Dr. Marjorie Darrah, Dr. Roxann Humbert, Leah McJilton

INCLUDES QUALITATIVE RESEARCH PLAN

WEST VIRGINIA UNIVERSITY
Department of Physics & Astronomy

RURAL

Q1.1: Can we better classify the locale where student participants lived in during their middle and high school years by identifying resources available in the area or cultural factors?

Q1.2: What resources do students have access to that would have affected their decision to attend college or pursue STEM? (e.g. museums, mass transit, cultural events, etc.)

RURAL DATA COLLECTION

- Considered many federal definitions of locales
- Creating a Spreadsheet based on research on locals

  - Counties
  - County Populations
  - RUCC 2013 Codes
  - Urban Centric Locale Codes
  - Locale Description
  - Cities/Towns
  - Libraries
  - Transit Systems
  - Post Secondary Schools
  - Museums
  - Cultural Activities
  - STEM Activities
  - High Schools

FIRST GENERATION

Q2.1: How does "Degree of FG" impact the effectiveness of interventions to increase persistence?

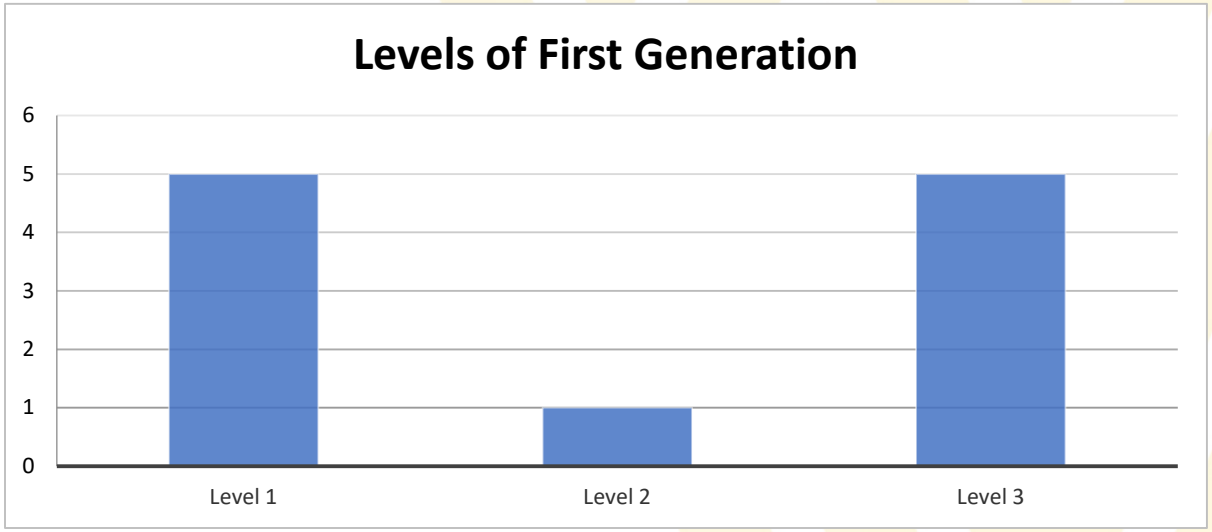
Defining "Degree of FG"

Based on Pilot Student data we have identified the following levels:

- **Level 1:** Parents or guardians attended some college.
- **Level 2:** Siblings attended or completed college; parents did not attend.
- **Level 3:** Extended family (grandparents, aunts/uncles, cousins) attended or completed college; parents or siblings did not.
- **Level 4:** No one in immediate or extended family attended college

