Development of a Comprehensive Mentoring Model for Hispanic and Low-Income Students in STEM

Florida Atlantic University - Drs. Romance, Zilouchian, Zhuang
Palm Beach State College – Dr. Hamadeh
East Carolina University – Dr. Vitale

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A Collaborative HSI TITLE III Project

FAU COLLEGE OF ENGINEERING & COMPUTER SCIENCE Florida Atlantic University

BROWARD COLLEGE

PALM BEACH STATE COLLEGE

USDOE Title III HSI Framework

Overarching Question

The presentation is part of a comprehensive Title III project that builds upon *evidenced-based learning theory and instructional strategies* to support Hispanic and Low-Income Students degree completion at the State College and their successful transfer to the University to complete a Bachelors Degree in Computer Science and Engineering.

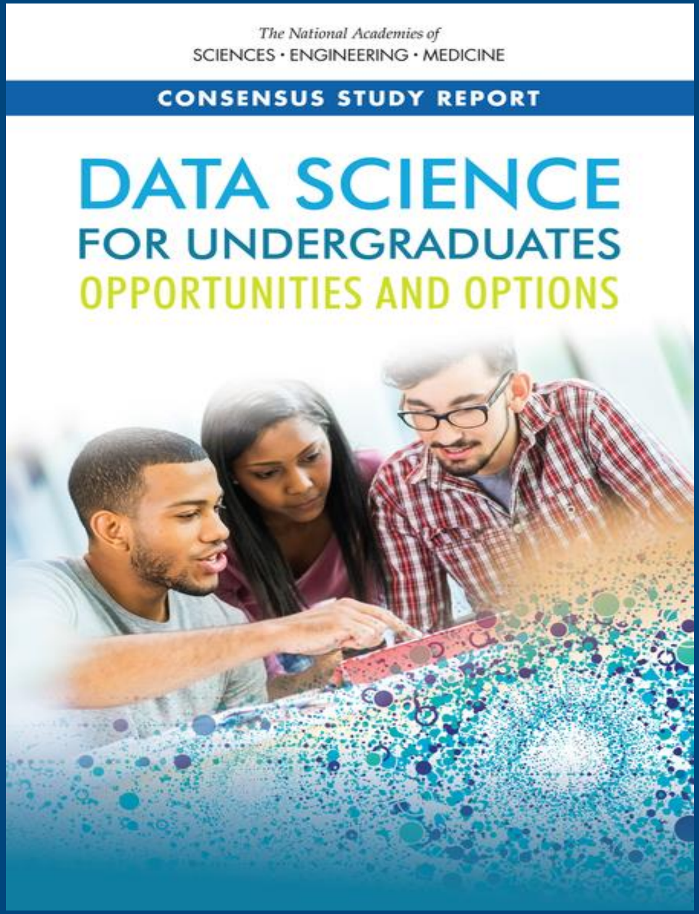
Presentation Focus

Multi-Institution Objectives

- Recruit more Hispanic and low-incomes students interested in computer sciene and engineering
- Ensure that their educational preparation and related experiences at the State College and University are aligned with the needs and hiring interests of business/industry, government, and national security job sectors …given
  - the onset of ubiquitous and disruptive technologies
  - the blurring of boundaries among institutions, across departments
  - use of BIG DATA and data-analytics
  - the work-related trend of engaging with interdisciplinary teams
  - are aware of information technology trends

Information Technology Trends

- Cloud Computing
- 3D Technologies
- Augmented Reality
- High-Performance Computing
- Cyber Security
- Social Networks
- Mobile Systems and Applications
- Bioinformatics and Biotechnology
- Big Data and Data Analytics
- Artificial Intelligence and Deep Learning…



What do we know about Underrepresented Student Groups in STEM….

-Enrolled disproportionately in developmental math (and reading courses)

-Admitted as part of a FLDOE open-enrollment process and may not have prerequisite background knowledge and skills to succeed in college courses

- Research findings -
  - unable to enroll in a college level mathematics course
  - experience increased time to graduation
  - generally experience increased dropout rate from courses, programs, or from college

(Chen, 2009; Ganga, 2018; National Academy of Engineering [NAE], American Society of Engineering Education [ASEE], 2014; National Research Council [NRC], 2011; Xu, 2016)

What research tells us….

