Changing Students' Lives with Personalized Executive Function Mentoring

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UCF

Statement of the Problem

- **Problem:** Students with executive function deficits are not prepared to perform and persist in postsecondary STEM majors (Committee on STEM Education, 2018).

- **Potential Solution:** iCAN

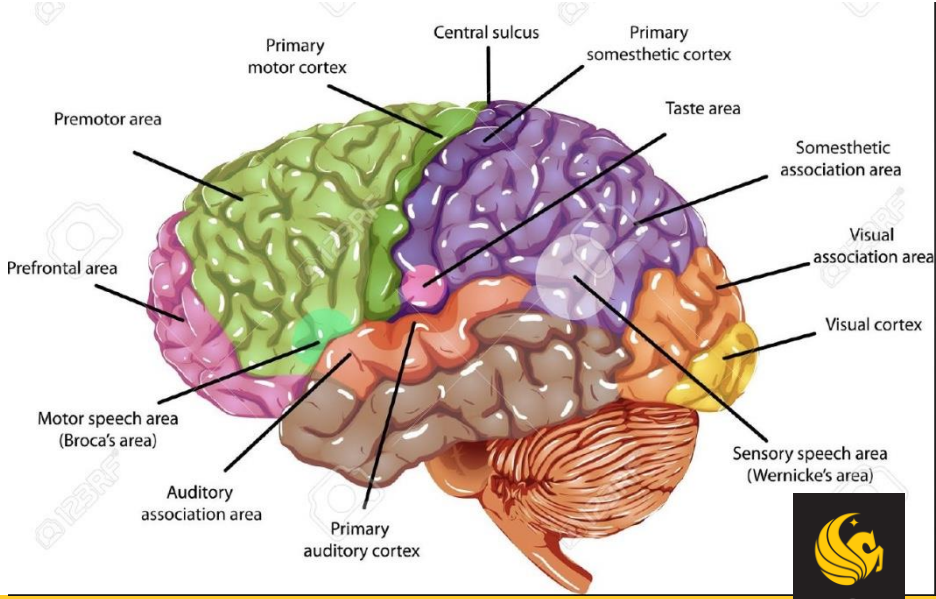
What are Executive Functions (EF)?

Cognitive control abilities that depend on the prefrontal cortex.

Brain functions used to manage attention, emotions, and pursuit of goals.

EF emerge during preschool and fully mature during early adulthood.

EF are more predictive of school success than IQ.



Critical Executive Functions

- Planning
- Task initiation
- Organization
- Working memory
- Inhibitory control
- Cognitive flexibility
- Emotional control (Diamond, 2013)

Universal Design for Learning

"**Universal Design for Learning (UDL)** means a scientifically valid framework for guiding educational practice that provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient."

Higher Education Opportunity Act of 2008

UDL Instructional Planning Process

Step 1: Establish Clear Outcomes

Step 2: Anticipate Learner Variability

http://udl-irn.org/

Step 3: Measurable Outcomes and Assessment Plan

Step 4: Instructional Experience

Step 5: Reflection and New Understandings

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iCAN

Interdisciplinary Coaching As a Nexus for Transforming how Institutions Support Undergraduates in STEM

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National Science Foundation
WHERE DISCOVERIES BEGIN

LANDMARK COLLEGE

UCF

Toni Jennings
Exception Education Institute

Operational Definitions

- **Executive Function** - A dynamic network of higher order cognitive abilities (e.g., planning, response inhibition, problem resolution, working memory, and mental flexibility) that support actions toward a targeted goal (Barkley, 2012; Goldstein, Naglieri, Princiotta, & Otero, 2014).
- **Universal Design for Learning** - a framework for providing multiple options of instruction and assessment that meets the needs of all students.
- **STEM Performance** – A student's GPA in an introductory STEM course.
- **STEM Persistence** - When students possess self-efficacy along with requisite content knowledge and social skills for continued participation in STEM courses and careers (Bandura, 1977).


CURRENT ENROLLMENT
68,571 STUDENTS
January 2019
UCF

- Private college located in rural Putney, Vermont.
- Exclusively serves undergraduate students with disabilities.
- Graduation rate is nearly double the national average.
- Student-to-faculty ratio 6:1.
- Tuition approximately $50,000 annually.

Current Enrollment

450 STUDENTS

LANDMARK COLLEGE

Study 1: Landmark College

Research Purpose: Determine the most effective supports at Landmark College.

