NISTS 2023
BE A CONNECTOR FOR TRANSFER STUDENT SUCCESS
Virtual • February 1-3 | Portland, OR • February 22-24

NISTS Award Winner *Research Spotlight*

2878 - Persistence of Engineering Transfer Students: Identifying Student-Influenced and Institution-Influenced Academic Success Factors

Matriculation Trends and Issues, Credits and Degree Pathways

This correlational study utilized secondary, longitudinal data to examine the extent to which student-influenced and institution-influenced factors predict the academic success and degree completion of engineering transfer students at public four-year institutions in North Carolina. Results indicated that first-term academic performance is impacted by student background, college/department of engineering characteristics, and attempted and earned hours in the first semester. Further, persistence was affected by age, the amount of transfer credit, college/department of engineering characteristics, and cumulative GPA and total earned hours at the receiving institution by the student. This study provides practical and actionable findings that will aid four-year engineering institutions in increasing the academic success and persistence of vertical transfer students pursuing baccalaureate engineering degrees.

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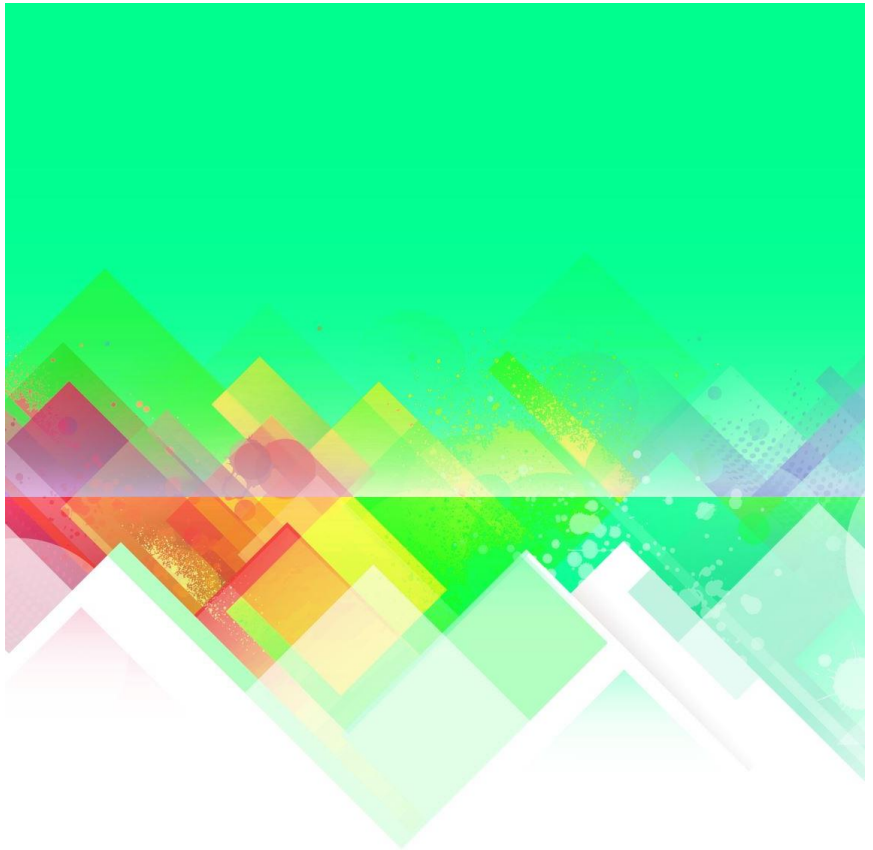
PERSISTENCE OF ENGINEERING TRANSFER STUDENTS: IDENTIFYING STUDENT AND INSTITUTION INFLUENCED ACADEMIC SUCCESS FACTORS



