Advancing STEM Equity Through Research-Based Education Practices

Virtual Town Hall in collaboration with The National Academies of Sciences, Engineering, and Medicine

August 5, 2020 | 1:00 – 4:00PM ET

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The National Academies of
SCIENCES • ENGINEERING • MEDICINE

PANEL SESSION 1 |

Cultivating a Campus Culture of Evidence-based STEM Instruction

Introduction & Moderator: Leanne Wells
Director, Center for the Advancement of Teaching

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Moving Research into Practice

Laird Kramer

Director STEM Transformation Institute

Professor of Physics

Laird.Kramer@fiu.edu

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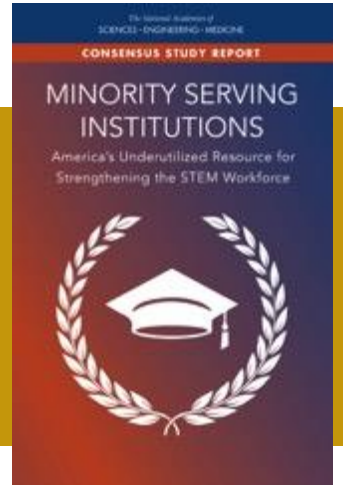
Minority Serving Institutions
America's **Underutilized** Resource for Strengthening the STEM Workforce



- Culture of Intentionality for Evidence-based Outcomes-driven Instructional Strategies
- Adapt to Student Needs / Meet Students Where They Are / Use Their Experiences in Learning
- Role of Leadership / Must Develop Leadership
- Partnerships: Educational / Governmental / Professional Societies / Foundations / Funders
- Role of Private and Public Funding
  - Multifaceted Return on Investment at MSIs: Social Mobility / Economic Prosperity
  - What's the Best Investment Opportunity?
- Thoughtful Accountability

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Modeling Practices of Calculus Project

- Calculus Common Barrier for STEM Students / National Calls for Experiments in Mathematics
- Curriculum: Integration of Instructional Strategies Developed on Campus / Across Nation
- Experiment: Large Scale Randomized Controlled Trial to Establish Strong Evidence
- Results: Very Compelling Outcomes on Exams and Course Grades (Results Embargoed)
- Scaling: Most Sections in Spring 2020 / All Sections Fall 2020 and Beyond
- Collaborative Partner: Broward College
- Broad Dissemination Underway / Reach Out if Interested
- Funded through FIU & NSF HSI PROGRAM (#1832450)

- (Sample of Strategy Deployed Across STEM Courses)

STEM Transformation Institute

- Grass Roots Faculty Initiative: Institutionalized in 2013
- Advance Research in STEM Education and Transform Institutional Education Practices
  - 20 Discipline-based Education Research Faculty Across STEM Departments
  - 28 Faculty / Postdocs / Staff Within Institute Carrying Out Dozens of Research Projects
  - SUCCEED: School of Universal Computing, Construction, and Engineering Education
- Learning Assistant Program (One Change Movement):
  - Undergraduates Facilitate Learning in STEM Classrooms / Drive Faculty Change
  - Mature Courses See 15-25% (up to 40%) Increase in Pass Rates
  - 325+ LAs deployed in 70+ STEM Courses Impacting >12,000 Student Enrollments Each Semester
  - LAs and Students Rapidly Adapted to Remote Teaching / Faculty Learned from LAs

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Weaving STEM Education Research into Institutional Identity

Monique Ross, Ph.D.

Assistant Professor of Computer Science, College of Engineering and Computing

STEM Transformation Institute

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Beholden to Metrics

Performance Based Metrics

Metrics Common to all Institutions (Florida)

1. Percent of Bachelor's graduates employed (Earning $25,000+) or continuing their education
2. Median Wages of Bachelor's graduates employed full-time POST-GRADUATE INCOME
3. Average cost to the student (Net tuition per 120 credit hours) - undergraduate
4. Four-year graduate rates (full-time FTIC) GRADUATION RATES
5. Academic progress rate (2nd year retention with GPA above 2.0) RETENTION
6. Bachelor's degrees awarded in areas of strategic emphasis
7. University access rate (percent of undergraduates with Pell-grant)
8. Graduate degrees awarded in areas of strategic emphasis
9. Board of Governors choice – percent of Bachelor's degrees without excess hours
10. Board of Trustees choice – Bachelor's degrees award to minorities

https://www.flbog.edu/wp-content/uploads/Overview-Doc-Performance-Funding-10-Metric-Model-Condensed-Version-Nov-2019.pdf
https://academic.fiu.edu/docs/BOG-Performance-Funding-Model-for-FIU.pdf

Context Matters

2016 R1 Very High Research Activity

Approx. 54,000 students

4th Largest University in Nation

Largest HSI, 66.9% Hispanic population

Est. 1972
5,667 students
80% MDCC xfer

Context Matters

Vision

Florida International University will **achieve exceptional student-centered learning** and upward economic mobility, produce meaningful research and creative activities, and lead transformative innovations locally and globally, resulting in recognition as a Top-50 public university.

Mission

Florida International University is an urban, multi-campus, public research university serving its students and the **diverse population of South Florida**. We are committed to high-quality teaching, state-of-the-art research and creative activity, and collaborative engagement with our local and global communities.

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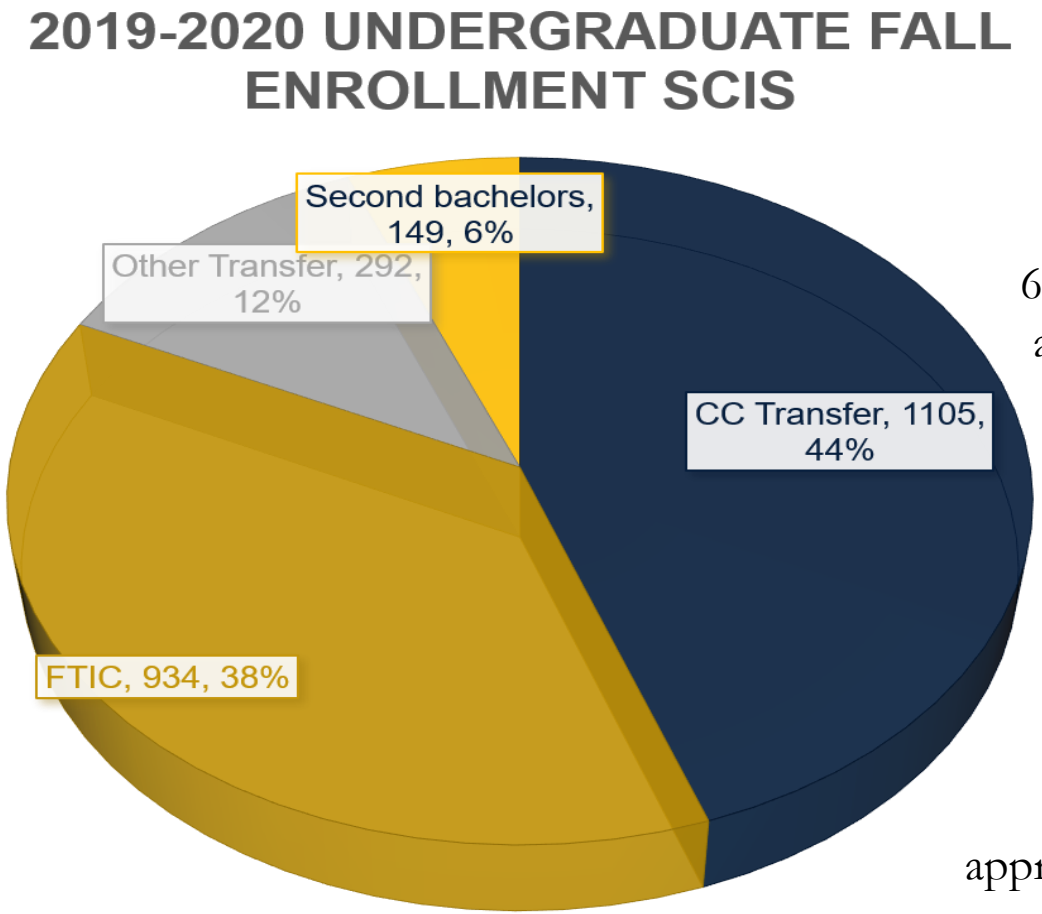
Context Matters