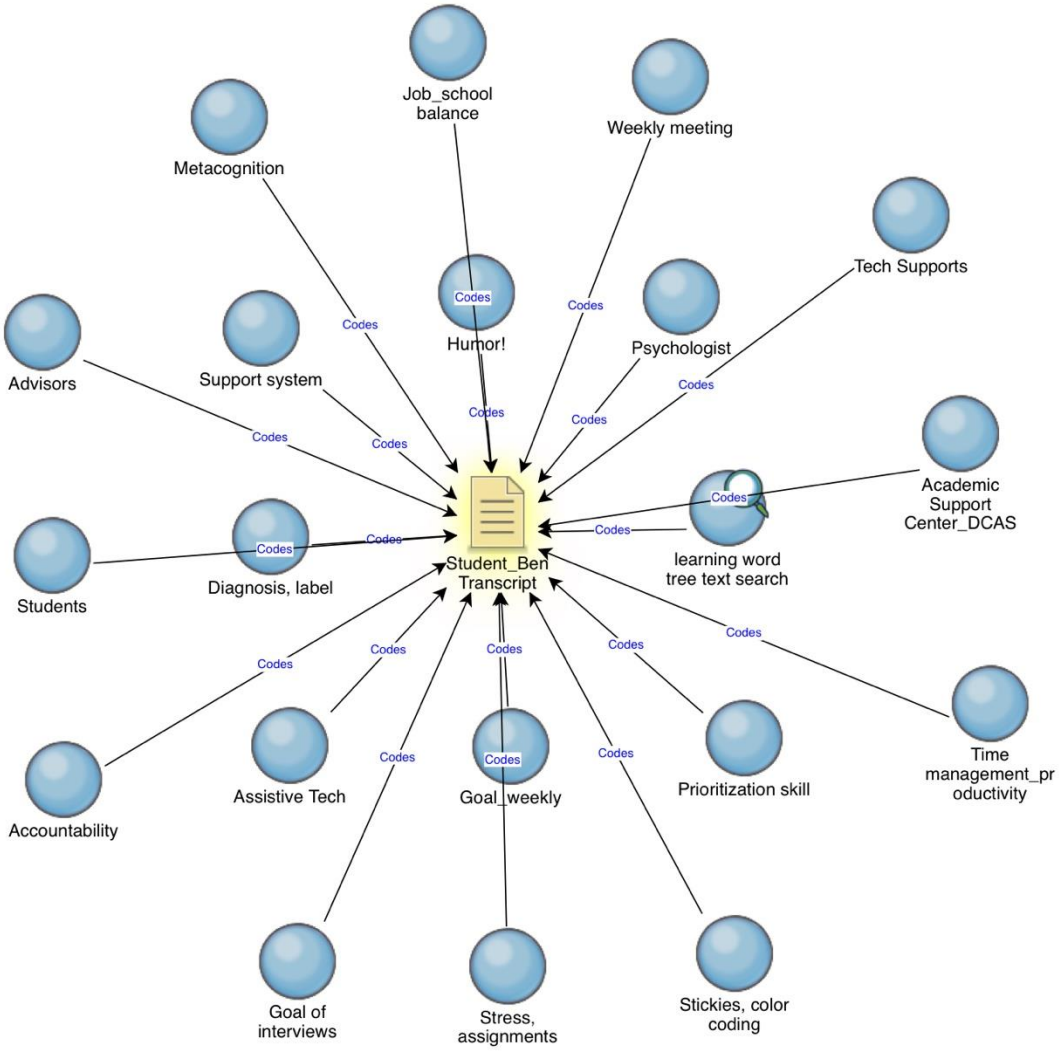
Procedure: Semi-structured interviews

- 20 undergraduate STEM majors with EF deficits
- 5 academic coaches
- 5 academic advisors

Analysis: Qualitative

Video recorded interviews, transcription, member checking, NVivo Version 11.2.1.

Example word tree of a Landmark College student's key nodes. Nodes are the most prevalent themes that emerged from interview data.