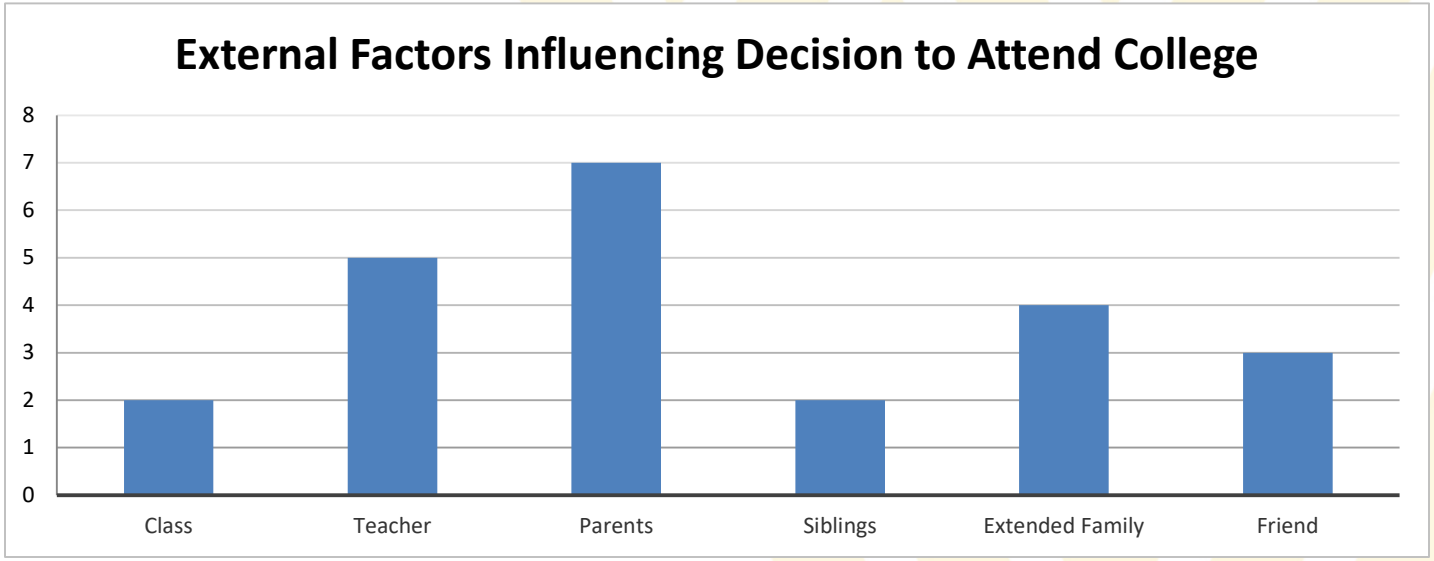
FIRST GENERATION

- **Pilot Group Interviewees**



FIRST GENERATION

Q2.2: What influences facilitate a FG student's decision to go to college?



