Meeting Broadening Participation Challenges with Collaborative Science

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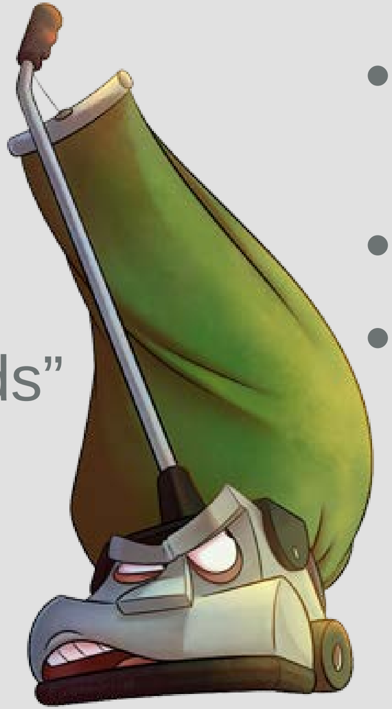
What does Broadening Participation have to do with a Vacuum?



- Inter-/Trans-disciplinary
- Collaboration
- “Effective Science”

- “Disciplines” & “Fields”
- “Silos”
- “Isolation”

Recent Broadening Participation Work

Principal Investigator

NSF #EEC 1619843 ($617,202) “Race-Gender Trajectories in Engineering: The Role of Social Control across Neighborhood and School Contexts.”

NSF #DRL 1800199 ($299,999) “Exploring ways to use National Datasets to Promote Broader Participation of Race-Gender Groups in STEM”.

NSF #EEC 1833161 ($99,985) “Race-Gender Trajectories in Engineering: The Role of Social Control across Neighborhood and School Contexts – Supplement,” Co-PI: Dr. Sheretta Butler Barnes

Director, ICQCM

NSF #ECR-EHR 1937687/1937490/1937391 ($999,996) “Institute in Critical Quantitative, Computational, and Mixed Methods Training For Underrepresented Scholars (ICQCM).”

Spencer Foundation ($150,000) “Institute in Critical Quantitative, Computational, and Mixed Methods Training For Underrepresented Scholars (ICQCM).”

Recent Broadening Participation Work

Steering Committee Member of NSF Advisory Board

DRK-12 Broadening Participation Topical Group Synthesis Project, 2017 - 2018

Technical Advisor/Methodologist

NSF's Broadening Participation in LifeSTEM and NSF INCLUDES for HBCUs, HSIs, MSIs and TCUs (facilitated via NSF #DRL-1738128), 2016 - present

Frequent Panelists

CAREER Awards, NSF Includes, Broadening Participation, NSF Alliance, Site Visits

BROADENING PARTICIPATION

THE REALITIES

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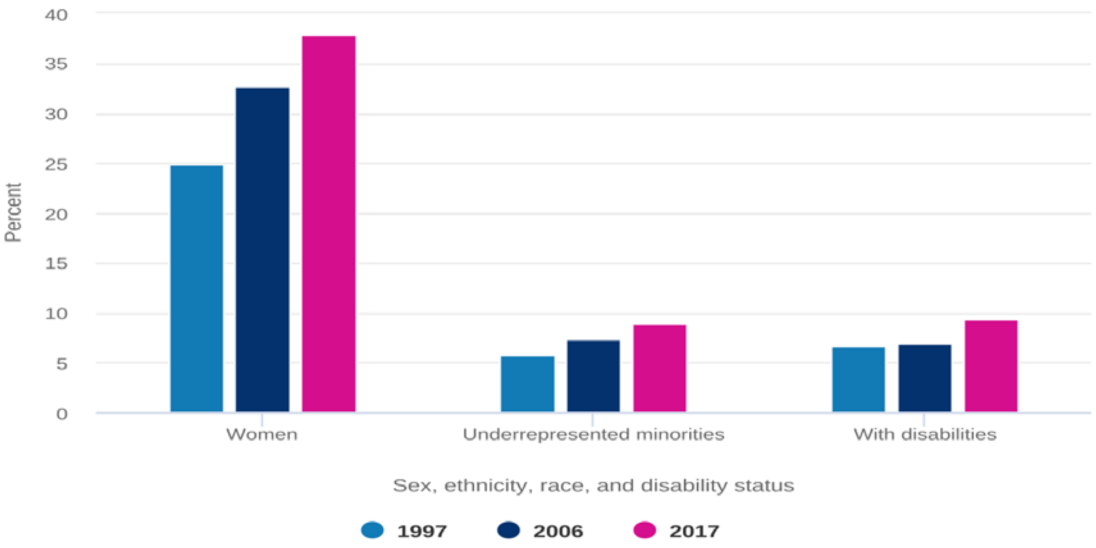
Rising Demand, Waning Supply