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NISTS 2023 Conference

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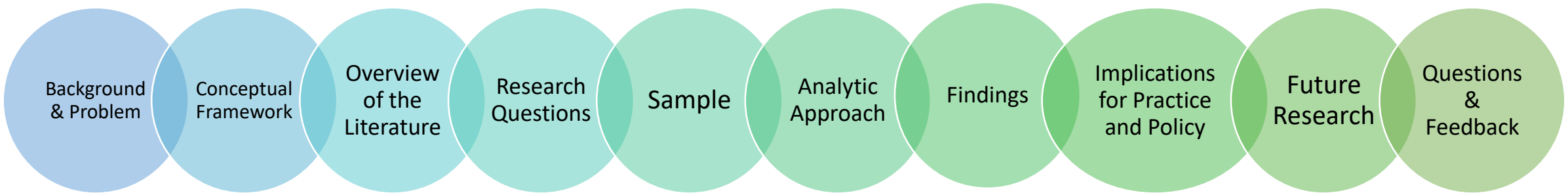
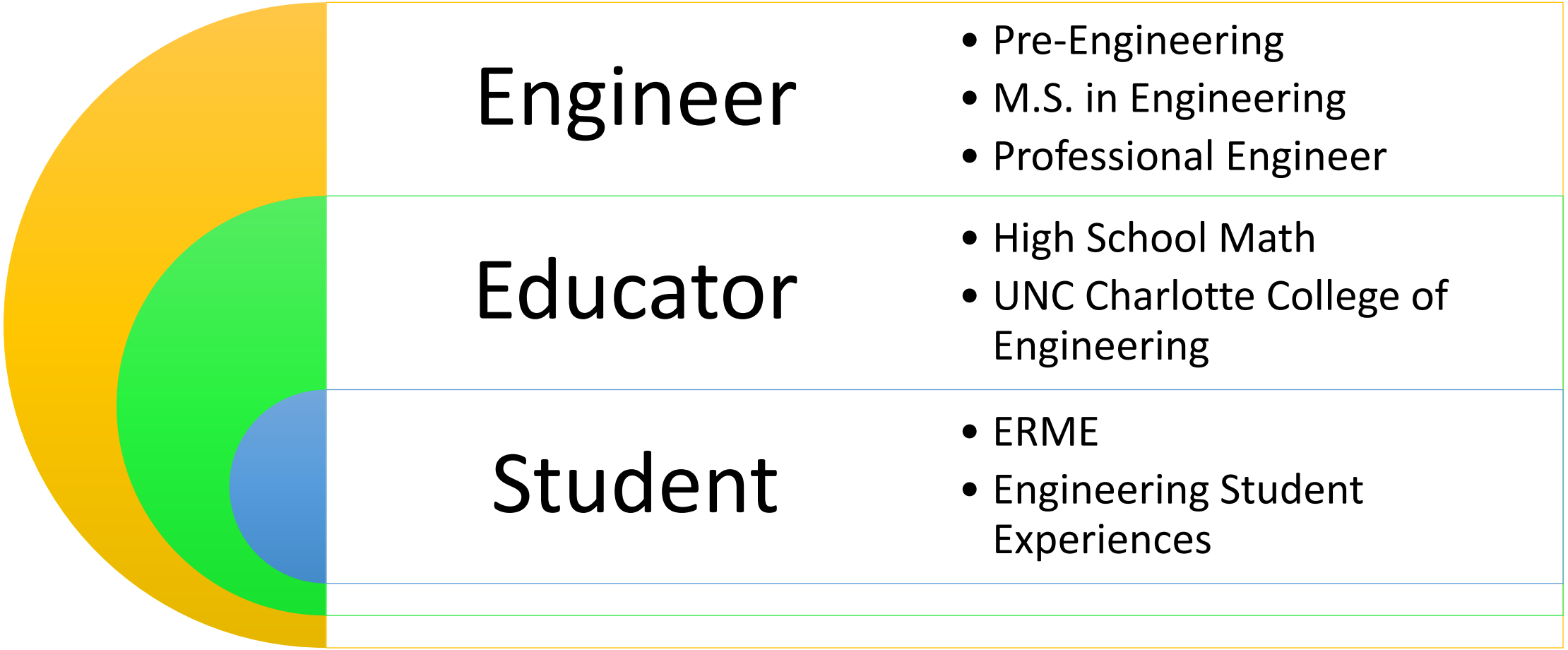
Presentation Roadmap



Researcher Background



Background: Engineering Pathways

Engineering Workforce

- Projected to continue to grow for many years to come (Torpey, 2018)
- National initiatives have been created to strengthen, grow, and diversify (PCAST, 2020)
- Government and industry sectors expressed need for investing in and developing programs that broaden participating in engineering (NSF, 2016)

Why Transfer Pathway?