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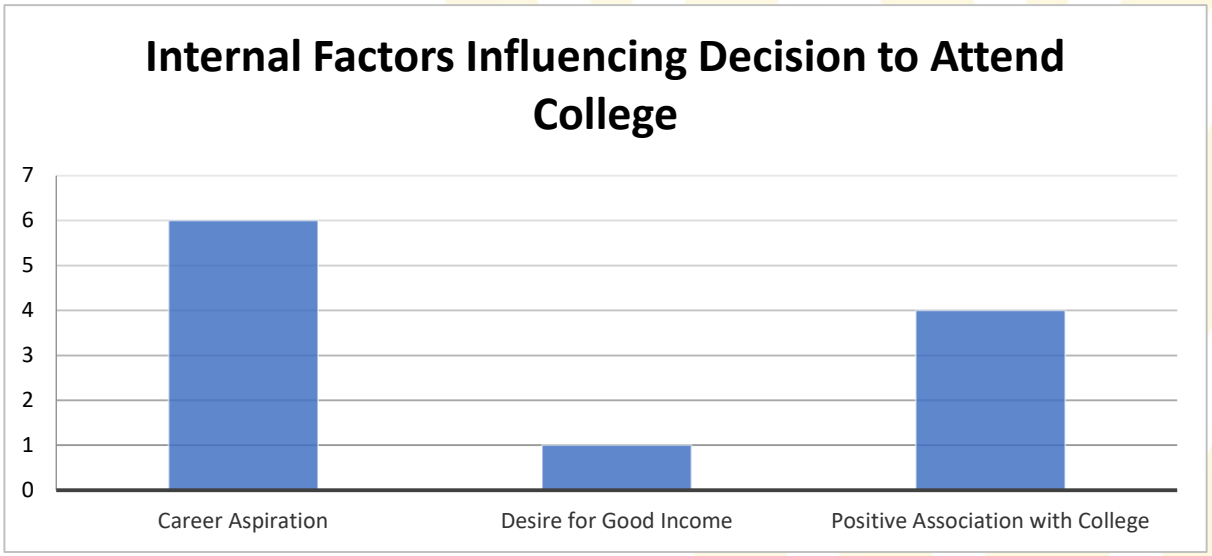
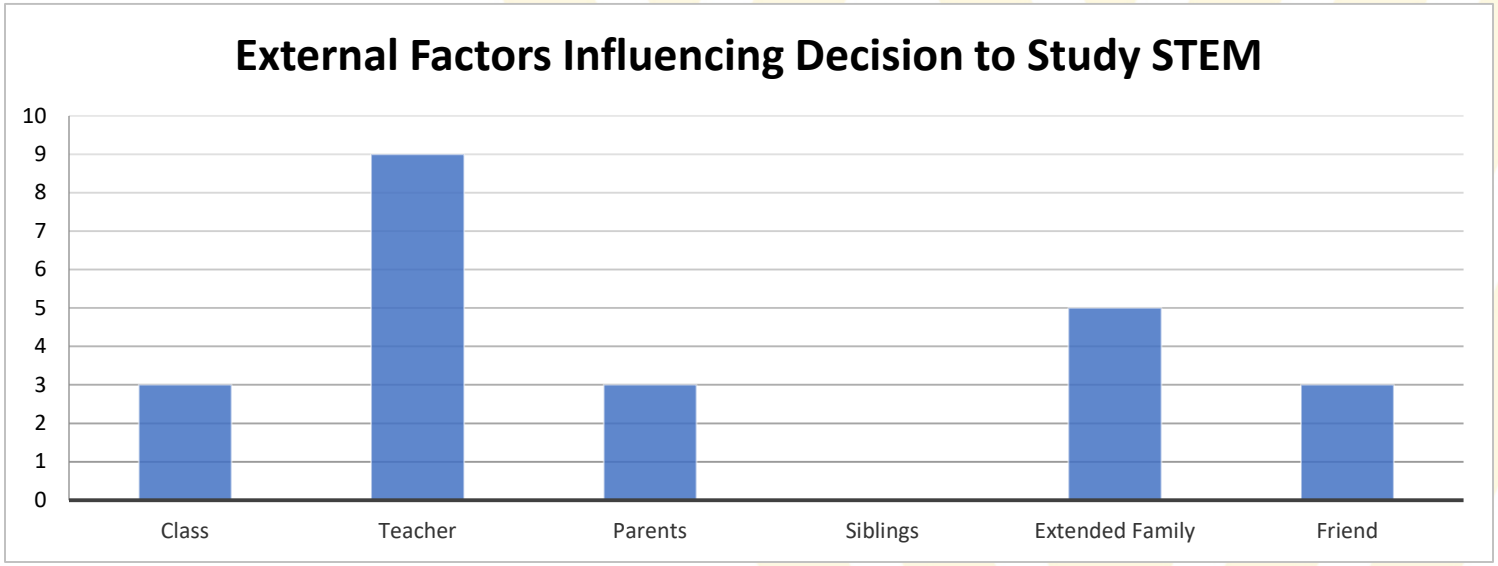


FIRST GENERATION

Q2.2: What influences facilitate a FG student's decision to Study STEM?



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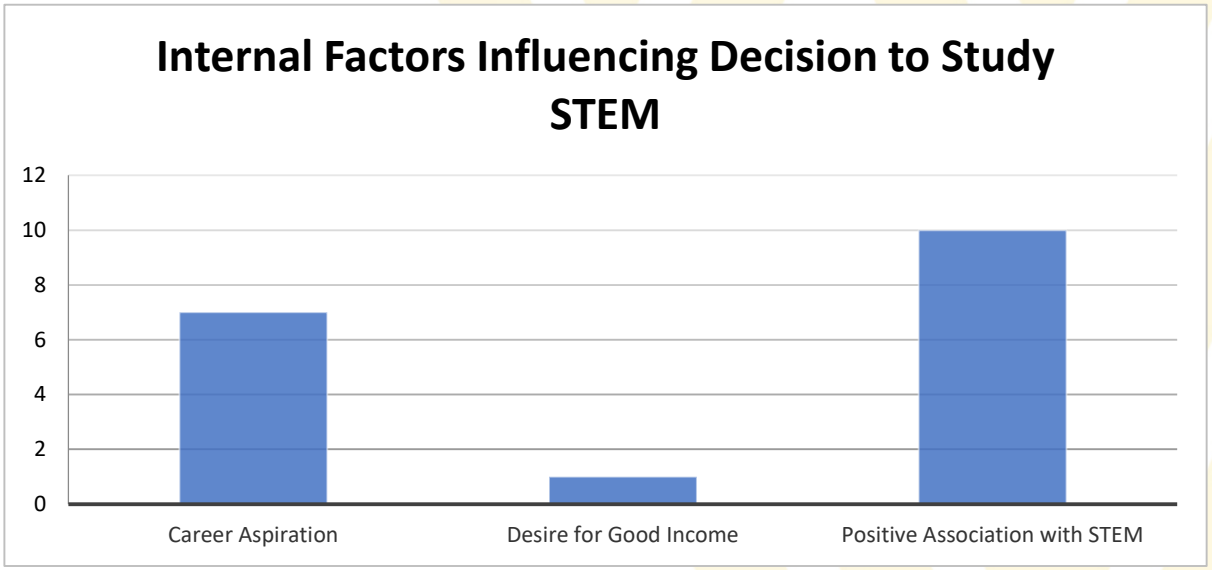