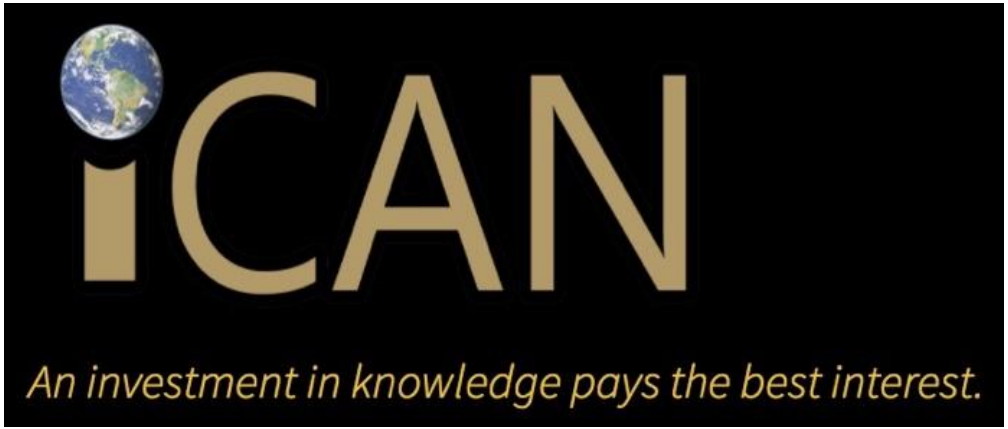


There was an undeniable element of apprenticeship and mentoring with… “side-by-side” work together… leading to realizations that, “Wow, this professor believes in me!”

Landmark College Study Results

- Develop personal relationship with academic advisors.
- Use technology to enhance task initiation, time management, & self-efficacy.
- Participate in weekly meetings to enhance accountability, goals prioritization, and self-advocacy.
- Use cognitive-behavioral therapy (CBT) to enhance self-growth, determination, grit, persistence, and resilience.

Performance & Persistence of Students with Disabilities at UCF



KNIGHTS ACCESS

Research Purpose: Determine the most effective model for scaling supports from Landmark College at UCF.

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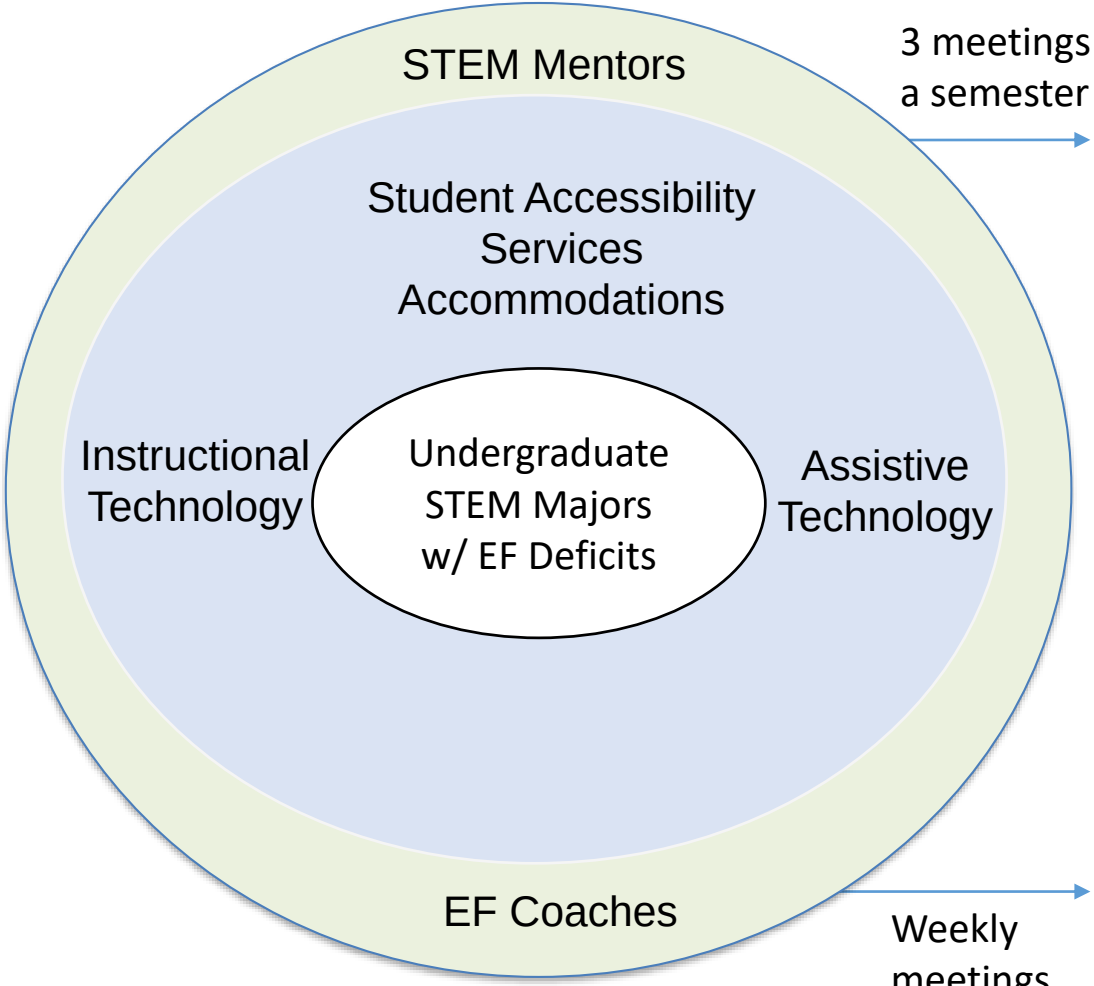
Research Questions