- Number of high school students project to decrease for 12 years (WICHE, 2020).
- Student mobility has grown more prominent in the last 20 years (Lee et al., 2016)
- Students who migrate from two-year to four-year institutions have become a significant subpopulation
- Community college students are heterogeneous student population

Statement of the Problem(s)

Vertical Transfer Students

- **Only 15%** of two-year to four-year (vertical) students will transfer successfully (National Student Clearinghouse Research Center, 2021)
- After transfer, **48% will earn a baccalaureate degree within 6 years** (compared to 63% of first-time, first-year (FYFT) students)

Engineering Transfer Students

- NCES and ASEE do not collect or report national-level graduation rates for engineering transfer students

Engineering Education

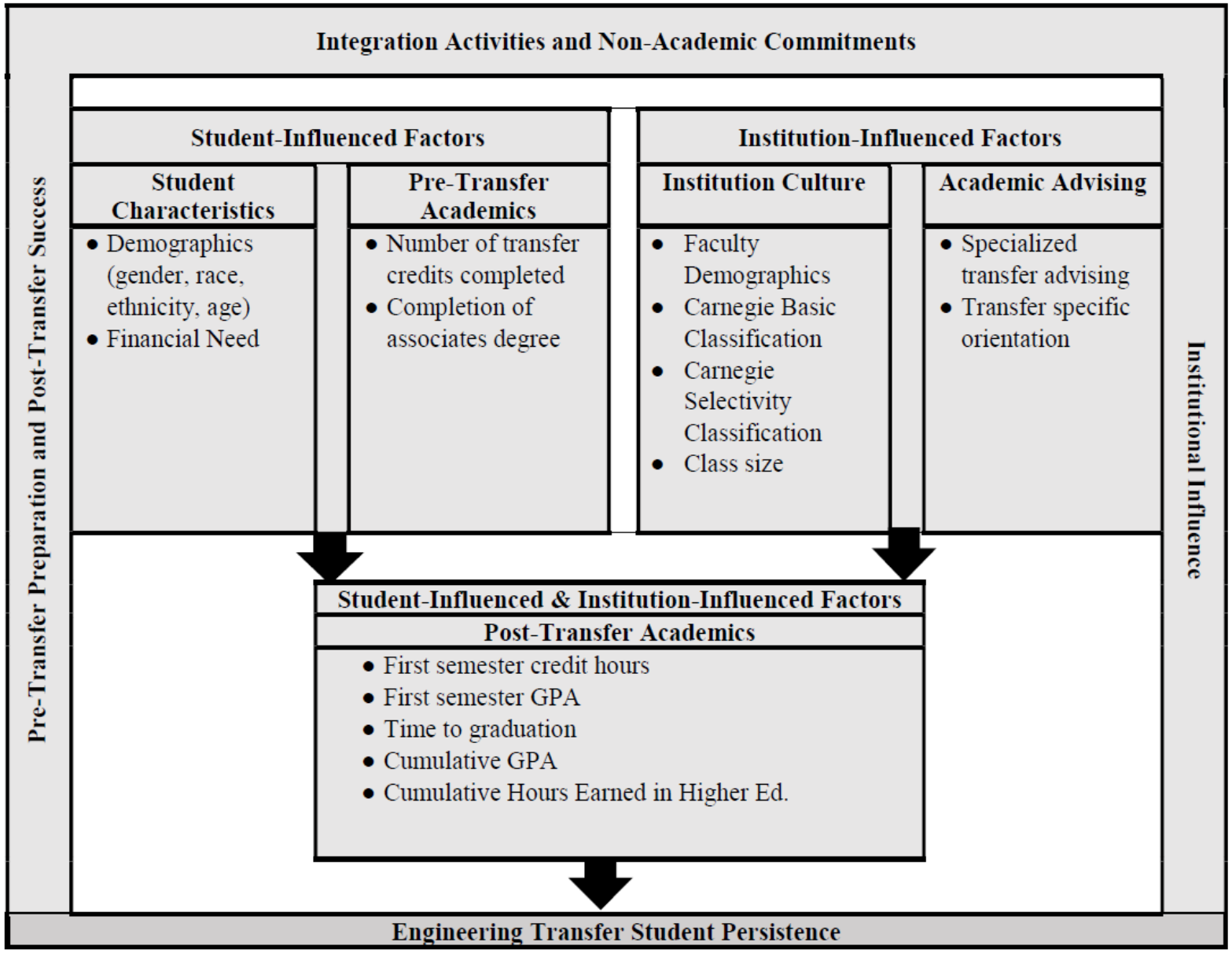
- NAE and NRC hosted a summit in 2011 to discuss the vertical transfer pathway to engineering
- Higher education leaders agreed that there was **a need for a comprehensive and coordinated plan to enhance vertical pathway**
- Since then, the body of literature on engineering transfer student persistence remains sparse (Smith and Van Aken, 2020)