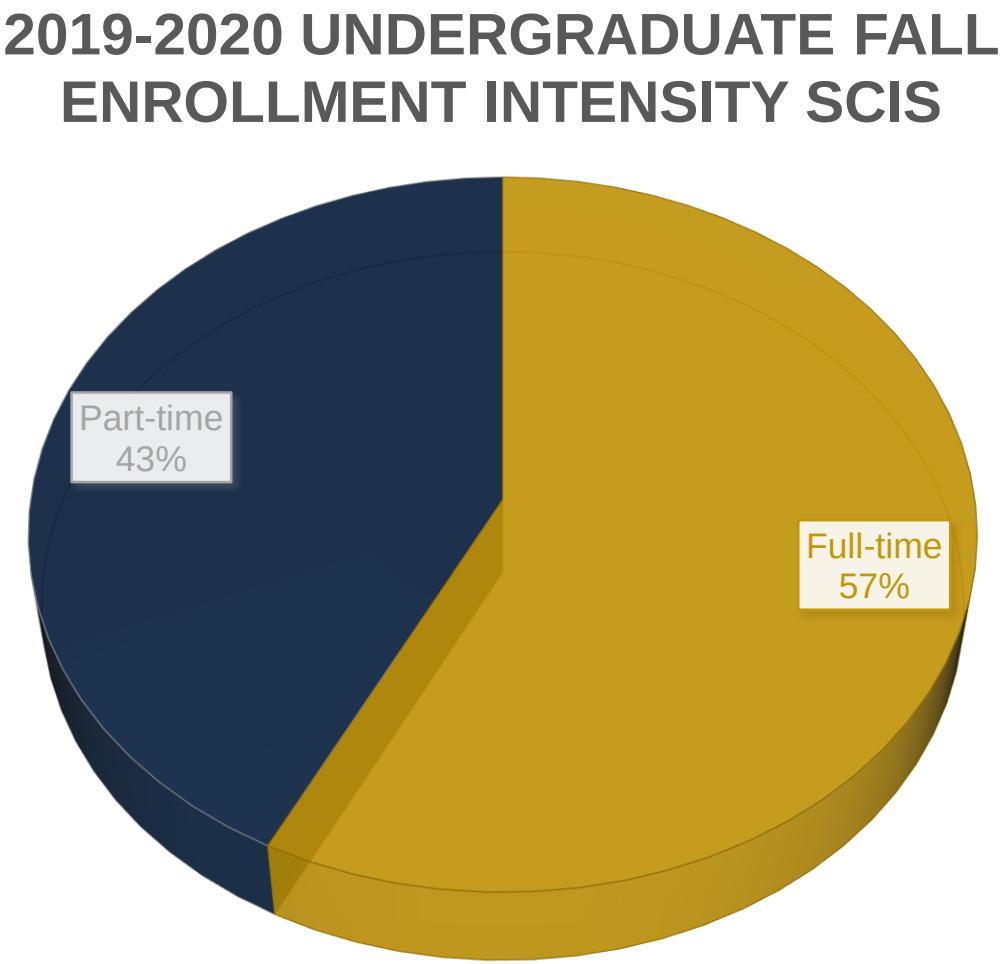
62% started their academic career elsewhere

38% First Time in College

approx. total = 2,480

**SCIS – School of Computing and Information Sciences

Context Matters



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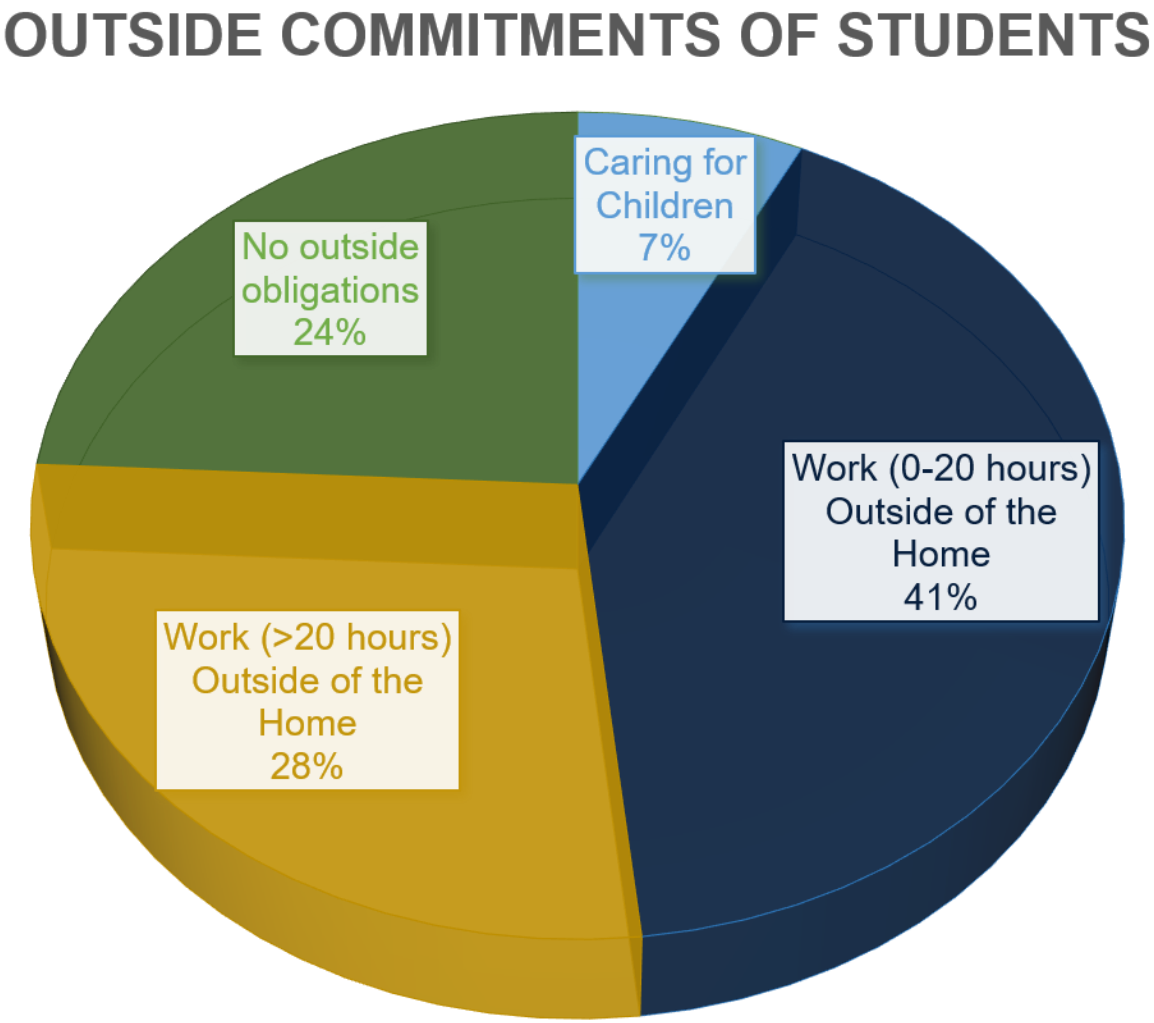
Beholden to Metrics

- MSIs are often less selective or open access
  - Contextual factors must be considered
    - students' financial circumstances,
    - life stage,
    - commitments to work and family, and
    - academic preparation

National Academies of Sciences, Engineering, and Medicine 2019. Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

Context Matters



76% of students have outside obligations

Beholden to Metrics

- Performance Based Metrics – retention, graduation rates, *and* persistence lead to **deficit thinking**
  - Weaknesses – focuses on inadequacies of students and aims to "fix" them
    - Preparedness
    - Time to completion
    - GPA
  - Belief that students who in any way do not conform to a "traditional" or privileged financial situation, home life, or route to education are not likely to succeed.