PROGRAM ASPECTS

Q3.1: What programmatic aspects cause a student to want to continue to pursue STEM?

- First round of interviews have revealed the following were important to FG students
  - Meeting others who will be attending college with them in the fall
  - Interacting with faculty before fall semester

PROGRAM ASPECTS

Q3.2: What programmatic aspects cause a student to question the choice to pursue STEM?

Q3.3: What non-programmatic aspects cause a student to question the choice to attend college and/or to pursue STEM in college?

SURVEY FOR FIRST2 PARTICIPANTS

- The point of the Pilot Student interviews was to determine how to construct a survey to be used with First2 Participants starting this first year.
- Survey complete – IRB approval
- Survey to be given later this month.

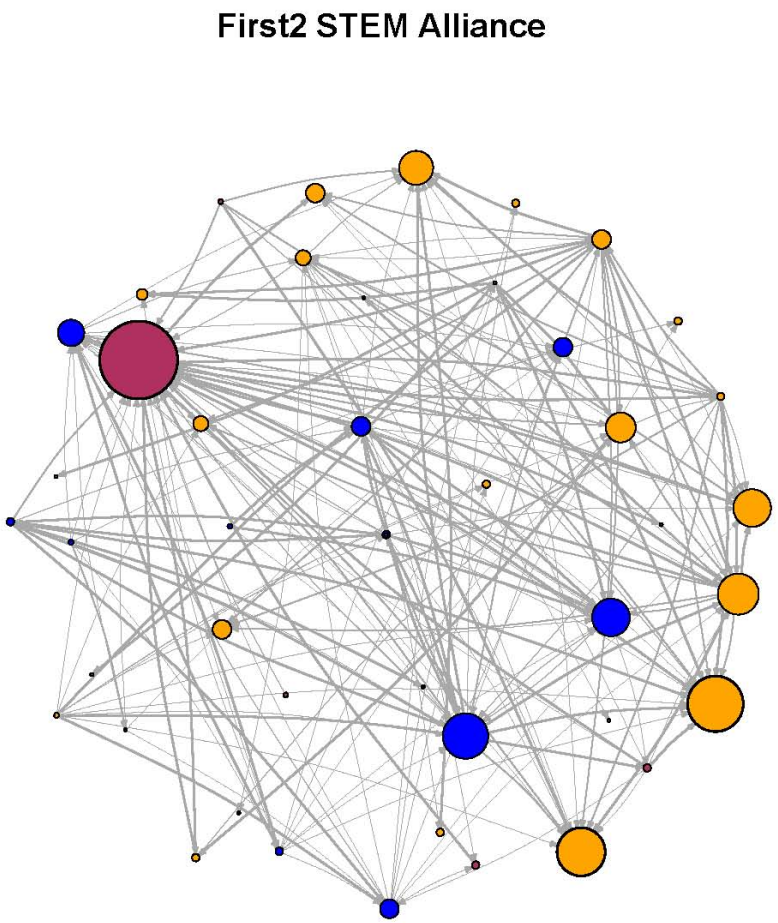
NETWORK

Q4.1: What types of meaningful networks are forming among entities within the state?

Q4.2: What are the structures of the relationships that are forming?

Q4.3: What are the best ways that the network can share knowledge and resources to assist student persistence in STEM?