- (RQ1) Are there differences in performance, as measured by GPA, between students with UDL Executive Function mentoring and those without?
- (RQ2) Are there differences in STEM persistence, as measured by a change in major from STEM to non-STEM, between students receiving UDL Executive Function mentoring and those without?

Research Design & Sample

- A mixed-methods, matched pairs, experimental design was employed during the project.
- 274 undergraduate STEM majors completed the 9-question screen and expressed interest in participating in the study.
- 120 students were selected to participate based on interviews with project staff.
- Participants were assigned to treatment (n=60) or control (n=60) conditions based on Barkley Deficits in Executive Function Scale for Adults (BDEFS) scores.
- Project expectations were explained.
- IRB consent was obtained.



3 meetings a semester

STEM mentors connect students to the STEM community, provide social skill modeling, positive reinforcement, & content-specific skills

Target STEM Gateway Courses:

- Biology & Environmental Science
- Chemistry
- Engineering & Computer Science
- Mathematics & Statistics
- Physics

Graduate students in special education majors provide UDL executive function coaching as part of their secondary methods course requirements

Weekly meetings

Treatment Group by Academic Level

Year	Number	STEM Majors
Freshman	9	Physics, Computer Science, Engineering, Health Science, Criminology, Nursing
Sophomore	11	Computer Science, Engineering, Statistics, Nursing, Biology
Junior	29	Physics, Computer Science, Engineering, Health Science, Criminology, Statistics, Chemistry, Interdisciplinary Mathematics
Senior	11	Computer Science, Engineering, Animal Science, Biology, Actuarial Science
Total	60	

Treatment participants included 36 females and 24 male undergraduate STEM majors. The sample included 12 African Americans, 8 Hispanics, 1 Other, and 39 White students.

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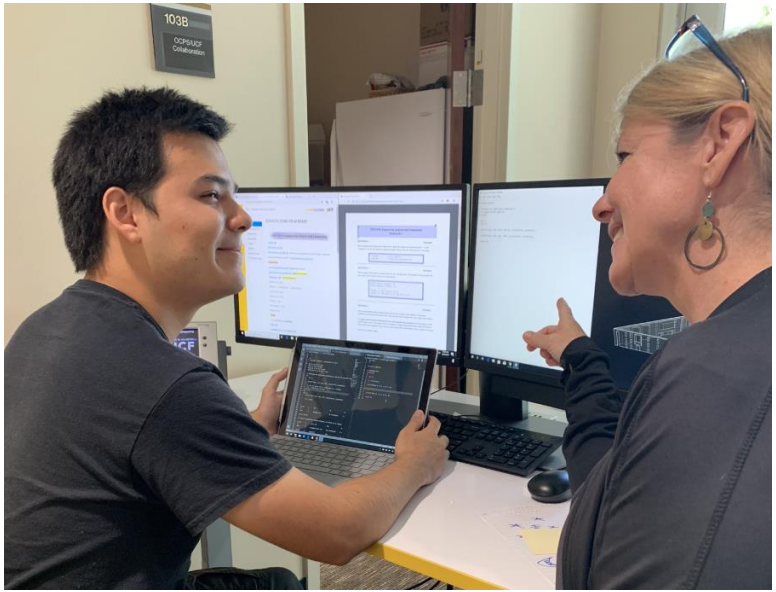
UDL Executive Function Coaching

- Flexible, proactive process
- One-to-one interaction
- Non-directive questioning
- Planning
- Effective time management
- Problem solving
- Growth mindset
- Self-control



Instruments

- Participants were administered an electronic version of the Barkley Deficits in Executive Function Scale for Adults (BDEFS) during the first 3 weeks of the semester.
- Reported reliability (Cronbach's alpha) ranged from .75 to .98 for factor scores and from .68 to .99 for summary scores.
- Matched pairs were created based on two overlapping deficit areas (e.g., shifting & inhibition).