Why North Carolina?

- The UNC System includes **5 universities** that offer baccalaureate engineering degrees
- UNC System and NC Community College System have partnered to create a statewide Comprehensive Articulation Agreement that establishes transfer credits
- **80%** of NC community college transfer students migrate to public or private universities in NC (D'Amico & Chapman, 2018)
- **Steady growth** in number of **vertical transfers** to NC universities
- **Differences in retention and graduation rates** between NC vertical transfers and UNC System FTFY students (D'Amico & Chapman,2018)

Conceptual Framework: Engineering Transfer Student Persistence

Modified from Smith & Van Aken's 2020 Literature-Based Conceptual Model



Themes from Literature Review

Vertical transfer pathway offers an opportunity to increase participation and diversity in the engineering workforce.

Only 25% of the literature reviewed utilized a theoretical framework

Advanced statistical methodologies have been underutilized

Pre-transfer preparation affects persistence (Lakin et al., 2016; Lopez & Jones, 2017)

Institutions must create a supportive culture that provides transfer-specific student support (Townley et al., 2013; Allen & Zhang, 2016)

The interaction between student and institution factors that impact persistence has been explored by very few studies

Research Questions

How do student and institutional factors predict the academic success of engineering transfer students in their first term at the receiving institution?

How do institution-influenced factors moderate the relationship between pre-transfer academic factors and the academic success of engineering transfer students during their first term at the receiving institution?

How do student and institutional factors predict baccalaureate engineering degree attainment of transfer students?

How do institution-influenced factors moderate the relationship between post-transfer academic factors and baccalaureate engineering degree attainment?

Methods

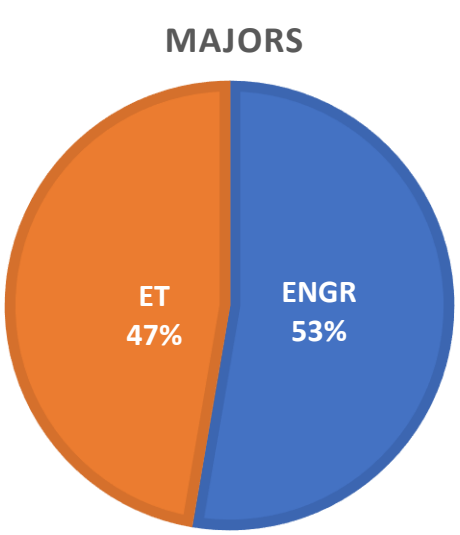
- Longitudinal data of **4,163 engineering transfer students** from 2009 to 2016
- Nonexperimental, correlational design using secondary institutional data
- Student data from Belk Center for Community College Leadership and Research at NC State University
- College/Dept of Engineering data from IR Offices at each institution & Carnegie Classification