- Jobs in STEM fields will increase 17% between 2014 and 2024
- Size of the U.S. science and engineering labor force has declined since the turn of the 21st century
- The STEM workforce is no more diverse now than 14 years ago (Bidell 2015)
- White and Asian share of STEM workforce is 70.8% and 14.5%, respectively, while being just 73% of the working age population

HIGHER EDUCATION

FIGURE 6-E

Women, underrepresented minorities, and those with disabilities as a percentage of the academic doctoral workforce: 1997, 2006, 2017



Note(s)

Underrepresented minority groups include black or African American, Hispanic or Latino, and American Indian or Alaska Native. Survey of Doctorate Recipients asks the degree of difficulty—none, slight, moderate, severe, or unable to do—an individual has in seeing (with glasses); hearing (with hearing aid); walking without assistance; lifting 10 pounds; or concentrating, remembering, or making decisions. Respondents who answered "moderate," "severe," or "unable to do" for any activity were classified as having a disability.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, Survey of Doctorate Recipients. Related detailed data: WMPD table 9-22.

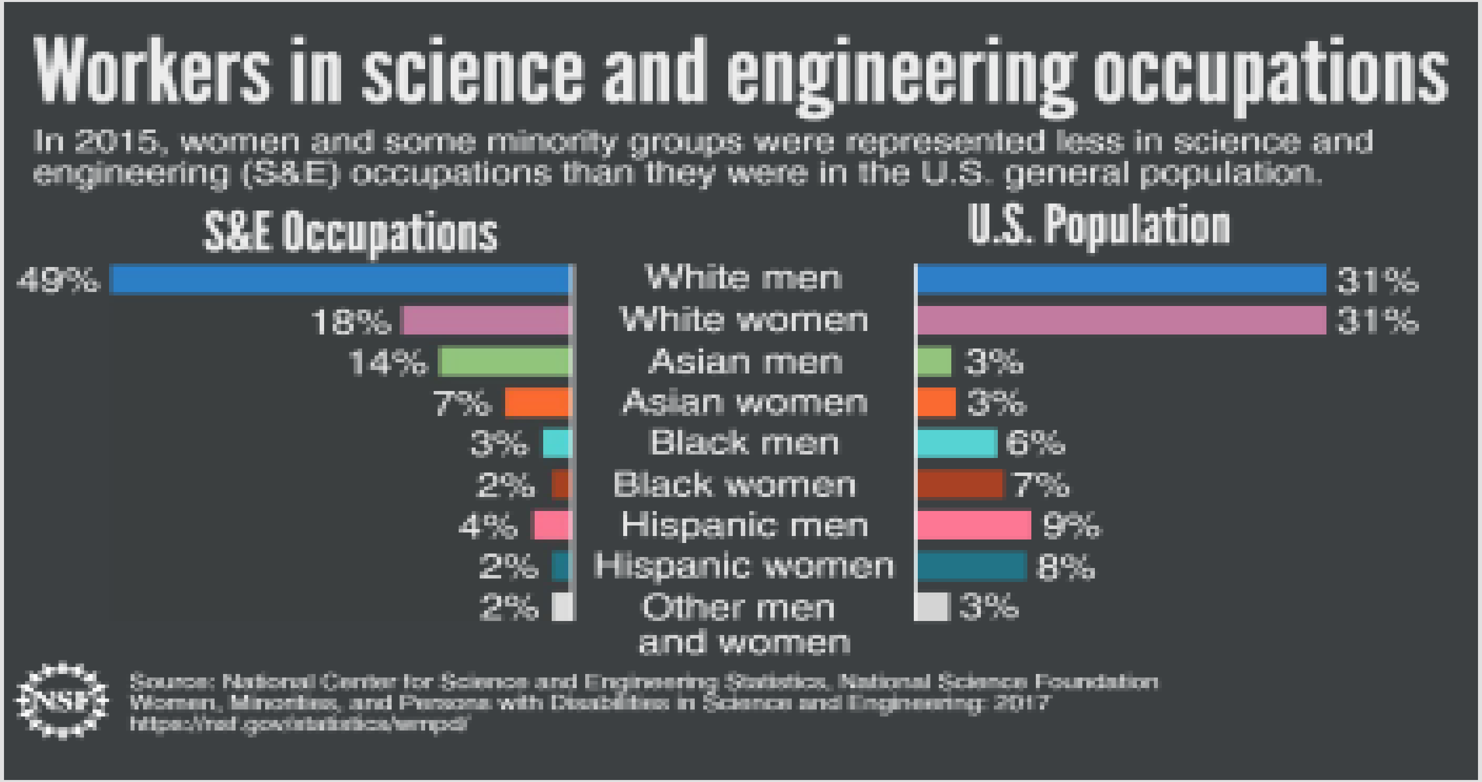
URGs

1997: 5.8

2006: 7.3

2017: 8.9

STEM WORKFORCE INEQUALITIES



STEM INEQUALITIES IN POST-SECONDARY EDUCATION

In 2016,

- Hispanics/Latinx earned 13.5% of science and 10% of engineering bachelor’s degrees; Black/African Americans, 9% and 4%; and Indigenous or Alaska Natives, 0.5% and 0.3%.