- Student achievement in college math
  - Undergraduates across all ethnicities continue to struggle with Gateway Mathematics Courses (Bailey, et al., 2010; Bressoud, 2014, 2015; Saxe & Braddy, 2015)
- Student under-preparedness for college
  - National Assessment of Educational Progress - K-12 (NAEP, 2016)
  - TIMSS (Martin, et al., 2016)
  - PISA (OECD) (Kastberg, 2016)
- Increasing job market needs that cannot be met
  - (see Eagan, et al, 2014; NAE/ASEE, 2014; **NASEM, 2016, 2017, 2018, 2019**; NRC, 2011; PCAST, 2012)

They are not in cloud, they are on the 1st floor

Our Cloud Computers

FAU College of Engineering & Computer Science, Florida Atlantic University | Palm Beach State College | Broward College

Who Are Our Mentors ?

- Upper level juniors and seniors enrolled in FAU’s College of Engineering and Computer Science
- Have a high GPA and high interest in helping others
- May have been participants a the State College
- Have participated in mentor training sessions at FAU
- Have a strong background in mathematics

Mentoring Model - Roles and Responsibilities

Mentors – support HSI participant success

- serve in an academic/motivational support role
- are assigned to the State College campuses for 10 hrs/wk
  – support for gateway mathematics and computer science courses
- meet with participants to support math and computer science learning how to learn (e.g., studying, preparation for tests)
- provide guidance related to preparation for university transfer and upper level course work

Mentoring Model - Professional Development

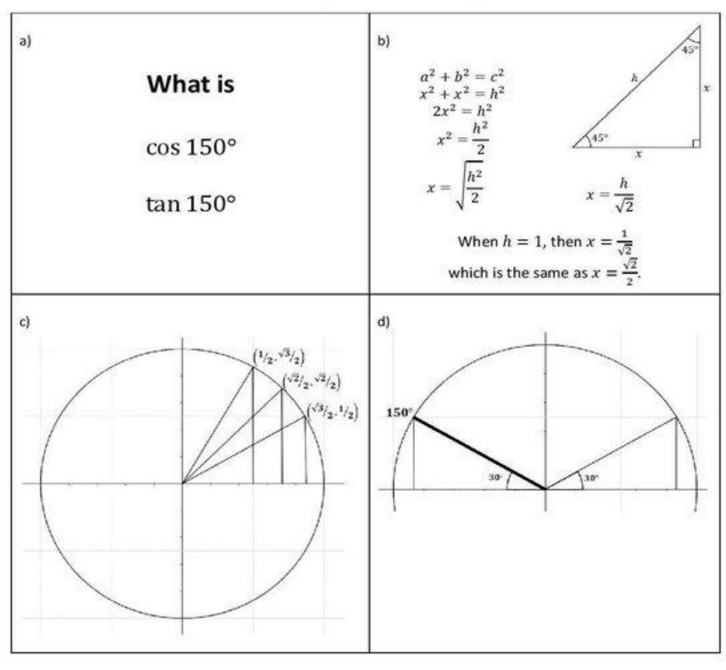
Roles and Responsibilities ….

- collaborate with Math Faculty
- Participate in monthly learning sessions to ensure consistency with the theme of conceptual learning
- share findings/approaches taken – group discussion regarding topics student-mentees find most difficult

Mentoring Model - Professional Development to – Increase Mentee success

Model thinking out loud to help develop new habits of mind

- analyze the problem—critical skill for success in any form of analytical or computational thinking
- reflect on prior knowledge – needed to solve the problem
- if they don't remember, begin with a review of what they have been learning …(remind them that they know, i.e. mini-review)
- establish a baseline from which new learning can take place, then have them continually refer back to what they know, and engage often in cumulative review