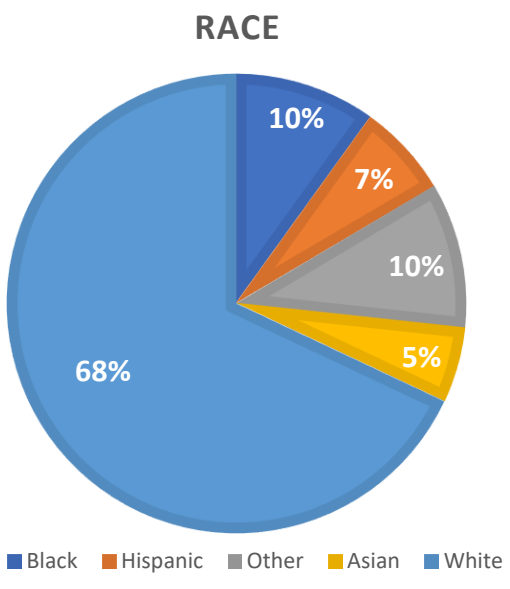
Summary Table of Receiving Institutions

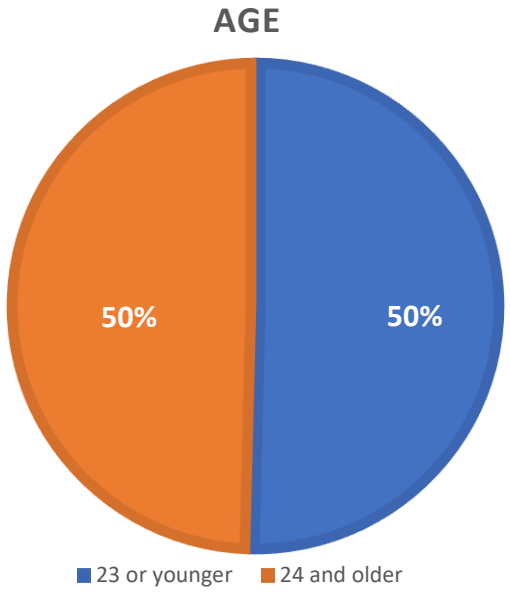
Institution	Basic* Classification	Selectivity* Classification	Average % Female Faculty in COE	Average % URM Faculty in COE	Average COE class size
NC A&T (n=252)	Doct. Uni.: High Research	Inclusive	12.6%	45.3%	21.0
ECU (n=1,355)	Doct. Uni.: High Research	Selective	30.3%	1.1%	23.2
NC State (n=835)	Doct. Uni.: Very High Research	More Selective	16.0%	5.6%	17.3
Charlotte (n=1,465)	Doct. Uni.: High Research	Selective	16.1%	6.5%	31.7
WCU (n=256)	Master's Colleges & Universities	Selective	4.5%	3.3%	25.0

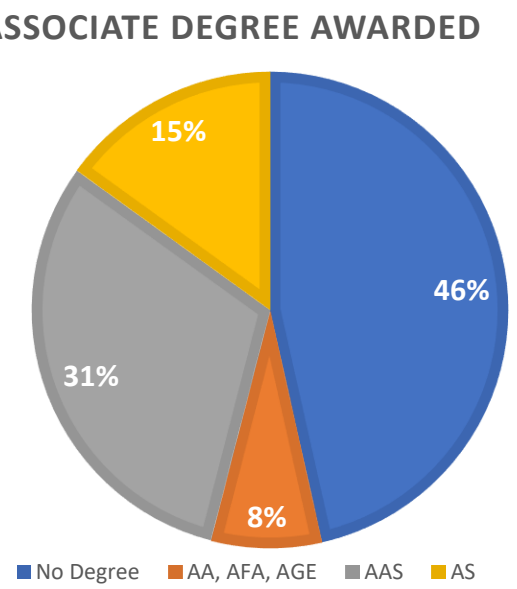
* Carnegie Classification in Table are based on 2018