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National Academies of Sciences, Engineering, and Medicine 2019. Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

Beholden to Metrics

- Not just language or metrics but…

How we understand …

… the community/environment,

… people's position in that community, and

…how to act/perform within that community

National Academies of Sciences, Engineering, and Medicine 2019. Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

Anti-deficit Frameworks

- Remember that “students enroll in college with a set of unique characteristics, experiences, and backgrounds, as well as changing educational needs and goals”
    - transfer rates,
    - course completion,
    - skills enhancement, in addition to graduation rates
- Suggest disaggregating success rates by enrollment intensity, whether full time, part time, or some combination, as well as using metrics that expand the time period by which students are tracked, particularly for students who begin at two-year institutions.

National Academies of Sciences, Engineering, and Medicine 2019. Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce. Washington, DC: The National Academies Press. https://doi.org/10.17226/25257.

Anti-deficit Frameworks

- Cultural capital
- Stereotype threat theory
- Attribution Theory
- Campus ecology theory
- Identity theory
- Critical Race theory
- Theories on college student retention
- Possible selves theory

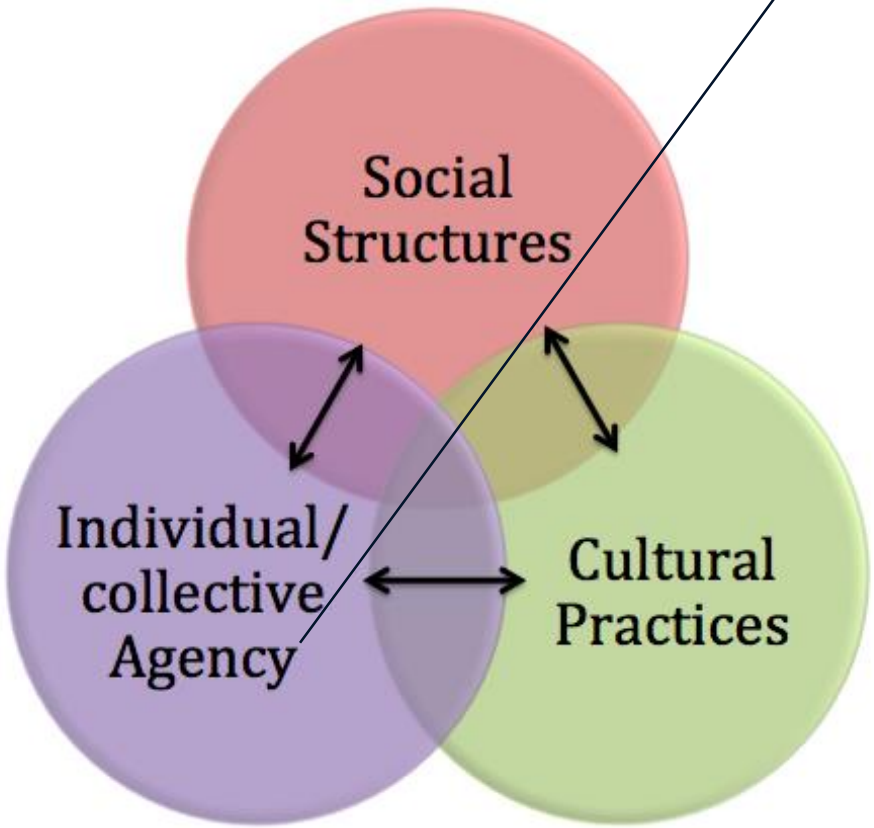
Harper, S. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research*, *2010*(148), 63–74. https://doi.org/10.1002/ir

Identity Theory

Communities of Practice

- Norms
- Values
- Beliefs
- Discourse/ language
- Practices
- Identity salience

Agency



"[…] one's ability to act in a given situation."

"[…] agency depends on both having the knowledge and having the means."

"[…] people's beliefs in their capability to exercise control over their own functioning."

LA Program

Dr. Hagit S. Kornreich Leshem

Dr. Sabriya Rosemond

Team: Karla Valdivia, Chris Grau

Theoretical Frameworks: Zone of Proximal Development, Identity Theory, Metacognition

Methodology: Mixed Methods, Survey Instruments

Informs our practice:

(1) Create inclusive and equitable course climate for underrepresented groups in STEM.

(2) Shape and understand impact on micro-interactions in STEM courses and large-scale institutional change.

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Catalyzing Change in Calculus (C3)

Dr. Laird Kramer

Team: Drs. Charity Watson, Adam Castillo, Pablo Duran, Geoff Potvin and Eddie Fuller

Theoretical Frameworks: Communities of Practice, Constructivist, Agency

Methodology: Surveys – measuring attitudes, self-confidence

Informs our practice: The project has developed and implemented a curriculum for calculus that engages students in developing mathematical ideas using the practices of mathematicians. The Modeling Practices Curriculum develops concepts and techniques in calculus using active learning approaches and peer supported group learning in order to develop Ginsberg and Wlodkowski's four motivational conditions for culturally-responsive teaching: establishing inclusion, developing attitude, enhancing meaning, and engendering competence in all activities.

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Cracking the Diversity Code

Dr. Monique Ross

Team: Atalie Garcia, Jake Lopez,

Theoretical Frameworks: Identity Theory, CRT - Intersectionality, Community Cultural Wealth

Methodology: Interpretative Phenomenological Analysis, Survey instruments

Informs our practice: Using it to broaden participation of Black and Hispanic women in computing

Weaving STEM Education Research into Institutional Identity

- Redefined metrics at the institution
  - Anti-deficit framing
- Informed our…
  - pedagogical practices,
  - support systems,
  - physical classrooms,
  - hiring emphasis (DBER faculty hires)
- Vision and Mission

  […] **achieve exceptional student-centered learning** […] serving students and the **diverse population of South Florida.**

Administrative Leadership that Promotes Institutional Transformation

Dr. Elizabeth Bejar

Senior Vice President of Academic and Student Affairs

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STEM Transformation Institute: Timeline

2012: STEM Dialogue Presidential Convening on FIU's role in STEM Education Research

Top Administration / Faculty / Leaders of 6 Foundations / White House OSTP / APLU

2013: STEM Institute Launched

FIU President joins NASEM's Barriers and Opportunities for 2 & 4 STEM Degrees

2014: First new DBER Faculty Hires

New Provost and Dean of Arts, Science & Education

Hosts White House College Opportunity Initiative STEM Education Workshop

HHMI Science Education & FIUteach Projects Launch

2015: FIU President chairs NASEM's STEM Indicators Report

2017: Six new DBER Faculty Hires / STEM Institute moves into expanded space

2018: SUCCEED: School of Universal Computing, Construction, and Engineering Education

FIU President cochairs NASEM's Roundtable on Systemic Change in STEM (3rd role)