- Black/African Americans, Indigenous/Alaska Natives, and Latinx collectively received 22% of all S&E bachelor’s degrees and 9% of all S&E doctorate degrees despite being over 30% of the U.S. population.

UNEQUAL STEM EDUCATION OPPORTUNITIES OCCUR IN K-12

- African Americans followed by Hispanics are overrepresented in lower-level ninth grade mathematics and science courses and underrepresented in upper-level courses relative to other subpopulations (NSF 2016a, 2016b).
- Same pattern holds for males in mathematics relative to females (NSF 2016a), yielding a potentially compounded shortfall in STEM-related preparedness for African American and Hispanic males.

IN CONTRAST…

Importance of Inter-Institutional Collaboration

HBCUs produced **25 percent** of all bachelor's degrees in STEM fields earned by African Americans in 2012.

While enrolling 9% of all Black college students and comprising just 3% of colleges and universities (Pew 2017)

HBCUs BROADEN PARTICIPATION

- Twenty-one of the top 50 institutions for educating African-American graduates who go on to receive their doctorates in science and engineering, are HBCUs.

- Xavier University, an HBCU, awards more undergraduate degrees in the biological and physical sciences to African-American students than any other university in the nation (https://nces.ed.gov/fastfacts/display.asp?id=667).

COLLABORATING ACROSS THE DIVIDES

REQUIRES:

- HBCU/TCU/HSI **leadership** in research partnerships
  - Too often, PWIs include HBCU/TCU/MSIs as sites within a sample rather than as partners in proposed research
- Research teams at PWIs need to rethink their assumptions
  - MSI STEM success is the preferred one to which most PWIs should aspire
  - Broadening participation that includes only PWIs can be enriched by collaborating with MSIs
  - Collaboration is an aspiration that should be sought in all facets of research between multiple institutions

Collaboration with Associations of Color

- **EXP 1**: Data collection about experiences of Native American Faculty at the annual meetings of the Native American faculty at American Indigenous Research Association and Native American and Indigenous Studies Association
- **EXP 2**: Mentorship model for college students through partnership with NSBE, Women in Science & Engineering (WISE), and NIHBSA
  - Collaborative work is reviewed favorably and often strongly encouraged
  - Collaborations often present research design advantages
  - Helps with making research results public once its finished

NSF Broadening Participation

Broadening participation is embedded in its Strategic Plan through a variety of investment priorities related to the Learning and Stewardship strategic outcome goals, including:

- Preparing a diverse, globally engaged science, technology, engineering, and mathematics (STEM) workforce;
- Integrating research with education, and building capacity;
- Expanding efforts to broaden participation from underrepresented groups and diverse institutions across all geographical regions in all NSF activities; and
- Improving processes to recruit and select highly qualified reviewers and panelists.

To expand efforts to increase participation from underrepresented groups and diverse institutions throughout the United States in all NSF activities and programs.

PROMINENT THEORIES RELATED TO BROADENING PARTICIPATION

Intersectionality (Collins 1990; Camacho and Lord 2011)
Culturally Relevant Pedagogy (Ladson-Billings 1995; Nasir and Hand 2008)
Micro-Aggressions/Trauma (Sue 2007; McGee and Pearman 2015)
Sociocultural Theory (Wertsch et al. 1995; Stinson 2008)
Stereotype-Threat (Steele and Aronson 1995; Good, Aaronson and Harder 2008)
Labeling Theory/Self Fulfilling Prophesy (Rist 1970; Ferguson 2000)
Impostor Syndrome (Wenneras and Wold 1997; Kolligian and Sternberg 2010)
Cultural Capital (Bourdieu 1977; Carter 2003)
Cultural Ecological Model/Acting White (Ogbu 1987; Forham and Ogbu 1986)
Critical Race Theory (Ladson-Billings and Tate 1995; Villenal and Deyhle 1999)
Resiliency/Grit (Masten 1994; Duckworth 2016)
Social Capital (Loury 1977; Bourdieu 1986; Coleman 1988)
Social Cognitive Career Theory (Bandura 1986; Lent et al. 1994)

BP Theory and Change

It's about…

- **CHANGE** in educational practices, institutional practices, communities of practice, the structure of OTLs, etc.,
- **CHANGE** in learning behaviors, and/or
- **CHANGE** in beliefs (socio-cultural, psycho-social, or attitudinal) about practices, learning and the environments in which both take place…

That will broaden the participation of traditionally underserved and underrepresented populations in STEM

DRK-12 Broadening Participation Topical Group Synthesis Project
2017 - 2018

http://cadrek12.org/broadening-participation

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Home

Broadening Participation in STEM

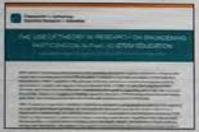
http://cadrek12.org/broadening-participation

Broadening participation aims to strengthen the STEM fields and STEM literacy by engaging and building capacity in all people in STEM learning and professional training, particularly those from groups that have been traditionally underrepresented in STEM fields. This spotlight focuses on increasing involvement in STEM in several ways:

- supporting interest and achievement in STEM learning for underserved or underrepresented student populations;
- increasing teacher diversity and voice in STEM research, development, and policy; and
- forming strategic research and development partnerships.