Transfer Student Demographics









Analytic Approach

Research Questions	Predictor Block(s)	Outcome	Analyses
RQ1: How do student and institutional factors predict the academic success of engineering transfer students in their first term at the receiving institution?	• Student • Institution • Post-Transfer Academics (First-Term)	1st term GPA	Multiple Regression, Descriptive Statistics
RQ2: How do institution-influenced factors moderate the relationship between pre-transfer academic factors and the academic success of engineering transfer students during their first term at the receiving institution?	• Student • Institution • Post-Transfer Academics (First-Term) • Interaction of Institution-Influenced and Applied Transfer Hours	1st term GPA	Multiple Regression, Descriptive Statistics
RQ3: How do student and institutional factors predict baccalaureate engineering degree attainment of transfer students?	• Student • Institution • Post-Transfer Academics (All Terms)	Baccalaureate ENGR/ET degree attainment	Logistic Regression, Descriptive Statistics
RQ4: How do institution-influenced factors moderate the relationship between post-transfer academic factors and baccalaureate engineering degree attainment?	• Student • Institution • Post-Transfer Academics (All-Terms) • Interaction of Institution-Influenced and Cum. GPA	Baccalaureate ENGR/ET degree attainment	Logistic Regression, Descriptive Statistics

Outcome Variables

- Academic success was measured by ***First-Term GPA*** variable; continuous; ranged from 0.00-4.33; *M*= 2.71, *SD*=1.08
- Persistence was measured by ***Degree Completion*** variable; dichotomous; **49%** students **earned an ENGR or ET baccalaureate degree**
- Students who started as engineering majors but changed majors were tracked descriptively only; **4%** (or 147) students changed their major and earned a non-ENGR or ET baccalaureate degree.

Key Descriptive Findings

Carnegie Basic Classification	First-Term GPA	Cum. GPA of Persisters
Master's University	3.07	3.32
Doctoral Uni.	2.79	3.16
Doctoral Uni.- High Research	2.66	3.17
Doctoral Uni.- Very High Research	2.55	3.17

ENGR/ET Persistors:

Average Transfer Hours	Average Cum. Hours in Higher Ed.
60	**150**

> 6.5 semesters at receiving institution

RQ 1: How do student and institutional factors predict first term GPA?

Block 1: Student-Influenced

Demographic	*B(SE)*
Female	.01(0.05)
Black or AA* **	**-.27(0.05)**
Hispanic or Latino*	**-.13(0.06)**
Other	-.06(0.05)
Asian	-.12(0.06)
Age (>24)* **	**.13(0.03)**
Pell (eligible)	-.04(0.03)
Pre-Transfer Academics	
Appl. Transfer Hrs.* **	**.003(0.00)**
AA, AFA, AGE	-.11(0.06)
AAS	-.03(0.04)
AS	.03(0.04)

Block 2: Institution-Influenced

ENGR/ET Environment	*B(SE)*
% of Female Faculty* **	**.01(0.00)**
% of URM Faculty	.00(0.00)
Average Class Size	-.00(0.00)