Semi-structured Interviews

- 60 participants in treatment participated in semi-structured interviews with their graduate student coaches.
- Broad questions were designed to illuminate the institutional, situational, and individual barriers or scaffolds influencing the students' decisions about performance and persistence in a STEM major.
- Specific questions asked students to identify how they engaged in the STEM community and why they were choosing to persist or withdraw.
- Interviews served as data sources for graduate students' case studies.

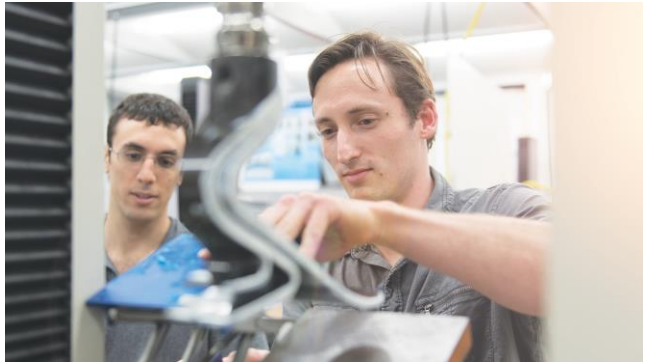
Case Studies

The following template was used to guide the construction of case studies for participants in the treatment condition.

- Information about the coach
- Information about the STEM major
- Career aspirations
- Courses
- Support systems
- EF assessment information
- Evidence-based practices (UDL)
- Coaching strategies implemented
- Communication log
- Reflection
- References

Post-intervention Survey

- A 16-item post-intervention survey was developed by the researchers to analyze critical aspects of the iCAN model.
- Content validity was established using a Delphi process with coaches, mentors, professors, experts in STEM fields, and participants (Fletcher & Marchildon, 2014).

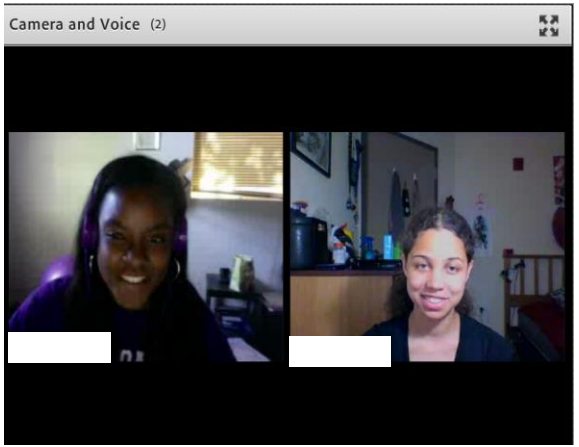


Procedure

- A protocol was developed, refined, & implemented to ensure treatment fidelity.
- Each mentor demonstrated mastery of UDL and EF concepts prior to participating in the project.
- Coaches met with students weekly over the course of one semester.
- Coaches shared the BDEFS results with their students.
- The pair worked together to collaboratively identify short and long-term goals for the semester.
- Coaches developed UDL lessons to teach the student a particular EF skill (e.g., task initiation via prompts from their cellular phones).
- The average number of meetings between coach and student was eight, with an average meeting time of 30 minutes.

Implementing the iCAN model @ UCF

- Participants were recruited from the student Accessibility Services office.
- Graduate student coaches were practicing special education teachers in the M.Ed. Program.
- Coaches provided personalized EF instruction using the UDL framework.
- Each graduate student coached 1 college student with an EF deficit in a STEM major.
- Coaching occurred using face-to-face, phone, or virtual modalities.
- Coaching implementation fidelity was assessed using a multi-rater review of 30% of video, audio, and narrative transcripts from the coaching sessions.



Treatment Group Demographics

Semester	Undergraduate STEM Majors	Graduate Students in Exceptional Ed.	STEM Peer Mentors	Attrition
Spring 2016	7	9	6	2
Fall 2016	20	24	6	4
Spring 2017	16	19	6	3
Fall 2017	10	12	6	2
Spring 2018	7	9	6	2
Total	**60**	**73**	**30**	**13 (21%)**

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Results for RQ1: STEM Performance

- An independent-samples t-test was conducted with GPA as the dependent measure and condition (i.e., treatment vs control) as the independent variable.
- There was a significant difference in scores with students in the treatment condition (M=3.23, SD=0.41) outperforming the control (M=2.75, SD=1.18) condition; t(118)= -2.94, p = .004.