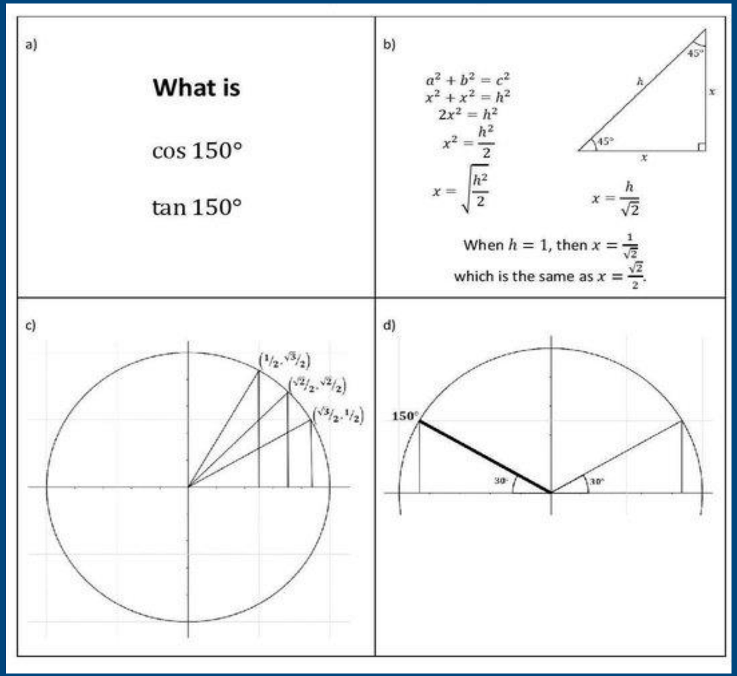
Mentoring Model - Professional Development to – Increase Mentee Success

Model thinking out loud to help develop new habits of mind …..

- systematically guide mentees new learning by having then explain step by step what they are doing and WHY

  (if necessary, mentor can display the strategies that an expert would use to develop new learning e.g., literature on expert problem-solving)

- ask the mentees to explain back (share) their new thought processes and understanding (i.e. a formative assessment)



Mentoring Model – Facilitating Mentor Training about Learning

Participate in Monthly Professional Development

- Receive 3 hrs/mo - job-embedded training in math teaching/learning and affective strategies to motivate students
- Demonstrate how to link their math and engineering backgrounds – reflect on how they come to understand and apply concepts
- Practice – the process of mentoring –including
  - group discussion and suggestions - using select math problems (e.g., final exam results in College Algebra)
  - solving progressively more sophisticated mathematics problems .. reflecting on depth of knowledge and ease of accessibility

Mentoring Model - Training - Learning

Mentors identify specific problems in explaining math concepts

- review habits of mind…analysis, prior knowledge, review, baseline understanding, new step by step learning, application
- articulate the practices of mathematics (e.g., draw pictures; show how relationships change; word problems).
- share and discuss their experiences as well as their challenges
- apply what they have learned to guide mentees on the big ideas in mathematics and how to use them when problem solving.

What Guides our Work

Theory of Learning – cognitive science perspective

- Bransford, et al., (2000). “How People Learn” (National Research Council)
  - three major findings
- David Ausubel – Joseph Novak – E.D. Hirsch – Anders Ericsson – Richard Duschl
  - address fundamentals of learning
- National Academy of Science (NAS) – Reports
  - Bressoud (2014). *Attracting and Retaining Students to Complete Two-and-Four Year Undergraduate Degrees in STEM: The Role of Undergraduate Mathematics Education*. Report prepared for Barriers and Opportunities in Completing 2-and-4 year STEM Degrees. Washington, DC: The National Academies Press.
- Mathematical Association of America (MAA)
  - Saxe & Braddy (2015). *A Common Vision for Undergraduate Mathematical Sciences programs in 2025*. MAA. Washington, DC.