FIRST2 NETWORK (2018)



Blue – WVU

Maroon – FSU

Orange – anywhere else

Size of node corresponds to the number of times a person was mentioned

Edges are weighted according to reported tie strength

NETWORK STATISTICS

- Measures will be computed each year to monitor network growth. Some of the measures used are:
  - ***New Measure - *Social conductivity*** is the average “conductivity” between any two persons in the network. This considers all paths between two people. This is an application of the series/parallel resistor formulae taught in introductory physics. (D. Buch, 2019)
  - ***New Measure - *Robustness*** measures the impact on conductivity from indirect paths. Robustness measures the extent of the redundancy of multiple strong paths by averaging the differences between conductivity and strength of connection. (D. Buch, 2019)
  - ***Centrality index*** of a graph is a common measure calculated as the reciprocal of the sum of the length of the shortest paths between the node and all other nodes in the graph. These are reported as fractions of "maximum possible" closeness to allow for comparison across graphs of different sizes. (G. Sabidussi, 1966)

NETWORK STATISTICS

Network	Proportion of Isolated Nodes	Conductivity (Buch, 2019)	Robustness (Buch, 2019)	Centrality
First2 Alliance	0	2.8	0.86	0.072
Capacity Building	0.5	0.37	0.09	0.067
Summer Immersion	0.3	1.4	0.9	0.081
College Readiness	0.12	1.0	0.75	0.121
Faculty/Student	0.18	0.87	0.63	0.072

NETWORK SURVEY

- The First2 Alliance Network Survey will go out later this month
- Data from this year will be used to determine if the network has grown and has become more robust
- **Please fill it out!!!!**

UNDERSTANDING STEM MATRICULATION AT WVU

John Stewart

WVU Department of Physics and Astronomy

THE GOAL

- To understand the STEM degree selection and successful completion and of rural and first-generation students.
- This talk only analyzes students who have chosen to enroll in college; it cannot inform the discussion of the decision enroll in college.

DEFINITIONS AND DATA

THE DATASET

- We accessed the course records of all students who were enrolled as undergraduates at West Virginia University's (WVU) Morgantown campus from 2000 to present; 146,000 students.
- We restricted the dataset to US citizens who were admitted as First Time Freshman beginning after the Fall 2005 semester when WVU began collecting reliable first-generation data.

STEM

- Defining Science, Technology, Engineering, and Mathematics (STEM) students is not straightforward.
- For this talk, we divide students into four classes:
  - Non-STEM
  - Agriculture
  - Life sciences including biology and health professions. This also includes general science majors.
  - Physical science including engineering, math, chemistry, and physics.

URBANICITY/RURALITY

- THE NCES locale codes were used to code each student's high school. The codes are as follows:

- City – Large (11): Territory inside an Urbanized Area and inside a Principal City with population of 250,000 or more.

- City – Midsize (12): Territory inside an Urbanized Area and inside a Principal City with population less than 250,000 and greater than or equal to 100,000.

- City – Small (13): Territory inside an Urbanized Area and inside a Principal City with population less than 100,000.

- Suburban – Large (21): Territory outside a Principal City and inside an Urbanized Area with population of 250,000 or more.

- Suburban – Midsize (22): Territory outside a Principal City and inside an Urbanized Area with population less than 250,000 and greater than or equal to 100,000.

- Suburban – Small (23): Territory outside a Principal City and inside an Urbanized Area with population less than 100,000.

- Town – Fringe (31): Territory inside an Urban Cluster that is less than or equal to 10 miles from an Urbanized Area.

- Town – Distant (32): Territory inside an Urban Cluster that is more than 10 miles and less than or equal to 35 miles from an Urbanized Area.

- Town – Remote (33): Territory inside an Urban Cluster that is more than 35 miles from an Urbanized Area.

- Rural – Fringe (41): Census-defined rural territory that is less than or equal to 5 miles from an Urbanized Area, as well as rural territory that is less than or equal to 2.5 miles from an Urban Cluster.

- Rural – Distant (42): Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an Urbanized Area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an Urban Cluster.

- Rural – Remote (43): Census-defined rural territory that is more than 25 miles from an Urbanized Area and also more than 10 miles from an Urban Cluster.

- The National Center for Education Statistics (NCES) classifies the rurality of each US high school.
- These codes are called Locale codes.

RURAL AND VERY RURAL

School	City	State	Locale
EDGEWOOD ELEMENTARY	CHARLESTON	WV	13
GARNET CAREER CENTER	CHARLESTON	WV	13
LEWIS COUNTY HIGH SCHOOL	WESTON	WV	41
ROANOKE ELEMENTARY SCHOOL	ROANOKE	WV	42
PETERSON-CENTRAL ELEMENTARY SCHOOL	WESTON	WV	33
JANE LEW ELEMENTARY SCHOOL	JANE LEW	WV	42
ROBERT L. BLAND MIDDLE SCHOOL	WESTON	WV	33
LEADING CREEK ELEMENTARY	LINN	WV	42
MIDWAY ELEMENTARY SCHOOL	ALUM CREEK	WV	41
RANGER ELEMENTARY	RANGER	WV	42
WEST HAMLIN ELEMENTARY	WEST HAMLIN	WV	42

RURAL AND VERY RURAL

- LOCALE code 41 (Rural Fringe) contains high schools that would not be considered rural by most West Virginians (Wheeling).
- This talk uses LOCALE codes 42-43 as the variable VeryRural, LOCALE 41 as Rural.

