot of data, we just haven't spent the time analyzing it.

Mark Lipsey - Individual states have linked data into longitudinal systems. TX linked education data with labor statistics. There is potential to bring various data sources together, are any being pursued? Big data attempt to use lots of information to make predictions, can we make a model to predict results of changes in educational pathways? Sally - it's complicated but we're trying. Have a uniform CV system that would allow us to mine that data and track everyone.

Francisco Rodriguez - Matt, do you see congruence between STEM workforce and what the NSB writes about it? Matt - yes. Francisco - Nirmala, liked what you said about survey and non-cognitive skills. Do you see the survey affecting how we address this? Nirmala - we have a huge list of the ways people use skills from graduate education. We may need the small-scale information about this.

**2:15 PM- 2:30 PM - Wrap Up and Adjournment**
Francisco Rodriguez, EHR Advisory Committee Chair – reflected on topics that we discussed over the last two days. Also, stated that we affirmed (7) COV Reports. Francisco Rodriguez took the time to thank the all AC Members for participating. Also, asked if anyone had any further comments to please forward them.

Joan Ferrini-Mundy, Assistant Director, Directorate for Education and Human Resources – How do we go forward now that you've given us a framework? Everyone is a part of our planning and future and will have input. We should continue on with this open dialogue. Next meeting will likely be December (maybe 8th and 9th). We will have a virtual meeting between now and then to give an update on the HBCU information.