2019: Center for Transformation of Teaching Mathematics

STEM Institute: Transformed

- 2013 Launch:
  - 4 DBER Faculty / 1 Staff / 1 Postdoc / Several Graduate Students
  - ~ Half Dozen Active Research Grants
  - 153 Learning Assistants in 6 STEM Disciplines (and 1 in Engineering & Computer Science)
  - ~1 Active Learning Classroom
- 2020 Today:
  - 20 DBER Faculty / 28 Institute Faculty, Staff & PostDocs / Dozens of Graduates & Undergraduates
  - Multiple Dozens of Research Projects
  - 350 Learning Assistants in 160 Sections of 70+ Courses Across 11 Disciplines
  - 14 Active Learning Classrooms, 48-270 Seats, over 1,250 Total Seats (more on the way)
  - Over $50M in External Funding in Institute-led / Institute-partnered Projects

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PANEL SESSION 2 |

Student & Alumni Testimonials: The Salience of Asset and Equity-Based Perspectives and Practices

Introduction & Moderator: Dr. Rocio Benabentos,
Associate Director, STEM Transformation Institute

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PANEL SESSION 3 |

Partnerships as Drivers of Diversity, Equity, and Inclusion

Introduction & Moderator: Saif Y. Ishoof, Esq.
Vice President for Engagement

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STEP UP: An Innovative Partnership to Bring Gender Equity to Physic