CADRE BRIEFS & PAPERS

Creating Inclusive PreK-12 STEM Learning Environments (2018)
This brief highlights steps for education decision-makers to take to improve STEM education for ALL students.



The Use of Theory in Research on Broadening Participation in PreK–12 STEM Education: Information and guidance for prospective DRK–12 grantees (2018)
This paper seeks to provide a resource for prospective DRK-12 awardees by identifying some of the theories that current and recent DRK-12 awardees are using in their research on broadening participation.

Interdisciplinary Thought

…and the National Science Foundation

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Does Filling the STEM Pipeline Require Draining the School to Prison Pipeline?

Central Hypothesis

The order, conformity, and obedience seeking school strategies (i.e. social control) to which certain race-gender groups are disproportionately exposed, are related to lowered levels of the qualities that are known to support success in STEM, including collaborative problem solving and interpersonal confidence; engagement and self-efficacy; and creativity.

We’ve found…

Disciplinary sanctions (ISS)	=	44% drop in the probability that students will take an advanced math course
Each disciplinary sanction	=	Reduced scores by .67 points on standardized math tests
Schools with higher levels of social control (i.e. suspensions, random drug checks, metal detectors and school police)	=	Lowered odds of taking high level math courses

We've found…

Disciplinary sanctions (ISS) = Increased relative odds (OR = 3.77:1) of premature school departure

Percentage of Black students in schools

- = Increased odds of premature school departure (OR = 1.33:1)
- = But also increased chances of taking advanced math courses (OR = 1.37:1)

We’ve found…

- Even when controlling for an individual’s suspensions, as well as a school’s overall level of social disorder, attending a high-suspension high school significantly decreases a student’s math test scores from her freshman to junior year of high school, while also decreasing a student’s odds of attending college full-time.
- The decrease in math scores directly predict significant declines in college attendance.


Hands UP!
DONT SHOOT!


DON'T
SHOOT


We Are Praying
With Our Feet
HANDS
UP!

COLLABORATORS

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Karishma Furtado, Doctoral Student, WUSTL

FATAL INTERACTIONS WITH POLICE STUDY (FIPS)

- Spans 20 months from March 2013 - Jan 1, 2015
- Contains 1762 fatal interactions with police (FIPs) identified through a tedious cross-verification process of crowd-sourced reports (KBP & FE)
- Used GIS to link where the FIP took place to the nearest responding agencies
- Merged the fatalities to the ~3700 agencies of the nationally representative Law Enforcement Management and Administrative Survey (LEMAS) collected by the Bureau of Justice Statistics, and Census characteristics of the place where the fatality occurred

STUDIES

“Fatal Youth Encounters with Police: Assessing Race, Geospatial and Institutional Mechanisms”

“Race, Gender, and the Contexts of Unarmed Fatal Interactions with Police”

https://sites.wustl.edu/fips/

“How Neighborhoods Matter in Fatal Interactions between Police and Men of Color”

“Triggering Contact: A Qualitative Examination of Fatal Interactions with Police in St. Louis”

WHAT HAVE WE LEARNED?

Frequency?	**88 FIPs/month, ~2.9/day**
The oldest FIP?	**107**
The youngest FIP?	**5**
Percentage male?	**93.5**
Race/ethnic distribution of FIP?	**40.5 (W), 24.5 (AA), 14.7 (H), 20.4 (O)**

How Neighborhoods Matter in Fatal Interactions Between Police and Men of Color

Odis Johnson Jr., Christopher St. Vil, Keon Gilbert, Melody Goodman, & Cassandra Arroyo-Johnson *Social Science and Medicine, 220, January 2019, Pages 226-235*

RESEARCH QUESTIONS

- Which characteristics of the deceased significantly predict the odds of a FIP for males and how might they vary across racial/ethnic groups?
- How does an area’s racial composition, social disorganization, and economic inequality relate to the odds of a FIP, perhaps differently for MOCs, Black, and Hispanic males?
- How might the association of agency factors to police homicides differ for Black and Hispanic males relative to MOCs and others that were killed by police?

WHAT HAVE WE LEARNED?

Minority threat and defense of inequality theories inform FIPs for males of color.

- Income inequality heightens the chances of a police homicide for Hispanic males, **2.50 : 1**.
- Lowered racial segregation reduces the odds of fatal injury for Black males, **0.29 : 1**.
- Racial segregation increased the odds of a police homicide for Hispanic males, **2.82 : 1**.
- Percentage of Hispanic officers raises risks of fatal injury for Hispanic males, **2.63 : 1**.