Results for RQ2: STEM Persistence

- An independent-samples t-test was conducted with change in major as the dependent measure and condition (i.e., treatment vs control) as the independent variable.
- There was a statistically significant difference in the number of students with disabilities who changed majors with students in the treatment condition (M=1.0, SD = 0.00) outperforming those in the control (M=1.13, SD= 0.34); t(118) = 3.01, p = .003.
- Despite several of the students in the treatment condition reporting they might change majors, none of them did.

Most Effective UDL EF Practices

- Positive self-talk and mindset
- Flexible short and long-term goal setting
- Effective communication during study groups and sessions
- Assistive Technologies
- Visual scheduling (e.g., Gantt chart, JIRA, Basecamp)
- Digital reminders for task initiation & transitions
- Timer for achieving tasks / deadlines
- Writing support center

Most Effective Coaching Strategies for EF

- Build trusting relationships
- Active listening
- Mindfulness
- Socratic questioning
- Cognitive reframing
- Direct and indirect questioning
- Accountability
- Positive reinforcement
- Growth mindset
- Patience / wait time
- Humor
- Prompting

Study 3: STEM Performance and Persistence

Research Purpose: Determine implications of the STEM support network at UCF across traditionally marginalized populations.

Research Questions:

RQ1: Are there differences in performance in STEM, as measured by GPA, across gender, race, or disability status.

RQ2: Are there differences in STEM persistence, as measured by a change from a STEM major to non-STEM major, across gender, race, or disability status.

Research Design

- The team adapted a six-step model to guide the research design, (a) create a conceptual model, (b) determine the algorithm method analysis, (c) determine resampling method, (d) verify path coefficient, (e) evaluate model, and (f) report the results (Latan & Ghozali, 2012).
- Partial least squares structural equation modeling (PLS-SEM) served as the primary mechanism to analyze the data.

STEM Courses

- The inclusion criteria were students who were enrolled in at least one of 12 introductory STEM courses.
- The STEM courses were in the areas of (a) biology (2 courses), (b) environmental sciences (1 course), (c) chemistry (2 courses), (d) engineering (1 course), (e) computer science (1 course), (f) mathematics (1 course), (g) statistics (1 course), and (h) physics (3 courses).

Study Sample

Year	Frequency	Percent (%)	Cumulative %
2012 - 2013	13,844	17.6	17.6
2013 - 2014	14,083	17.9	35.5
2014 - 2015	15,753	20	55.5
2015 - 2016	17,164	21.8	77.3
2016 - 2017	17,875	22.7	100
Total N	78,719	100	

Note: The gender of the sample was nearly equally split with 52.1% (n = 40,988) females and 47.9% (n = 37,731) males.