Dr. Zahra Hazari
Professor of Science Education
STEM Transformation Institute

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NSF

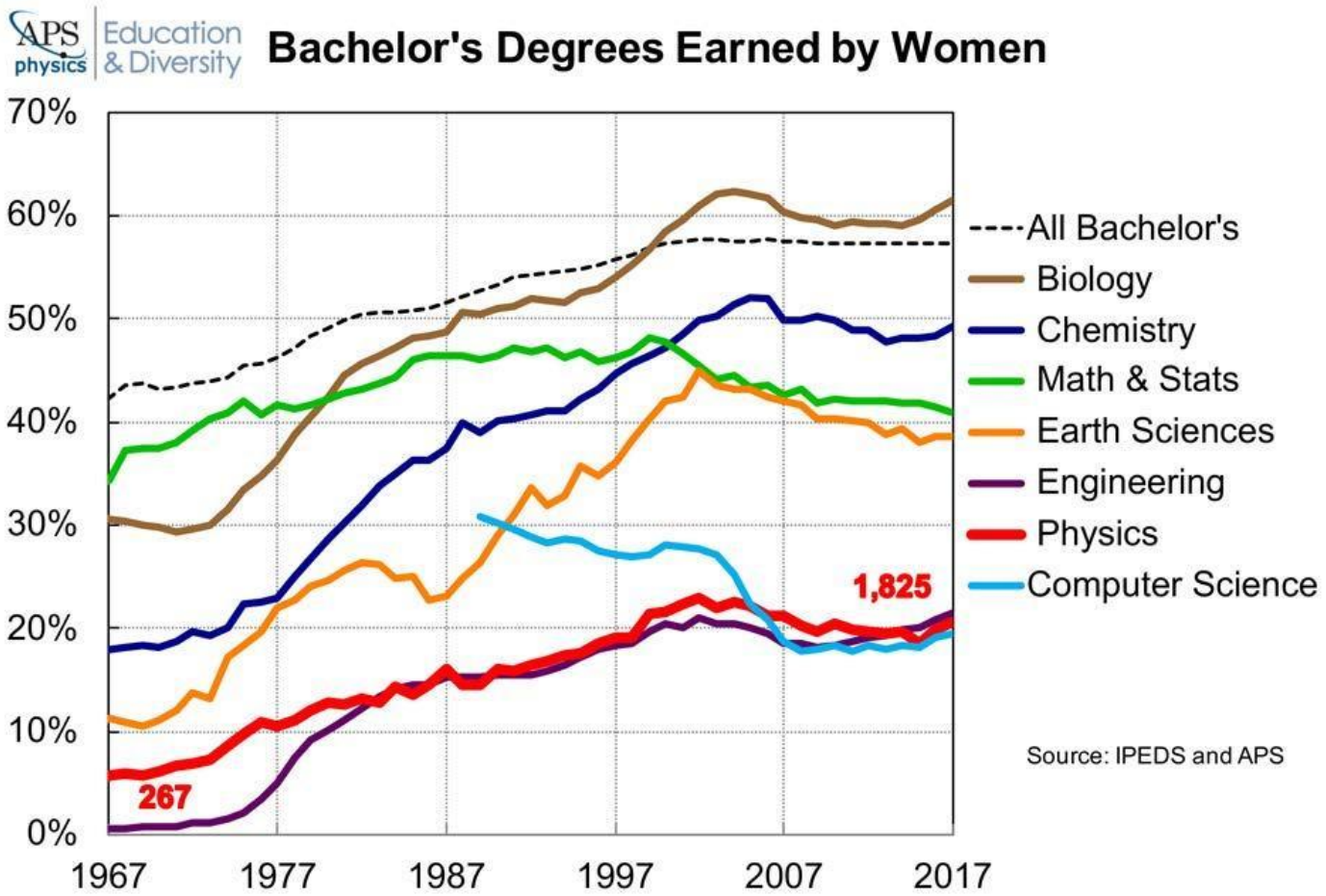
FIU STEM Transformation Institute

APS physics

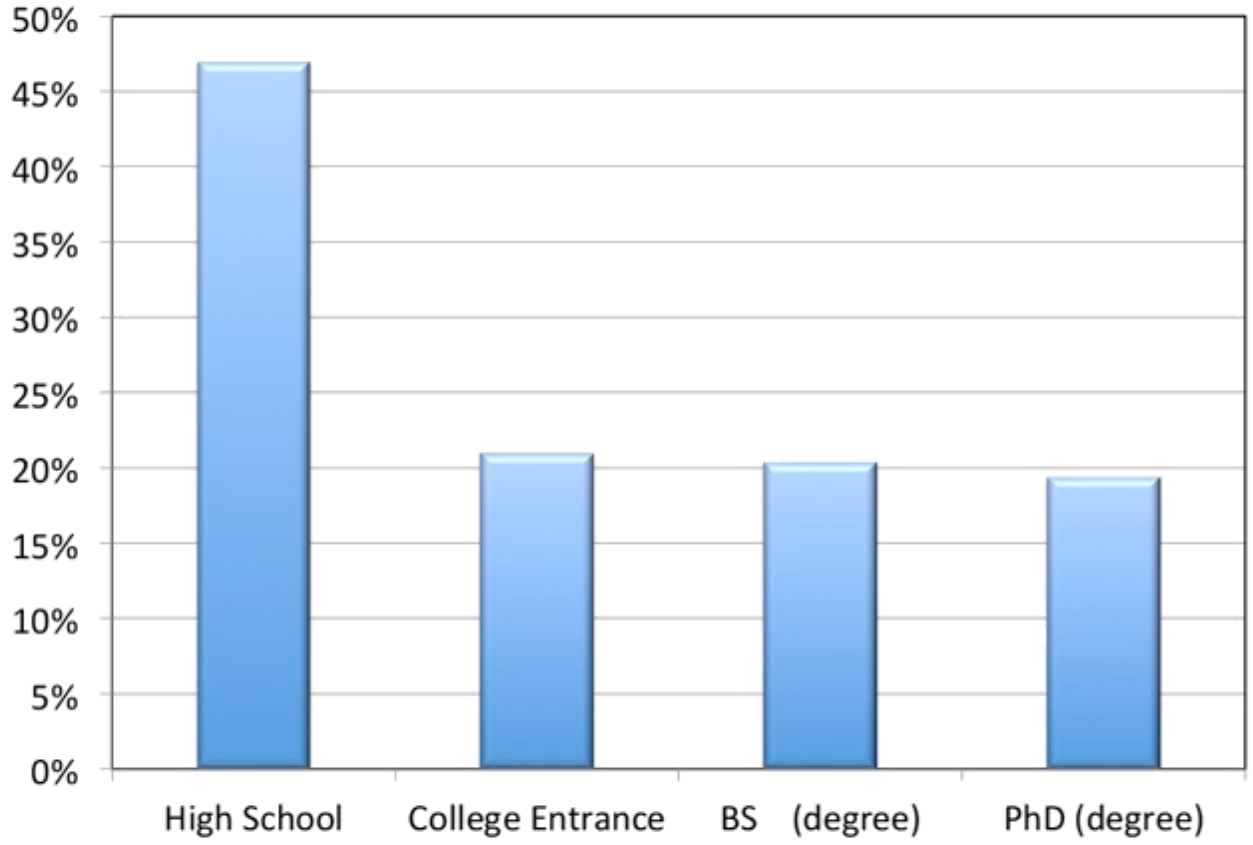
AAPT PHYSICS EDUCATION

A&M COMMERCE

Percentage Women Amongst Bachelor's

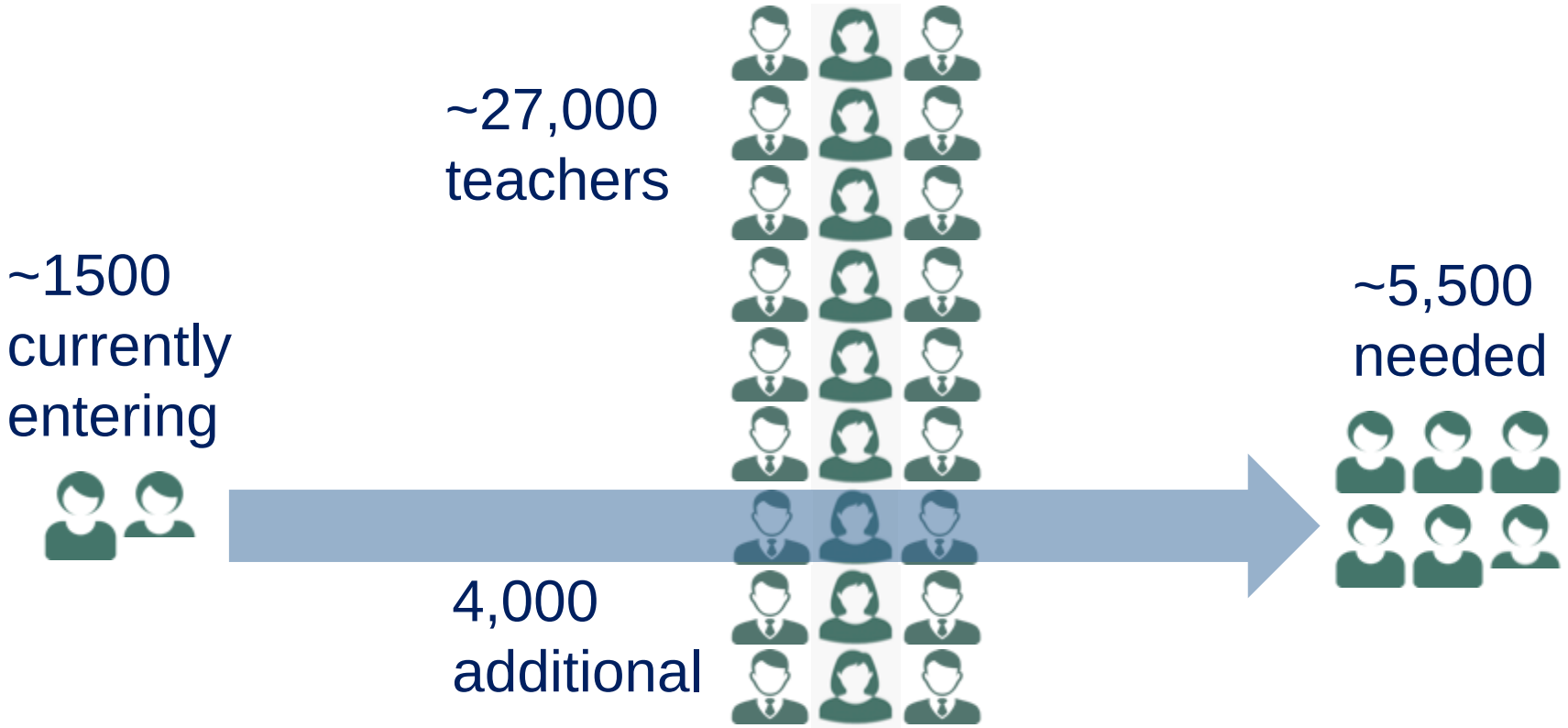


Percentage Women in Physics by Level



(Hodapp & Hazari, 2015)

STEP UP Project



(HERI, 2019; White & Tyler, 2014)

STEP UP Materials

- Goal congruity
- Values affirmation
- Utility value

- Underrepresentation discussion
- Unconscious bias

- Physics Identity
- Reducing marginalization
- Growth mindset
- Culturally relevant pedagogy

(www.stepupphysics.org)

STEP UP Research

- 20 teachers
  - 10 states
  - Diverse contexts (urban/suburban/rural, school demographics)
- 1448 students
  - 49% Female
  - 54% Underrepresented Racial/Ethnic Groups (URG)
    - Black or African American, Hispanic/Latinx, American Indian or Alaskan Native
- Pre/post surveys on future physics intentions