Institute in Critical Quantitative, Computational & Mixed Methodologies

A “Broadening/Capacity” Collaboration

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THE "DATA SCIENCE DIVIDE"

260 applications for the AERA Minority Dissertation Fellowship, ~40 used quantitative methods	Latinx and Black populations are 32% of all college students in 2016, yet constitute 11.8 and 19.1% of students taking data science and analysis courses
Large racial/ethnic disparities in the nation's research funding apparatus	Issues of access related to the culture of data science learning environments and limited diversity

Wash U Institute Aims To Train More Data Scientists Of Color

By SHAHLA FARZAN • SEP 8, 2019

Share Tweet Email

The Institute in Critical Quantitative, Computational, and Mixed Methodologies will launch in 2020. The program will train up to 75 researchers of color in data science methods.

WASHINGTON UNIVERSITY | FLICKR

Institute in Critical Quantitative, Computational, and Mixed Methods (ICQCM)

Secondary Institute Sites:

- ❑ Vanderbilt University
  Ebony O. McGee, Associate Professor of STEM Education, Peabody College
- ❑ University of Pennsylvania
  Ezekiel Dixon-Román, Associate Professor & Chair of the Data Analytics for Social Policy Program, School of Social Policy and Practice

ICQCM GOALS

- Increase participants’ comprehension of QCM
- Establish networks of expertise, support, and collaboration for the expansion of methodological capabilities
- Affirm underrepresented faculty through culturally relevant, inclusive, and asset focused opportunities to learn QCM
- Cultivate an informed and critical positionality with regard to the use, misuse, and transformative potential of QCM
- Identify ways to ameliorate inequities in opportunities to learn QCM within the racialized structure of the academy
- Diversify the population of principal investigators

ICQCM STRUCTURE

- Cohorts (~3 years of affiliation):
  - NSF Faculty Scholars, Spencer Doctoral Scholars, and TBA Advanced Quantitative and Computational Scholars
- Summits:
  - 5-day data-intensive training seminars
- Workshops:
  - 2-day grant proposal development seminars
- Network of Leading Underrepresented Methodologists:
  - “Institute Fellows”

ICQCM STRUCTURE

- Personal Methods Coach:
  - In-person and virtual guidance from Institute Fellows
- Critical Methods Community (CMC):
  - Institute Methods Message Board (IMMB)
  - Online training program in the statistical platform, *R*
  - Virtual webinars
- Repository of Knowledge about the Quantification of Race:
  - Data training modules from ICQCM summit
  - Online reference resource for broadening participation, critical theory, and data science innovation

WHY CRITICAL QCM & WHAT IS IT?

Methodologies as Contested Epistemological Practices

- Tenets of “critical theory” (e.g. CRT)
- Western “colonial” science
- Positivism and the stratification of knowledge

“Critical QCM” as an Answer to “Contestation” and Divides

- Calls for more “QuantCrit”
- The use, misuse, and transformative potential of QCM
- Implies the need for particular QCM approaches and diverse perspectives

Link to Broadening Participation Research

GETTING STARTED ON COLLABORATION

- Develop your idea with a research team months in advance of submission (Co-PIs, consultants, etc.)
- Identify the appropriate funding opportunity/program and contact the Program Officer/Director
- Submit your "one-pager" as requested (not unsolicited)
- Form your research partnerships (Collaborations, MOUs, etc.) before you submit a proposal
- Consult the PAPP-G (Proposal & Award Policy and Procedures Guide) for questions about collaborative awards (e.g. allowable expenses, participant compensation, travel, etc.) before submitting a proposal
- Notify your Chair, SPO/AOR immediately about your intent to submit and get assurances about resources and the timeline of submission

What Does NSF Fund?

And what are the steps to
get funding?

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REVIEW CRITERIA:
INTELLECTUAL MERIT & BROAD IMPACT

- What is potentially “**PARADIGM-SHIFTING**” about (1) what you are asking, and (2) how you have framed the problem/interests with theory? This requires that you consider what do we currently not know, and “how might the field have been wrong, uncertain or superficial about these social/programmatic dynamics?”
- What is potentially “**TRANSFORMATIVE**” about the knowledge that your questions and theory application might yield through research? AND, how will your work be leveraged to achieve these impacts?

THANK YOU

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http://sociology.wustl.edu/people

https://twitter.com/NEqualityMatrix

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NSF COMMON GUIDELINES: TYPES OF STUDIES

- **Foundational research and development**
  - Fundamental knowledge that may contribute to teaching and/or learning
- **Early stage/exploratory**
  - Examines relationships among constructs to establish logical connections
- **Design and development**
  - Design and iteratively develop particular interventions (programs, policies, practices or technologies); can also pilot test fully developed intervention to see if it achieves its intended outcomes

TYPES OF STUDIES CONT.