FIRST GENERATION

- First generation status is self-reported by students during the admission process.

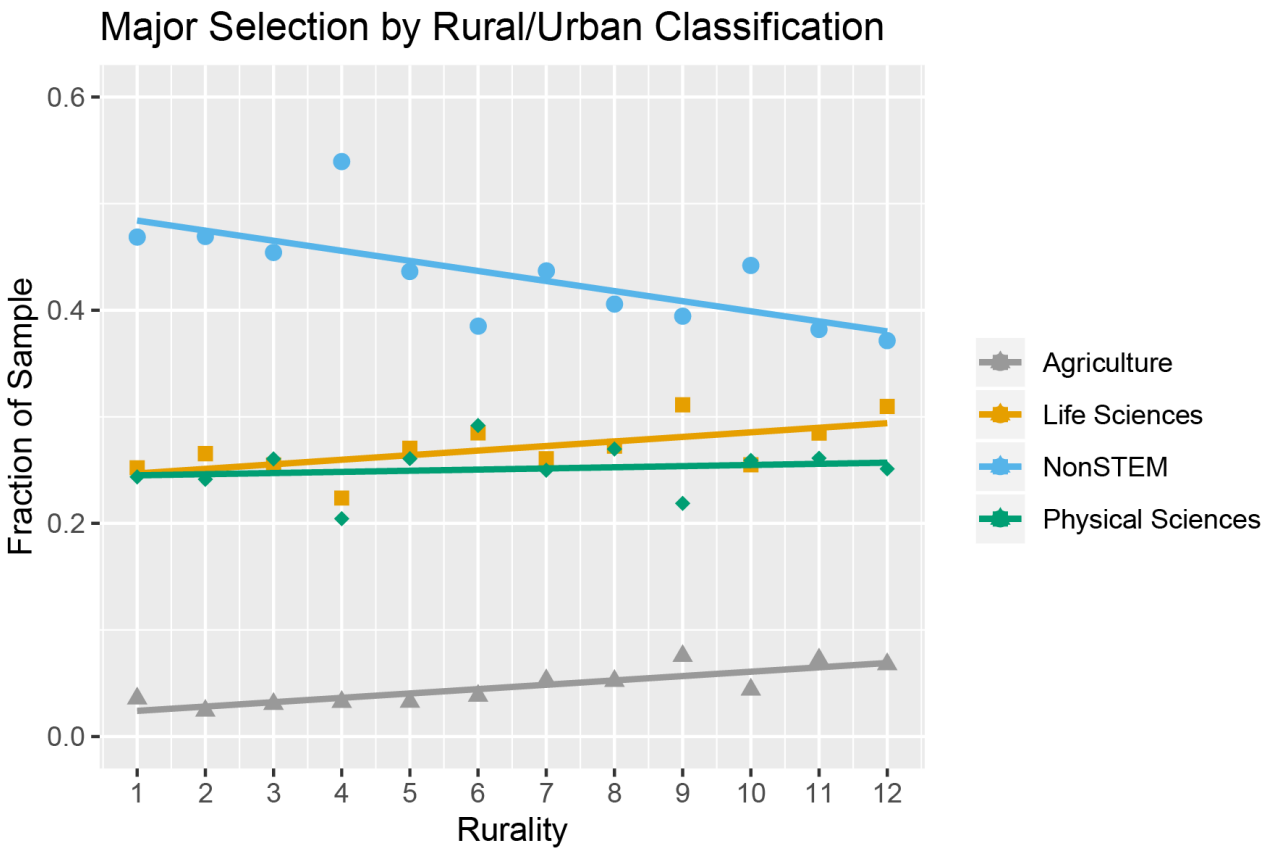
MATH ENTRY POINT

- The student's placement in the first mathematics class in college is a key predictor of success in retention models. Math Placement Codes Are:

- Not Calculus Ready
  - M122 - For students not ready to take college algebra.
  - M126 - College Algebra (requires 3 semesters of remediation)
  - M129 - Pre-calculus
- Calculus Ready
  - M153 - Two semester stretch calculus
  - M155 - Normal Calculus 1 - Preferred entry point
  - Adv - Enters at a class later than Cal 1 due to AP or Transfer Credit

STEM MAJOR ELECTION RATES

STEM MAJOR ELECTION RATES



STEM MAJOR SELECTION

- Rural students elect STEM majors at a somewhat higher rate than other students.