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Demographics

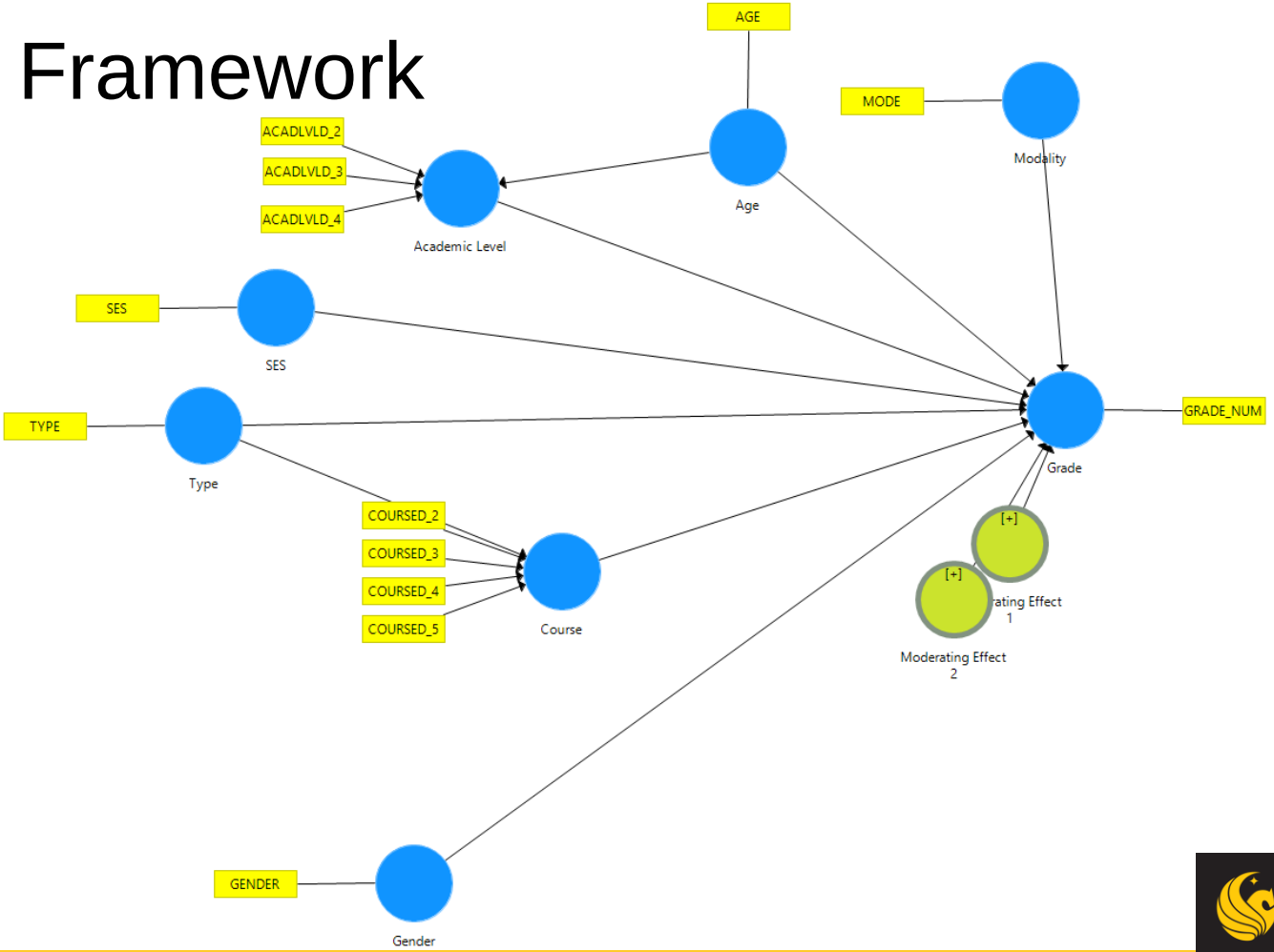
- Among all students, STEM majors (48.0%, n = 35,021) and non-STEM majors (52.0%, n = 37,987) were nearly equal.
- Less than four percent (3.7%, n = 2,728) of the students were receiving SAS services.
- A crosstab analysis revealed that a near-equal number of STEM majors (1,383) and non-STEM majors (n = 1,345) received SAS while enrolled in the STEM courses.