Impact Studies

- **Efficacy Studies**
  - Estimate the impacts of strategies under optimal conditions of implementation
- **Effectiveness Studies**
  - Examine implementation and estimate impacts similar to routine practice but still on a limited scale
- **Scale-up Studies**
  - Explore implementation and estimates impacts under conditions that prevail under wide-scale adoption

CORE KNOWLEDGE

- Foundational Research
- Exploratory/Early Stage Research

What's Included in Education "Research and Development" (NSF Common Guidelines)?

Proposals That:

- Test, develop, or refine theories of education and learning that advance knowledge acquisition and the factors that facilitate or impede learning
- Design and test new approaches to teaching and learning
- Investigate some application of practice (e.g., a new curriculum, a new technology)
- Study the impact of an education practice or policy (e.g., what effects are College and Career ready standards in mathematics having on instruction?)

Early-Stage or Exploratory Research

- Examines relationships among important constructs in education and learning
- Goal is to establish logical connections that may form the basis for future interventions or strategies intended to improve education outcomes
- Connections are usually correlational rather than causal

Design and Development Research

Design and Development Research

- Draws on existing theory & evidence to design and iteratively develop interventions or strategies
  - Includes testing individual components to provide feedback in the development process
- Could lead to additional work to better understand the foundational theory behind the results
- Could indicate that the intervention or strategy is sufficiently promising to warrant more advanced testing

STUDIES OF IMPACT

- Efficacy Research
- Effectiveness Research
- Scale-Up Research

Studies of Impact generate reliable estimates of the ability of a fully-developed intervention or strategy to achieve its intended outcomes

- **Efficacy Research** tests impact under “ideal” conditions
- **Effectiveness Research** tests impact under circumstances that would typically prevail in the target context
- **Scale-Up Research** examines effectiveness in a wide range of populations, contexts, and circumstances

DESIGN AND DEVELOPMENT (“D&D”) RESEARCH

- Draws on existing theory & evidence to design and iteratively develop interventions or strategies
  - Includes testing individual components to provide feedback in the development process
- Could lead to additional work to better understand the foundational theory behind the results
- Could indicate that the intervention or strategy is sufficiently promising to warrant more advanced testing
- **D&D studies should also contain research (e.g. Evaluation)**

Foundational Research

Fundamental knowledge that may contribute to improved learning & other education outcomes

Studies of this type:

- Test, develop or refine theories of teaching or learning
- May develop innovations in methodologies and/or technologies that influence & inform research & development in different contexts

Important Features of Each Type of Research

Purpose	How does this type of research contribute to the evidence base?
Justification	How should policy and practical significance be demonstrated? What types of theoretical and/or empirical arguments should be made for conducting this study?

(continued)

Important Features… *(continued)*

Outcomes	Generally speaking, what types of outcomes (theory and empirical evidence) should the project produce? What are the key features of a research design for this type of study?

Comparison, in brief: JUSTIFICATION

Exploratory/ Early Stage Research	- A clear description of the ***practical education problem*** and a compelling case that the proposed research will inform the development, improvement, or evaluation of education programs, policies, or practices - A strong ***theoretical and empirical rationale*** for the project, ideally with citations to evidence

Comparison, in brief: JUSTIFICATION

Design and Development Research	
	‣ A clear description of the ***practical problem*** and the initial concept for the planned investigation, including a well-explicated ***logic model*** ‣ In the logic model, identification of ***key components of the approach***, a description of the relationships among components, and ***theoretical and/or empirical support*** ‣ Explanation of how the approach is different from current practice and why it has the potential to improve learning

Comparison, in brief: JUSTIFICATION

Efficacy Research

- Clear description of the intervention/ strategy and the ***practical problem*** it addresses; how intervention differs from others; and connection to learning
- ***Empirical evidence of promise*** from a Design and Development pilot study, or support for each link in the logic model from Exploratory/Early Stage research, ***or evidence of wide use***
- Justification for examining impact under ideal circumstances, rather than under routine practice conditions

Comparison, in brief: OUTCOMES

Exploratory/ Early Stage	
Exploratory/ Early Stage	***Empirical evidence*** regarding associations between malleable factors and education or learning outcomes - A ***conceptual framework*** supporting a theoretical explanation for the malleable factors' link with the education or learning outcomes - A ***determination***, based on the empirical evidence and conceptual framework, of whether Design and Development research or an Efficacy study is warranted, or whether further Foundational or Exploratory/Early-Stage research is needed

Comparison, in brief: OUTCOMES

Design and Development Research	
	- A ***fully-developed version*** of the intervention or strategy - A well-specified ***logic model*** - Descriptions of the ***major design iterations***, resulting evidence, and adjustments to logic model - Measures and data demonstrating project's ***implementation success*** - ***Pilot data on the intervention's promise*** for generating the intended outcomes