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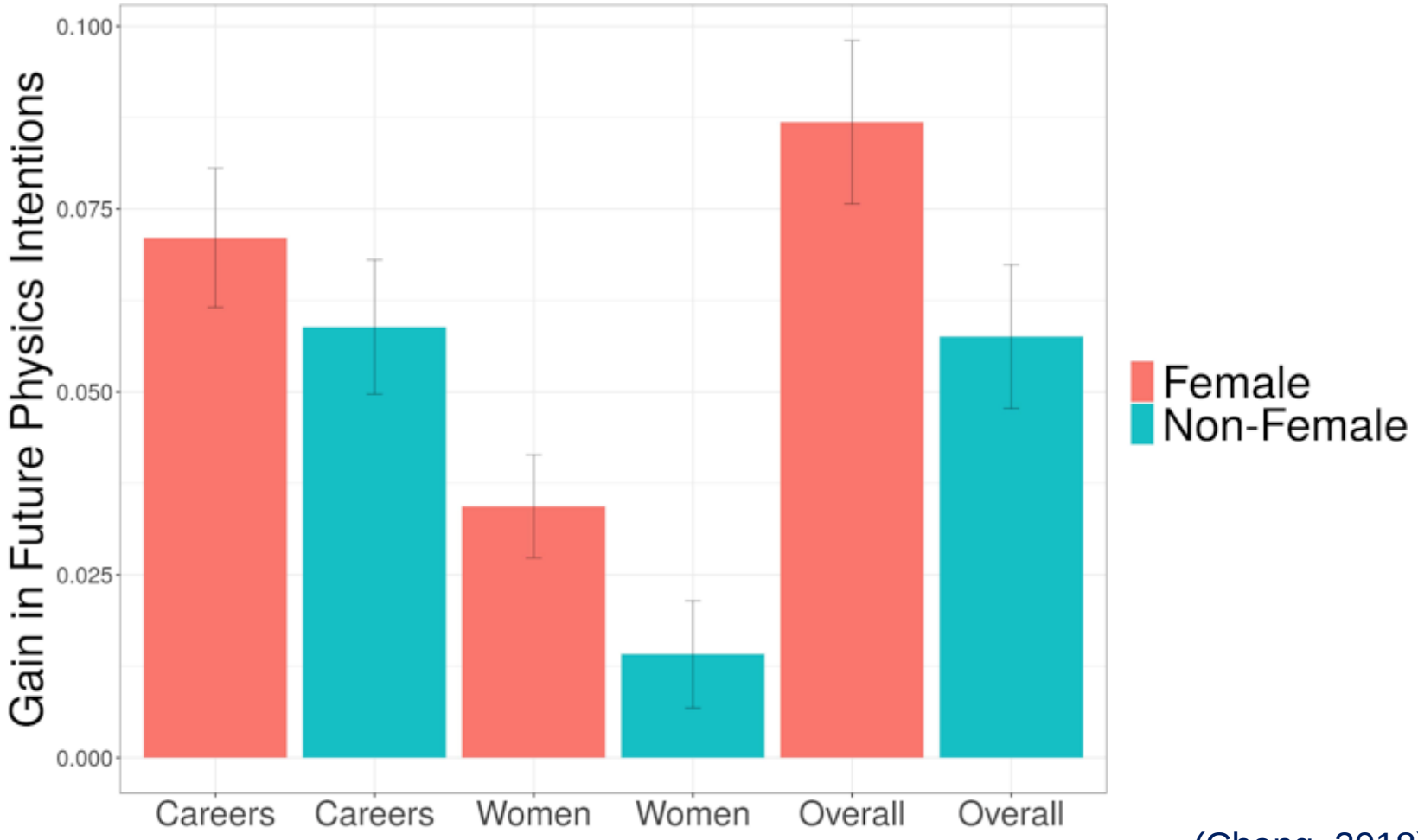
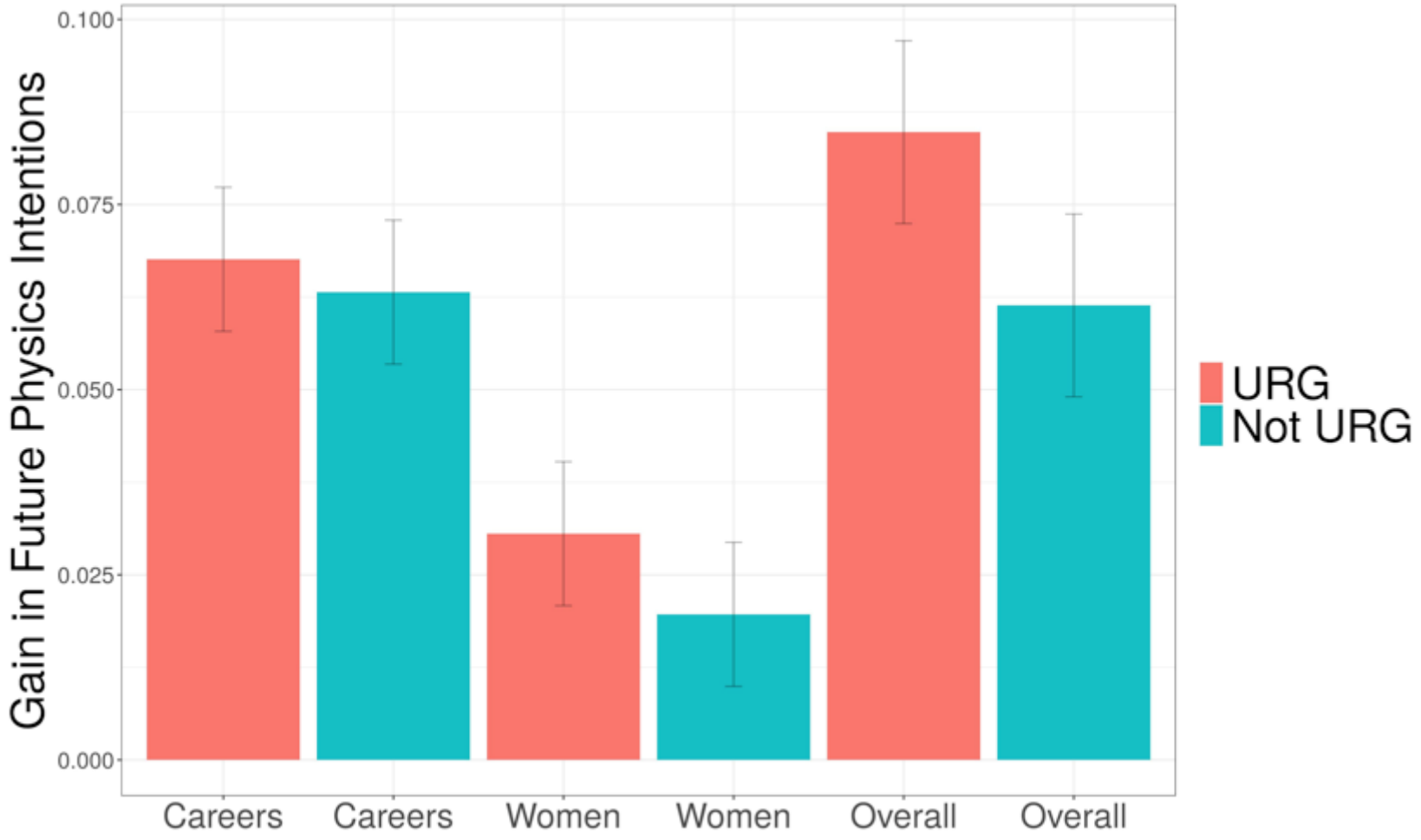
STEP UP Research



(Cheng, 2018)

STEP UP Research



STEP UP Propagation

- 97 Ambassadors
  - Run workshops
  - Support networks
  - Create virtual resources
- 2272 registered
  - 1039 teachers

Thank You

www.STEPUPphysics.org

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NSF

FIU STEM Transformation Institute

APS physics

AAPT PHYSICS EDUCATION

A&M COMMERCE

Informal Science Education Research Partnerships

Dr. Remy Dou, Assistant Professor of Science Education, College of Arts, Sciences and Education, STEM Transformation Institute

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What Is Informal Science Education?

what to learn
how to learn
when to learn

Learners Have **Less Choice**

Learners Have **More Choice**

K-12 Classrooms

Higher Education

School Field Trips

After School Programs

Zoos, Museums, Science Centers

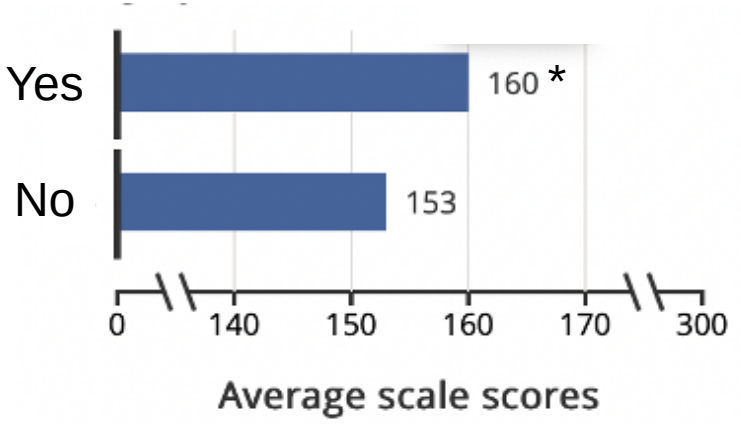
Libraries

Media (Television, Internet, Radio, etc.)

Students with informal learning experiences are more prepared for college.