	Non-STEM	Agriculture	Life Sciences	Physical Sciences
Not Rural (Locale 11-32)	48%	4%	25%	24%
Rural (Locale 41)	44%	4%	25%	26%
Very Rural (Locale 42-43)	38%	7%	29%	26%

STEM MAJOR SELECTION

- First-generation students elect STEM majors at the same rate as other students with higher rates of life sciences and lower rates of physical science and engineering.

	Non-STEM	Agriculture	Life Sciences	Physical Sciences
First Generation	47%	5%	28%	21%
Not First Generation	46%	4%	25%	25%

COLLEGE READINESS

COLLEGE PREPARATION

- Rural students have similar high school preparation and college success metrics, but tend to take more transfer classes and fewer AP classes.

	High School GPA	ACT Math Percentile	College GPA	AP Class Taken	Transfer Class Taken
Not Rural (Locale 11-32)	3.4	61%	2.8	16%	38%
Rural (Locale 41)	3.5	60%	2.8	17%	43%
Very Rural (Locale 42-43)	3.6	60%	2.8	11%	53%

COLLEGE PREPARATION

- First-generation students have somewhat weaker academic metrics; particularly concerning is the difference in college GPA.

	High School GPA	ACT Math Percentile	College GPA	AP Class Taken	Transfer Class Taken
First Generation	3.4	56	2.6	11%	35%
Not First Generation	3.5	62	2.9	17%	42%

COLLEGE SUCCESS

COLLEGE SUCCESS

- Rural students graduate at the same rate as other students (differences are not statistically significant).

	Graduation Rate Non-STEM majors	Graduation Rate Physical Science Majors
Not Rural (Locale 11-32)	60%	67%
Rural (Locale 41)	61%	68%
Very Rural (Locale 42-43)	57%	65%

COLLEGE SUCCESS

- First-generation students graduate at a lower rate ($p<.001$). This is overall graduation not graduation with a STEM major.

	Graduation Rate Non-STEM Majors	Graduation Rate Physical Science Majors
First Generation	50%	56%
Not First Generation	62%	69%

PHYSICAL SCIENCE, MATH, AND ENGINEERING MAJORS

COLLEGE PREPARATION

- Rural students have similar high school preparation and college success metrics, but tend to take more transfer classes and fewer AP classes.

	High School GPA	ACT Math Percentile	College GPA	AP Class Taken	Transfer Class Taken
Not Rural (Locale 11-32)	3.6	76%	2.9	36%	43%
Rural (Locale 41)	3.7	76%	2.9	36%	46%
Very Rural (Locale 42-43)	3.7	75%	2.8	22%	55%

COLLEGE PREPARATION

- First-generation students have somewhat weaker academic metrics; particularly concerning is the difference in college GPA.

	High School GPA	ACT Math Percentile	College GPA	AP Class Taken	Transfer Class Taken
First Generation	3.6	71%	2.7	26%	40%
Not First Generation	3.7	77%	2.9	37%	45%

COLLEGE SUCCESS

- Rural students graduate at the same rate with STEM degrees as other students (differences are not statistically significant).

	Graduation with STEM Major	Graduation with Non-STEM Major	Does Not Graduate
Not Rural (Locale 11-32)	53%	16%	31%
Rural (Locale 41)	57%	14%	29%
Very Rural (Locale 42-43)	52%	16%	32%

COLLEGE SUCCESS

- First-generation students graduate with STEM degrees at a lower rate ($p<.001$).

	Graduation with STEM Major	Graduation with Non-STEM Major	Does Not Graduate
First Generation	44%	15%	41%
Not First Generation	57%	16%	28%

Are students Calculus Ready?

MATH ENTRY POINT

WEST VIRGINIA UNIVERSITY
Department of Physics & Astronomy

MATH ENTRY POINT

- We define student's Math Entry Point is the first mathematics class they take at WVU.
- For physical science students, academically prepared for college, the math entry point should be Calculus 1 or a class more advanced than Calculus 1.