Block 3: Influenced by Student and Institution

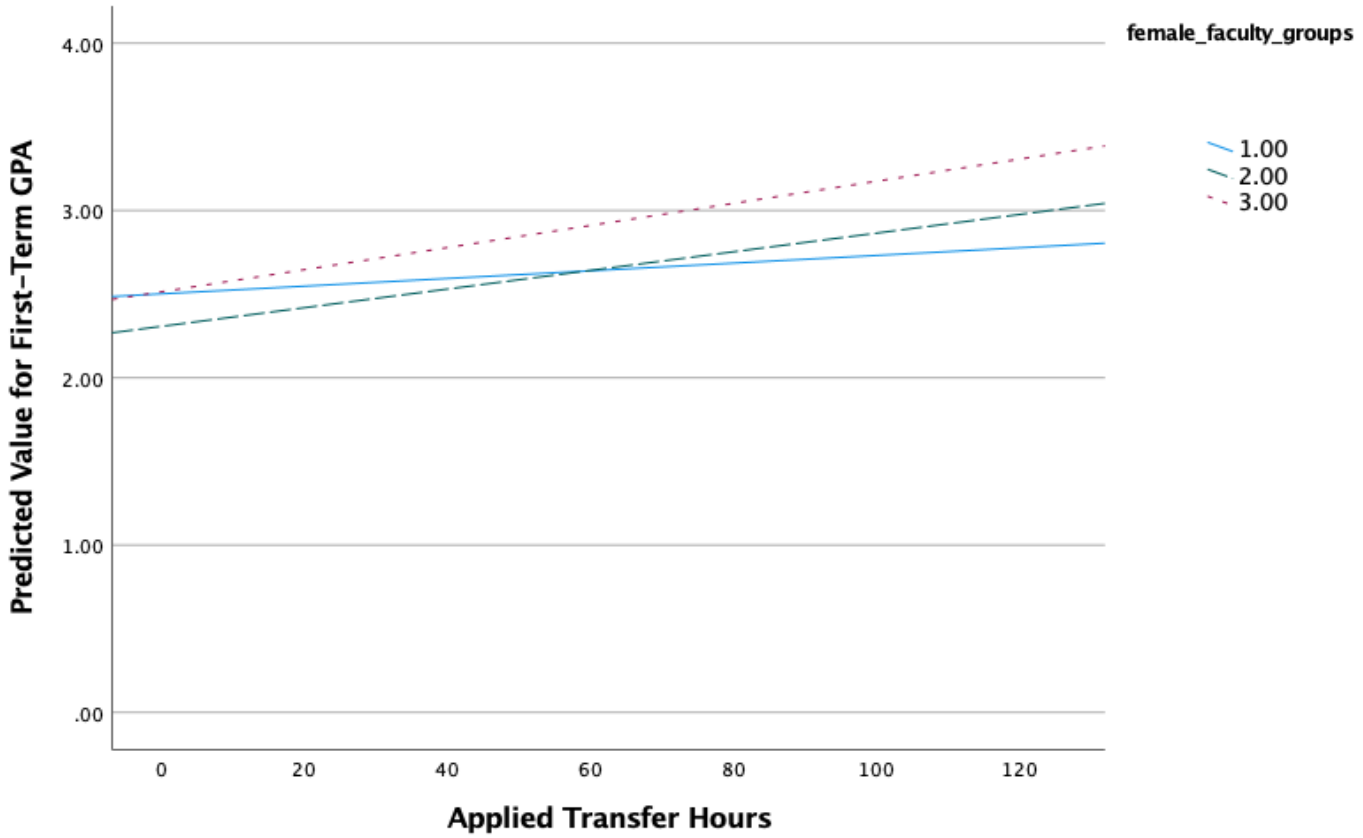
1st Term Academics	*B(SE)*
Attempted Hrs.* **	**-.22(0.01)**
Earned Hrs.* **	**.24(0.01)**

Note: Reference Variables for Race/Ethnicity was White and for Associate Degree was No Associate Degree,
**p*<.05, ***p*<.01, ****p*<.001

RQ 2: How do institution-influenced factors moderate the relationship between applied transfer hours and first term GPA?

Block 4: Interaction	
	B(SE)
Female Fac. X Appl. Trans. Hrs.*	**0.0003(0.00)**
URM Fac. X Appl. Trans. Hrs.*	**0.0002(0.00)**
Ave. Class Size. X Appl. Trans. Hrs.	-0.0001(0.00)

*Note: *p<.05, **p<.01, ***p<.001*



RQ 3: How do student and institutional factors predict baccalaureate engineering degree attainment?