Comparison, in brief: OUTCOMES

Efficacy Research	

Efficacy Research

- ***Detailed descriptions*** of the study goals, design and implementation, data collection and quality, and analysis and findings
- ***Implementation documented*** in sufficient detail to judge applicability of the study findings; when possible, relate these factors descriptively to the impact findings
- ***Discussion of the implications*** of the findings for the logic model and, where warranted, make suggestions for adjusting the logic model to reflect the study findings

EXAMPLE OF PROGRAMS:

- AISL - Advancing Informal STEM Learning
  - Pilots and Feasibility Studies, (2) Research in Service to Practice, (3) Innovations in Development, (4) Broad Implementation, (5) Literature Reviews, Syntheses, or Meta-Analyses, and (6) Conferences

- ITEST - Innovative Technology Experiences for Students and Teachers (STEM and ICT), PreK – 12
  - Exploratory projects that advance theory or examine associations among malleable factors that influence learning, moderating conditions, and educational outcomes.
  - Strategies projects that address the initial design, development, and implementation of innovative, technology-related interventions.
  - SPrEaD (Successful Project Expansion and Dissemination) projects that support the further examination and broader implementation of interventions that have demonstrated evidence of impact.

EXAMPLES (cont.):

- IUSE - Improving Undergraduate STEM Education
  - Two tracks: (1) Engaged Student Learning and (2) Institutional and Community Transformation.
  - Two tiers of projects exist within each track: (i) Exploration and Design and (ii) Development and Implementation
- HBCU-Up
  - Awards to develop, implement, and study evidence-based innovative models and approaches for improving the preparation and success of HBCU undergraduate students so that they may pursue STEM graduate programs and/or careers
  - Targeted Infusion Projects, Broadening Participation Research Projects, Research Initiation Awards, Implementation Projects, Achieving Competitive Excellence Implementation Projects, and Broadening Participation Research Centers

FUNDING LEVELS

- Discretionary (up to $50,000)
- Level I: ~$500,000
- Level II: ~ $2.5 Million
- Level III: ~ $5 Million
- Supplements: up to 20% of the “parent” grant

Funding levels may vary by Programs or DCLs, check the RFP/Solicitation

DRK-12 Broadening Participation Topical Group Synthesis Project 2017 - 2018

http://cadrek12.org/broadening-participation

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Synthesis Products

- Policy Brief
  - Audiences: State, district, and school leaders
  - Goals: Draw on the unique strengths of DRK-12 research to provide insights about broadening participation and identify some potential policy levers
- Theory Paper
  - Audience: Prospective DRK-12 grantees
  - Goals: Provide guidance about using theory in research on broadening participation, highlight some currently used theories, and identify opportunities for the use of different theories
- http://cadrek12.org/broadening-participation

Community for **Advancing Discovery Research** in **Education**

http://cadrek12.org | cadre@edc.org

http://facebook.com/cadrek12

http://twitter.com/cadrek12

CADRE strengthens the capacity, advances the research, and amplifies the influence of National Science Foundation DRK–12 projects and researchers, and the DRK–12 program.

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Inclusive Science, Technology, Engineering, Mathematics, and Computer Science Learning Spaces Look and Sound Different

In inclusive classrooms:

- All students are having experiences with STEM-related phenomena: engaging with the content; talking; collaborating; and sharing their ideas, knowledge, work and understanding.
- Teachers view all students as capable of learning, thinking about, and knowing STEM. They are listening to students’ ideas, and finding different ways for students to express those ideas. They create an environment of trust and norms for collaboration that empowers students to share and participate.
- The learning of language and the learning of content are intertwined.
- Pacing might be different from expected norms.

Broadening Participation Requires a Different Set of Responses from Education Systems

- Articulating a clear vision for, and long-term commitment to, broadening participation in STEM.
- Re-conceptualizing professional learning to more fully integrate strategies for broadening participation with science, mathematics, engineering, and computer science content.
- Providing the specific types of tools, materials, and other supports that inclusive learning environments require.
- Considering the effect of existing and prospective policies on students’ access to science mathematics, engineering, and computer science learning.
- Being open to different conceptions of success, and sharing success stories.

Insert a step within the calculation of fractions → Diverse Sample → Broadened Participation ≠ NSF FUNDING

EXAMPLE I

EXAMPLE I WITH INTEGRATED BP THEORY

Frustrated Students Experienced “Perceived Fraudulence” and Program Attrition

Insert a Step within the Calculation of Fractions

Higher Self-Efficacy and Positive Math Self-Concept

Diverse Sample

Proposes to Assess Self-Efficacy and Math Self-Concept after Computation Innovation for Treatment Group

Broadened Participation

=

Fundable Proposal

EXTRA CONTENT

The STEM Pipeline

Broadening Participation Work

Principal Investigator

NSF #EEC-1619843 – "Race-Gender Trajectories in Engineering: The Role of Social Control across Neighborhood and School Contexts" ($617,202).