MATH ENTRY POINT

	Graduation with STEM Major	Graduation with Non-STEM Major	Does Not Graduate
Advanced	80%	6%	14%
Calculus 1	70%	8%	21%
Stretch Cal 1	54%	13%	33%
Pre-Calculus	38%	26%	36%
Algebra	30%	26%	44%
Pre-Algebra	3%	65%	32%

MATH ENTRY POINT AND LOCALE

The math entry point of rural students is significantly different than non-rural students ($p<.001$).

	Locale 11-32 Not Rural	Locale 41 Rural	Locale 42-43 Very Rural
Advanced	12%	10%	4%
Calculus 1	34%	35%	26%
Stretch Cal 1	20%	21%	19%
Pre-Calculus	5%	5%	7%
Algebra	28%	28%	42%
Pre-Algebra	1%	1%	2%

MATH ENTRY POINT AND FIRST GENERATION STATUS

The math entry point of first-generation students is significantly different than non-first-generation students ($p<.001$).

	First Generation	Not First Generation
Advanced	9%	12%
Calculus 1	26%	35%
Stretch Cal 1	22%	20%
Pre-Calculus	4%	5%
Algebra	37%	27%
Pre-Algebra	2%	1%

NON-COGNITIVE VARIABLES

SELF-EFFICACY AND BELONGING

- Self-Efficacy – The student's belief that they can be successful in class was measured in 5 domains: current class, other math classes, other science classes, classes in their major, and success in the profession.
- Belonging was measured in 5 domains

SELF-EFFICACY – STRETCH CALCULUS (M153)

	Not Rural	Rural	Very Rural
Current Class	3.8	3.9	3.9
Other Math Classes	3.9	3.9	4.0
Other Science Classes	3.9	4.0	4.1
Majors Classes	3.9	4.0	4.1
Functioning in the Profession	4.1	4.2	4.3

5-point Likert scale

SELF-EFFICACY – NORMAL CALCULUS (M155)

	Not Rural	Rural	Very Rural
Current Class	3.8	3.7	3.6
Other Math Classes	3.9	3.9	4.2
Other Science Classes	4.0	3.9	4.1
Majors Classes	4.1	3.9	4.1
Functioning in the Profession	4.2	4.2	4.4

5-point Likert scale

BELONGING – STRETCH CALCULUS (M153)

	Not Rural	Rural	Very Rural
Current Class	4.7	4.6	4.5
Other Math Classes	4.6	4.5	4.5
Other Science Classes	4.5	4.6	4.5
Major Department	4.8	4.8	4.7
WVU	5.1	5.0	4.8

6-point Likert scale

BELONGING – NORMAL CALCULUS (M155)

	Not Rural	Rural	Very Rural
Current Class	4.6	4.8	4.7
Other Math Classes	4.6	4.8	4.7
Other Science Classes	4.7	4.8	5.0
Major Department	4.8	4.9	5.0
WVU	5.1	5.2	5.3

6-point Likert scale – Difference in belonging at WVU is not significant.

FIRST GENERATION STUDENTS

First generation students report slightly lower self-efficacy toward Stretch Calculus and approximately equal levels of self-efficacy toward normal calculus. Their sense of belonging is very similar to non-first-generation students.

SOMETHING INTERESTING

- Self-efficacy should be related to prior academic success (it has been shown to be in many studies).
- In Normal Calculus (M155), ACT/SAT mathematics score is a significant predictor of self-efficacy (as it should be); in Stretch Calculus (M153) it is not.
- It seems likely that the student's self-efficacy in M153 in inaccurate.

FUTURE

- Understand the relations of the various factors (this is really complicated).
- Deploy self-efficacy and belonging instruments at First2 partners.
- Replicate institutional analysis at other First2 partners.
- Continue to collect longitudinal self-efficacy and belong (with the cooperation of the math department).
- Bring the two halves of this talk together.

CONCLUSIONS

- Rural students elect STEM majors at a higher rate than non-rural students (physical science is about the same).
- First generation students elect STEM majors at the same rate.
- Rural students graduate at the same rate as non-rural students, but first generation students do not.

CONCLUSIONS

- Math readiness is a crucial factor affecting students college success.
- Rural and first-generation students are math ready at lower rates than other students.
- The self-efficacy and sense of belonging of rural and first-generation students is strikingly similar to other students.
- The self-efficacy of non-math ready students may not be accurate.