Demographics by Race for STEM Majors

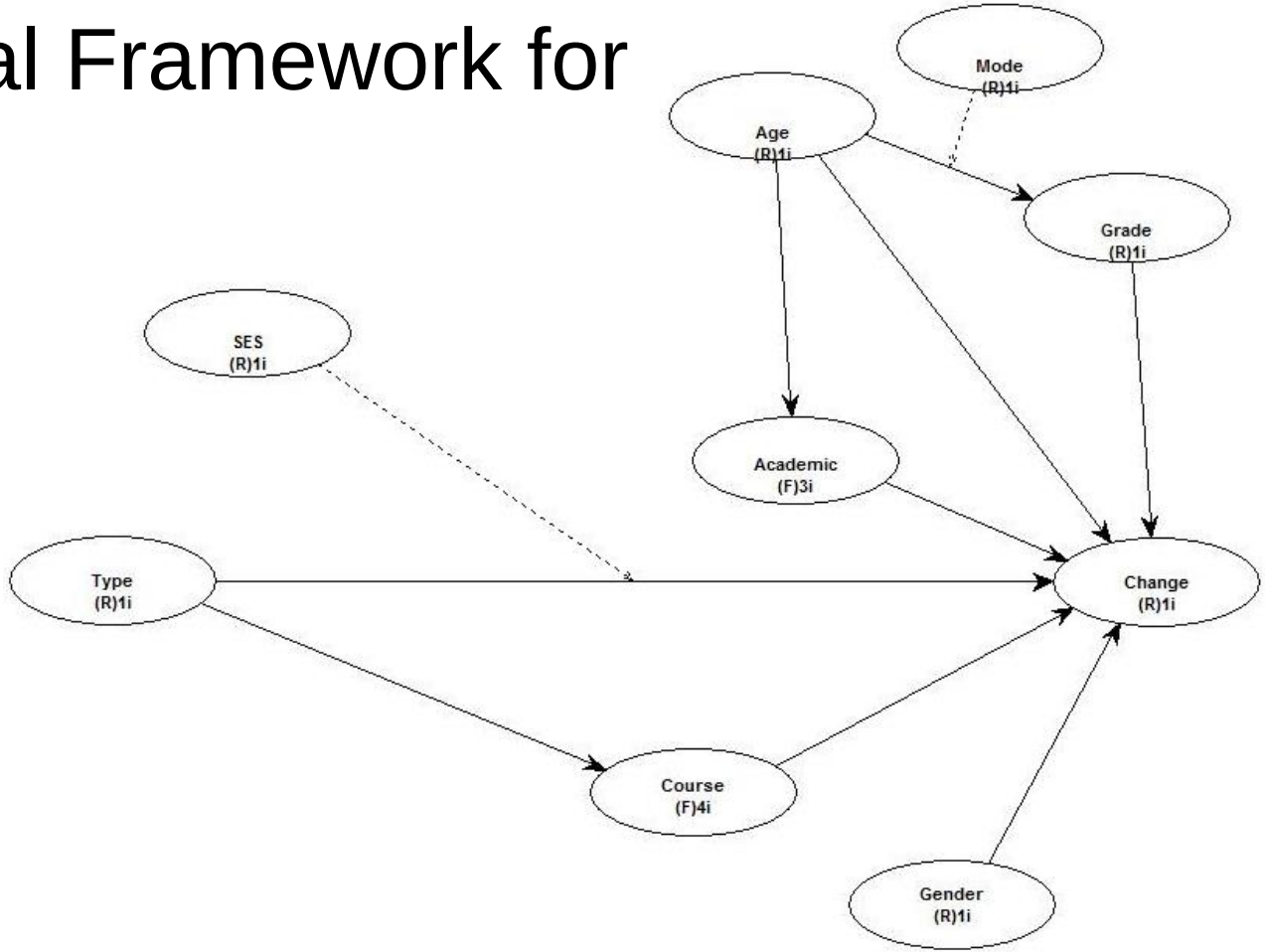
Race	SAS services	No SAS services	Total n
Asian	103	6077	6180
Black/ African American	271	9303	9574
Hispanic / Latino	682	18,335	19,017
White	1705	37,527	39,232

Note: Power analysis indicated 172 as the minimum sample sample size for multiple regression analysis in RQ2. Participants from the “SAS services” column were compared to an equal number of randomly selected students from the “no SAS services” column.

Conceptual Framework for RQ1



Conceptual Framework for RQ2



Results RQ1: STEM Performance

- No statistically significant differences in performance, as measured by GPA, across race, gender, or disability.

Results RQ2: STEM Persistence

Asian

- Low-income, transfer students were more likely to change from a STEM major to a non-STEM major.
- The lower the students' academic level and age, the more likely they were to change.

Black / African American

- Students enrolled in lower level Physics courses were more likely to change.
- The lower the students' academic level and age, the more likely they were to change.
- Transfer students identifying as low income were more likely to change.

Results RQ2: STEM Persistence

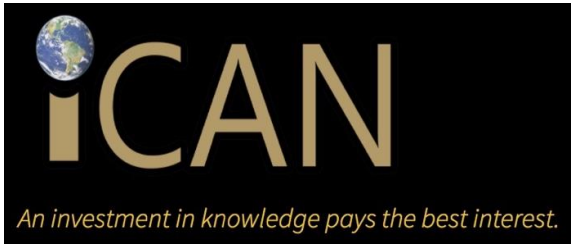
Hispanic / Latino

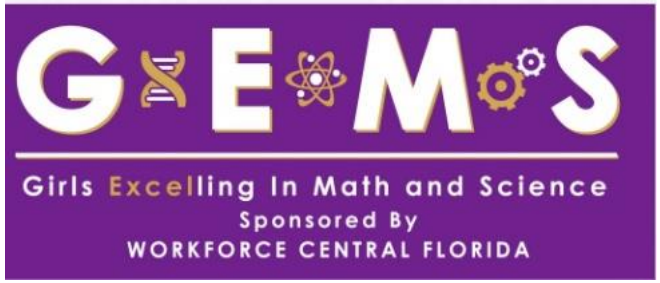
- Freshman students who received SAS were more likely to change majors.
- Students with grades of C or below were more likely to change.
- Students in biology courses were more likely to change.
- Young freshman and young juniors who did not receive SAS were more likely to change.

White

- SAS FTIC students and non-SAS transfer students were more likely to change.

Discussion & Implications





UNIVERSITY OF CENTRAL FLORIDA
PRIME STEM PROJECT

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THANK YOU!

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