What Guides our Work

Curricular Coherence in Gateway Courses

- Rethinking Conceptual Coherence - continued
  - determining what pre-requisite knowledge is needed for each course
  - determining if course outcomes are sufficient for success in subsequent courses
  - determining – from a broader perspective – the degree to which outcomes of ‘all’ mathematics courses are preparing students for a STEM degree (e.g., Electrical Engineering, Computer Engineering, Computer Science)

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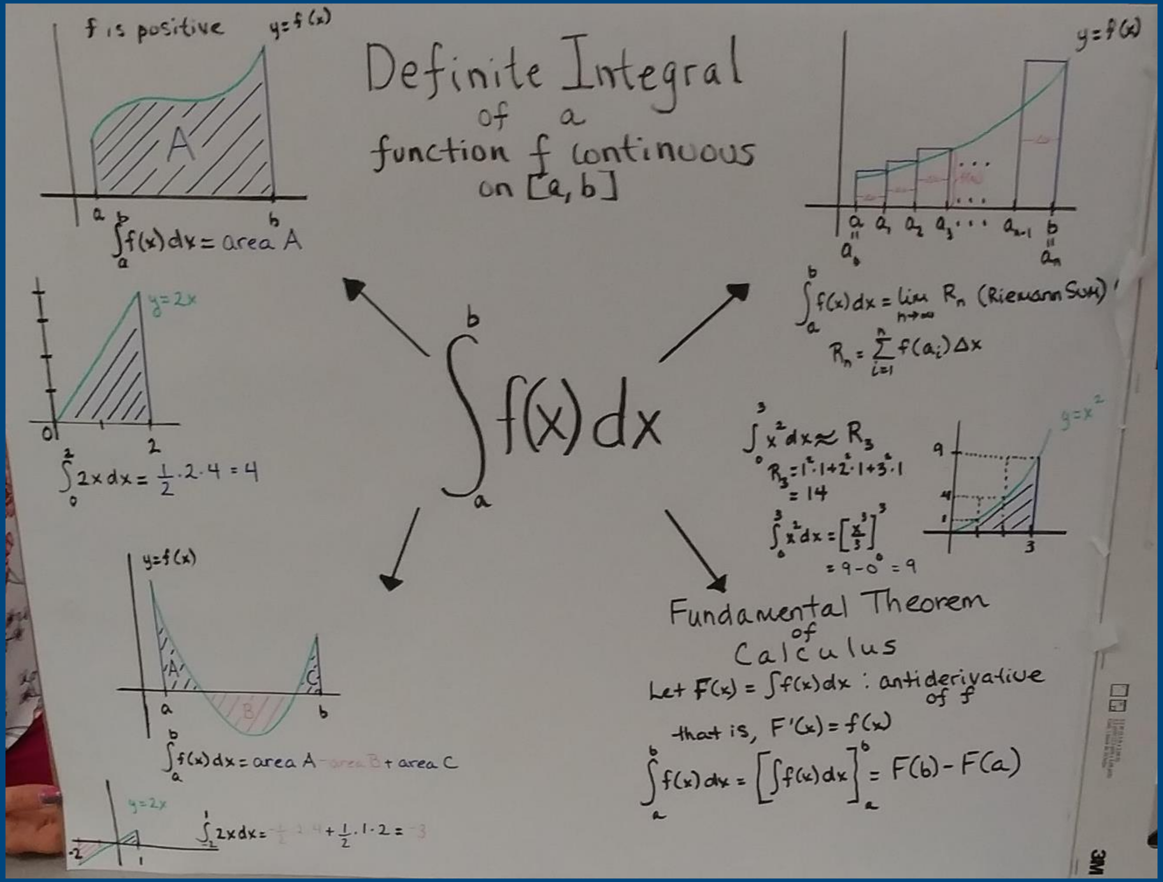
What Guides our Work

Curricular Coherence in Gateway Courses

- Curricular Framework Guide – A Fluid Document
  - detailing and agreeing upon – definition of conceptual coherence
  - identifying 'core' concepts – within and across gateway courses
  - applying the core concept framework to determine what concepts to expand upon and possibly ones to delete



Title III Project Components - BC, PBSC, FAU

Curriculum Refinement and Alignment

Leadership and Collaboration – Mathematics Faculty – BC-PBSC-FAU

Participant Support

- FAU Mentors
- Computer Science-Based Activities
- Learning Community
- Faculty Designated Math Sections
- Advisors and College Coordinators

The Goals….

Graduation –
- **AA – State College**
- **BS- FAU in Computer Science, Computer Engineering, and Electrical Engineering**

Career Pathways

Business – Industry - Government