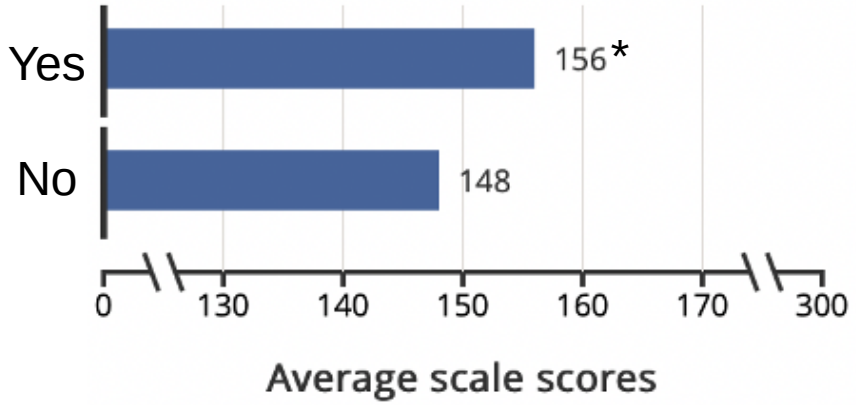
8th-Graders

Museums, zoo, or aquarium visits not part of school



12th-Graders

Museums, zoo, or aquarium visits not part of school

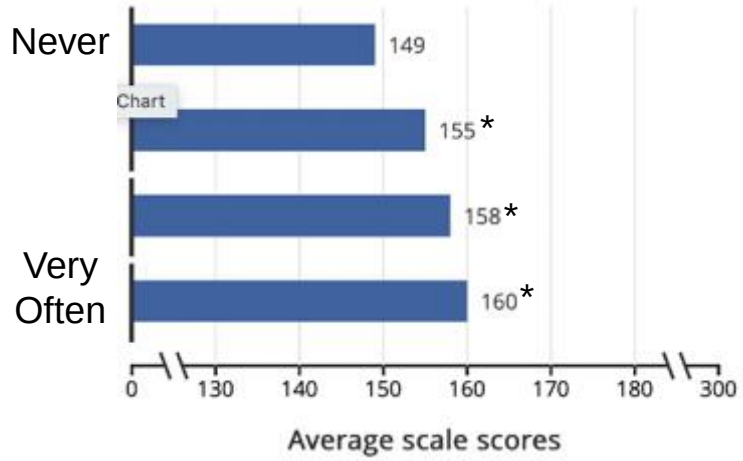


Scores on the science scale, 2015 National Assessment of Educational Progress

Students with informal learning experiences are more prepared for college.

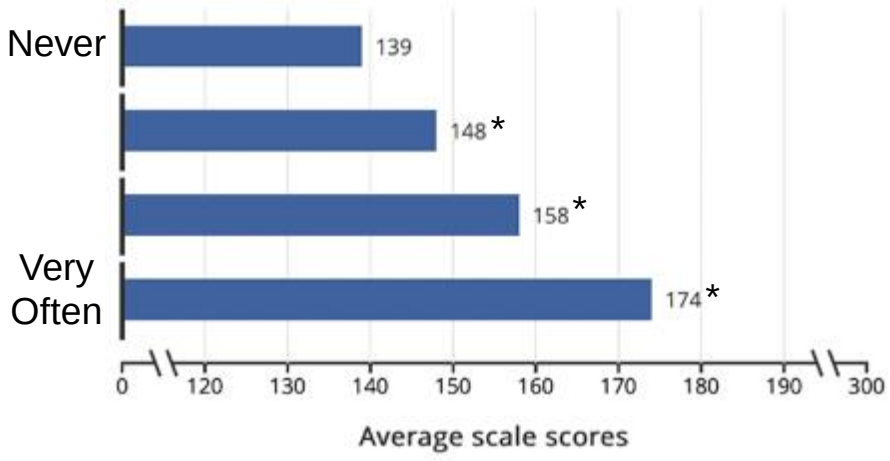
8th-Graders

Doing science activities not for schoolwork



12th-Graders

Doing science activities not for schoolwork

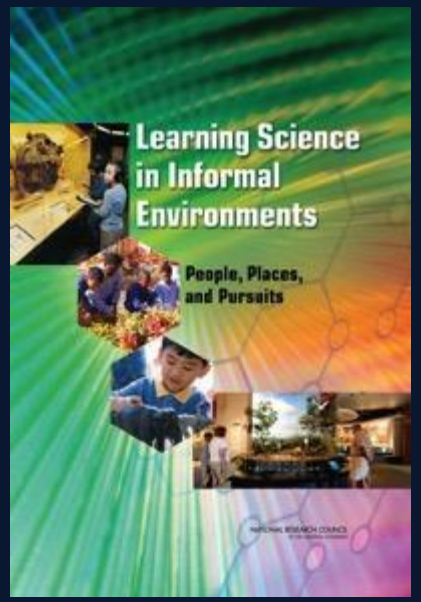


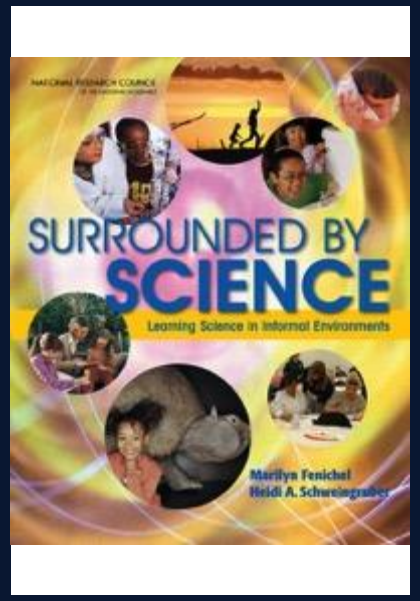
Scores on the science scale, 2015 National Assessment of Educational Progress

Foster Cultural & Community Engagement

Nurture positive identification with STEM

Generate awareness of and interest in STEM careers





National Research Council 2009, 2010

Highlights: International Hurricane Research Center

Partners: Museum of Discovery & Science, Ft. Lauderdale, Miami-Dade County Public Schools, Broward County Public Schools, the Miami Marlins, NOAA …

Activities:

- "Eye of the Storm" Video Series
- Interactive Exhibits
- Engagement with school visitors
- Public Communication of Science
- Wall of Wind Challenge
- STEM Weather Day
- STEAM Day @ Marlins Park
- …

Contact: Erik Salna, esalna@fiu.edu

Highlights: CASE Education Outreach

Partners: Girl Scouts of the USA, Miami-Dade Public Library System, Jumpstart, the Miami Heat, Miami Dade College…

Activities:

- STEM Workforce Pathway Model
  - Pre-School
  - Elementary, Middle, High School
  - Undergraduate Students
  - Graduate Students
  - Lifelong Learners
- …camps, internships, graduate research, K-12 curriculum, school visits, large community events (e.g., festivals), family nights, virtual programming

Contact: Nicholas Ogle, CASEoutreach@fiu.edu

…

Highlights: Research

Projects:

- **Talking Science**, NSF AISL #1846167, *Building on everyday conversations with family and friends to support Latina/o/x children's identification with STEM.*
- **Sustainability and Gender in Engineering**, NSF GSE #1036617, *Challenging existing practices in out-of-school physics programming to foster women's positive identification with physics.*
- **Verizon Innovative Learning Program**, Verizon Foundation, *Discovering how stereotypes of computer scientists motivate or dissuade middle school boys from minoritized communities to pursue CS careers.*
- **Eyes on the Rise**, (several), *Communicating and engaging with public audiences around the science and challenges of sea level rise.*
- …

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Highlights: Research - Talking Science

Projects:

- **Talking Science**, NSF AISL #1846167, *Building on everyday conversations with family and friends to support Latina/o/x children's identification with STEM.*

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TALKING SCIENCE

- **Ethnic culture**
- **Gender**
- **Family values**
- **Primary language**
- **SES**

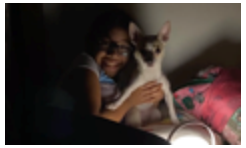
→ **STEM Identity**

STEM-Weather Day welcomed 2,300 local students to MMC

The Washington Post

'Eye of the Storm' gives you a better understanding about hurricanes, their power and their deadliness

CASE Education Outreach



Virtual "Camp In Camp Out" under the stars

Last year, pre-COVID 19, we:

- Participated in **32** community events on-campus and in the community.
- Reached **23,000+** community patrons through labs and demos.
- Donated over **$40,000** in in-kind programming.