NSF #DRL-1800199 – "Exploring ways to use National Datasets to Promote Broader Participation of Race-Gender Groups in STEM" ($299,999).

NSF #EEC-1833161 – "Race-Gender Trajectories in Engineering: The Role of Social Control across Neighborhood and School Contexts – Supplement," Co-PI: Dr. Sheretta Butler Barnes ($99,985).

Steering Committee Member of NSF Advisory Board

DRK-12 Broadening Participation Topical Group Synthesis Project, 2017 - 2018

Technical Advisor/Methodologist

NSF's Broadening Participation in LifeSTEM and NSF INCLUDES for HBCUs, HSIs, MSIs and TCUs (facilitated via NSF #DRL-1738128), 2016 - present

DATA SCIENCE DIVIDE

260 applications for the AERA Minority Dissertation Fellowship, ~40 used quantitative methods

Latinx and Black populations constitute a combined 11.8 and 19.1% of all students taking data science and analysis courses despite being 32 and 29% of all college students and working-age populations, respectively, in 2016

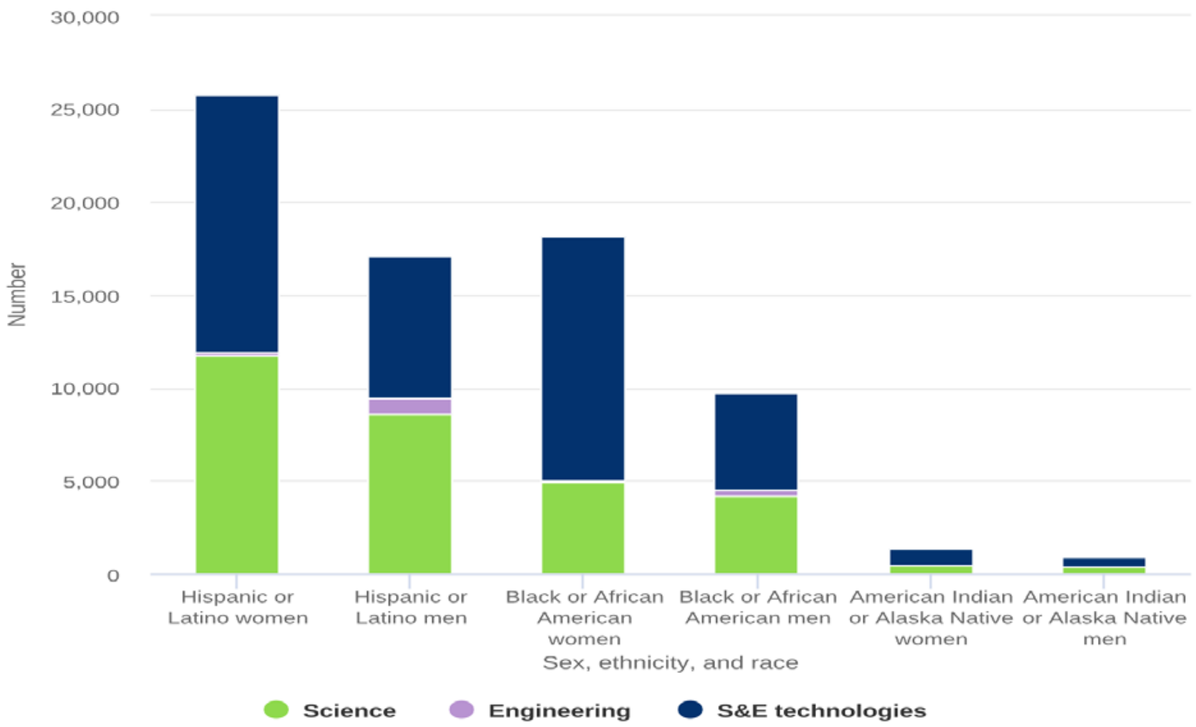
Large racial/ethnic disparities in the nation’s research funding apparatus

Issues of access related to the culture of data science learning environments and limited diversity

Epistemological assumptions of critical race/ethnicity theory, western science, positivism, and the stratification of knowledge

FIGURE 4-A

Associate's degrees in science, engineering, and S&E technologies, by sex, ethnicity, and selected race: 2016



S&E = science and engineering.

Note(s)

S&E technologies includes science, engineering, health, and other S&E technologies that prepare students for skilled technical jobs. Race and ethnicity breakouts are for U.S. citizens and permanent residents only. Hispanic or Latino may be any race. Data are based on degree-granting institutions eligible to participate in Title IV federal financial aid programs and do not match previously published data that were based on accredited higher education institutions.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, unrevised provisional release data, 2016. Related detailed data: WMPD table 4-3.

Gender advantages in degree receipt no longer exist for men of color as they do for White and Asian men, except in engineering

Research Perspective