Block 1: Student-Influenced

Demographic	*B(SE)*	*Odds Ratio*
Female	-.19(0.16)	0.83
Black or AA	-.12(0.18)	0.89
Hispanic or Latino	.00(0.21)	1.00
Other	-.22(0.17)	0.81
Asian	.16(0.25)	1.17
Age (>24)**	**-.34(0.12)**	**0.71**
Pell (eligible)	-.00(0.11)	1.00
Pre-Transfer Academics		
Appl. Transfer Hrs.***	**.02(0.00)**	**1.02**
AA, AFA, AGE**	**.70(0.23)**	**2.02**
AAS***	**.89(0.13)**	**2.44**
AS***	**.67(0.16)**	**1.95**

Block 2: Institution-Influenced

ENGR/ET Environment	*B(SE)*	*Odds Ratio*
% of Female Faculty***	**-.03(0.01)**	**0.97**
% of URM Faculty***	**-.01(0.01)**	**0.99**
Average Class Size***	**-.03(0.01)**	**0.98**

Block 3: Influenced by Student and Institution

1st Term Academics	*B(SE)*	*Odds Ratio*
First-Term GPA	.08(0.07)	1.08
Earned Hrs.	.03(0.02)	1.03
All Term Academics		
Total Semesters	.05(0.03)	1.05
Cum. GPA***	**1.31(0.12)**	**3.69**
Total Earn. Hrs.***	**.07(0.00)**	**1.07**

Note: Reference Variables for Race/Ethnicity was White and for Associate Degree was No Associate Degree,
**p<.05, **p<.01, ***p<.001*

RQ 4: How do institution-influenced factors moderate the relationship between cumulative GPA and degree attainment?

Block 4: Interaction		
	B(SE)	*Odds Ratio*
Female Fac. X Cum. GPA*	**-0.06(0.01)**	**0.94**
URM Fac. X Cum. GPA*	**-0.02(0.01)**	**0.98**
Ave. Class Size. X Cum. GPA*	**-0.04(0.02)**	**0.96**

*Note: *p*<.05, **p*<.01, ***p*<.001

Given that the odds ratios were close to 1.00 and the large sample size, it was determined that probing the interaction terms was not necessary.

Limitations

- Variables and variable definitions in UNC System Transfer Student dataset
- Engineering and engineering technology majors treated the same
- Student integration, goals, and commitments of transfer students not accounted for in this study
- Limited entry date to fall 2016

Implications for Policy and Practice

- Personnel working with transfer students of color should consider using a multifaceted approach that includes an anti-deficit mindset and targeted student support services
  - Inform transfer students of possible changes in academic culture through transfer-specific orientation and transfer-specialized advising
  - Require transfer students to participate in mentoring programs established at the beginning of the semester
- Explore ways to ease some barriers that non-traditional age transfer students face in their pursuit of advanced engineering degrees
- Findings from this study are promising for North Carolina community college students who pursue advanced engineering degrees in the UNC System

Implications and Recommendations for Research

- Explore other college/department of engineering characteristics such as differences between engineering disciplines, student involvement in student organizations, co-ops, internships, undergraduate research opportunities, and advising practices
- Application of Smith and Van Aken (2020) conceptual model in future studies
- Engineering Pathways program and the Associate of Engineering degree
- Lateral versus vertical transfer pathways (Smith et al., 2021)

Questions

Open Discussion

In small groups:

- In your opinion, what other **institutional** characteristics could impact academic performance and persistence?
- What about **student** characteristics?
- How can institutions better serve **non-traditional age** transfer students?

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Regression Analyses

RQ 1 and 2: Multiple Linear Regression (Fox, 2008)

- $y = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + \cdots + \beta_k(X_k) + \varepsilon$
- $HC4 = (X'X)^{-1}X'\text{diag}\left[\frac{{e_i}^2}{(1-h_{ii})^{\delta i}}\right]X(X'X)^{-1}$, where $\delta_i = \min\left\{4, \frac{nh_{ii}}{p+1}\right\}$ (Cribari–Neto, 2004)
- For interaction terms: $y = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + \beta_{12}(X_1X_2)$

RQ 3 and 4: Logistic Regression (Fox, 2008)

- $\text{Logit}\,(Y) = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + \cdots + \beta_k(X_k)$
- For interaction terms: $\text{Logit}(Y) = \beta_0 + \beta_1(X_1) + \beta_2(X_2) + \beta_{12}(X_1X_2)$