MIAMI HEAT

National Geographic Explorers Hub coming to FIU

International Hurricane Research Center

Journal Publications:

- ACM-TOCE
- Journalism Practice
- Journal of Research in Science Teaching
- Physical Review– Physics Education Research
- Research in Science Education
- Science Education
- …

Conferences

STEM TEACHER LEADERSHIP NETWORK

Theme of the Month Discussion: America's Strategy for STEM Education – Why it is Relevant to STEM Teacher-Leaders

STEM Ecosystems and Partnerships

IDENTITY | ZAHRA HAZARI

Learning Research

Building A STEM Ecosystem Through Partnerships

Impact

Dr. Remy Dou
redou@fiu.edu

Best Practices for Equitable and Sustainable MSI Research Partnerships

Dr. Trina Fletcher
Assistant Professor
SUCCEED + STEM Transformation Institute
www.trinafletcher.com
@trinalfletcher

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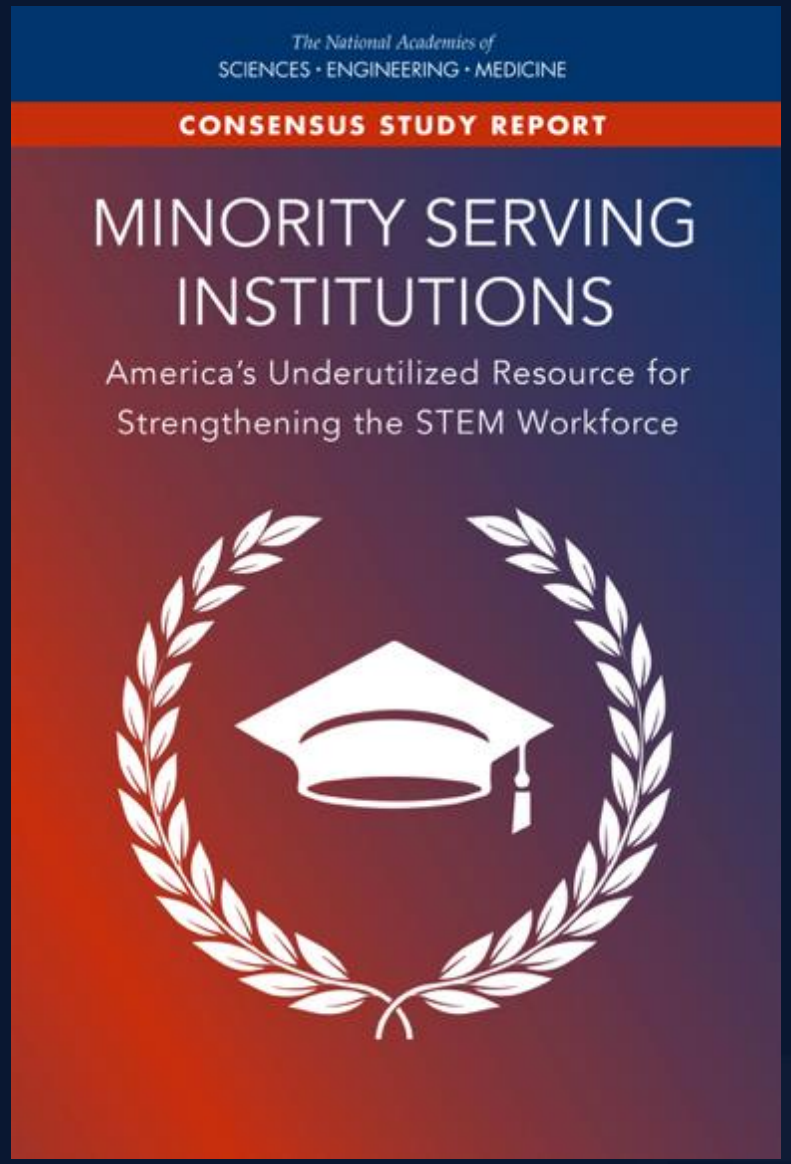
The importance and impact of this report



Fletcher, Trina. L., Fletcher, Tina. L., Williams, J. L., Benedict, B.S., Boyd, B. N., & Watkins, K. (2019, June). Paper presented at 2019 ASEE Annual Conference & Exposition, Tampa, Florida.

2 Major Concluding Points:

(1) Inequity in higher education

(2) Past and present missed opportunities for advancement

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Inequity in Higher Education & Missed Opportunities

Federal Funding

Industry Partnerships

State-level Policies

Systematic Discrimination

Hiring of Graduates

Global Impact and Implications of 2 Pandemics on Higher Education

COVID-19

Social Injustice

Outcomes - 2 Major Concluding Points

Trump Signs FUTURE Act to Help HBCUs, Minority-Serving Institutions

Stacy M. Brown, NNPA Newswire Contributor · December 24, 2019

The New York Times

MacKenzie Scott Gives $1.7 Billion to Historically Black Colleges and Other Groups

Netflix Chief Reed Hastings Donates $120 Million to Historically Black Colleges and Universities

Todd Spangler
Variety June 17, 2020

So how do we take advantage of this report?

Address MSI inequity in higher education?

Ensure opportunities to advance STEM education at MSIs are not missed?

The 5 R's for Equitable and Sustainable MSI Partnerships

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#1: Research

Who? What? When? Where? How? Why?

Student Diversity and STEM Disciplines

- 43.7% of HBCU undergraduate enrollment were students pursuing STEM degrees versus non-MSIs (40.0%).

- The non-African American and Black population on HBCU campuses continue to grow

Faculty and Leadership Diversity

48.9% of all STEM faculty at HBCUs identified as African American or Black compared to 3.0% at non-MSIs.

Students Financial Needs

68% of four-year HBCU students were Pell Grant eligible compared to 34% at four-year non-MSIs

Investments in STEM at MSIs

$30.5 B Total funds for science and engineering research, education, and infrastructure

700+MSIs received $783 million and $539 million of those funds were awarded to 20 institutions (NSF, 2015)

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#2: Relationships

- E-introduction from a mutual colleague
- Set-up “Get to know you” call(s)
- Prepare for the call
- Reference their work you found during step #1
- Explain your “why”

#3: Respect

- Goals, objectives, timelines and expectations should include personal and professional status
- Be **strategic** and **efficient**
- Patient, open-minded and considerate
- Consistently communicate

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#4: Resources

- Long history of inequitable funding nationally
- $30.5 B Total funds for science and engineering research, education, and infrastructure
- 700+MSIs received $783 million and $539 million of those funds were awarded to 20 institutions (NSF, 2015)
- Be fair and equitable with budgets
- Should be driven by the first two R's (research and relationship)

#5: Reflection

- Research – DONE
- Relationship – DONE
- Respect – DONE
- Resources – DONE
- Reflection
  - Re-cap and review what been discussed- goals, outcomes, purpose
  - Communicate and confirm what you've discussed
  - Everyone on the same page

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The 5 R's for Equitable and Sustainable MSI Partnerships

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THANK YOU!

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Advancing STEM Equity Through Research-Based Education Practices

Virtual Town Hall in collaboration with The National Academies of Sciences, Engineering, and Medicine

August 5, 2020 | 1:00 – 4:00PM ET

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