

InTeGrate

*Interdisciplinary Teaching about Earth
for a Sustainable Future*



Transforming Learning about the Earth: A progress report from the InTeGrate STEP Center

Cathy Manduca, Cailin Huyck Orr, Ellen Iverson, Carleton College;
Felicia Davis, Clark Atlanta; Richard Schulnerbrandt Gragg, FAMU;
Kim Kastens Lamont Doherty; David Steer, University of Akron

NSF, February 6



This work is supported by a National Science Foundation (NSF) collaboration between the Directorates for Education and Human Resources (EHR) and Geosciences (GEO) under grant DUE - 1125331



InTeGrate

*Interdisciplinary Teaching of Geoscience
for a Sustainable Future*



A five-year community effort to improve
geoscience literacy and build a
workforce prepared to tackle
environmental and resource issues

<http://serc.carleton.edu/integrate>



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InTeGrate

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A Systems Model for Transformation Undergraduate Earth Education

Website, Project Office

Materials
Development

Implementation
Programs

Professional
Development

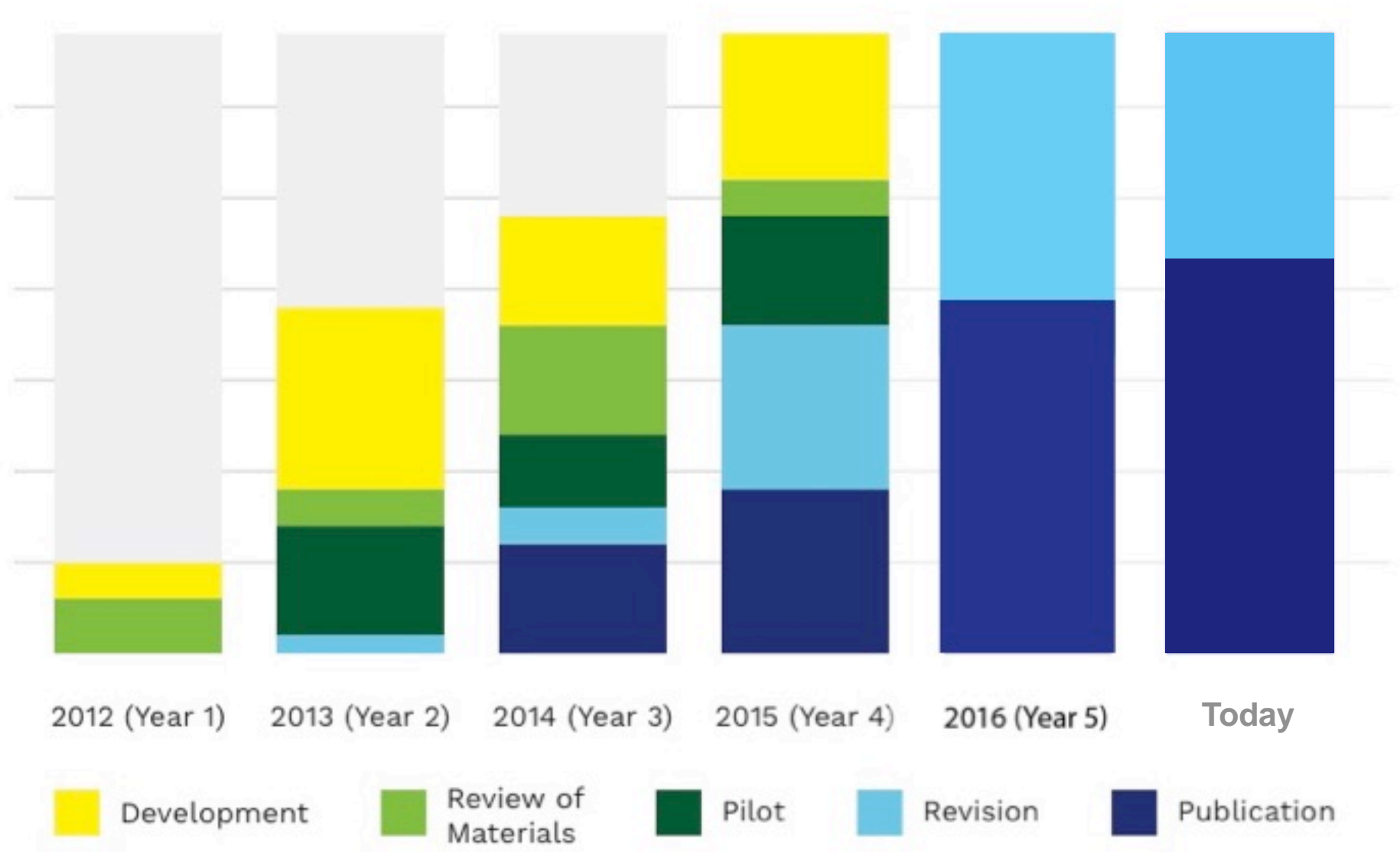
Assessment

Program Evaluation



InTeGrate Materials Development Progress

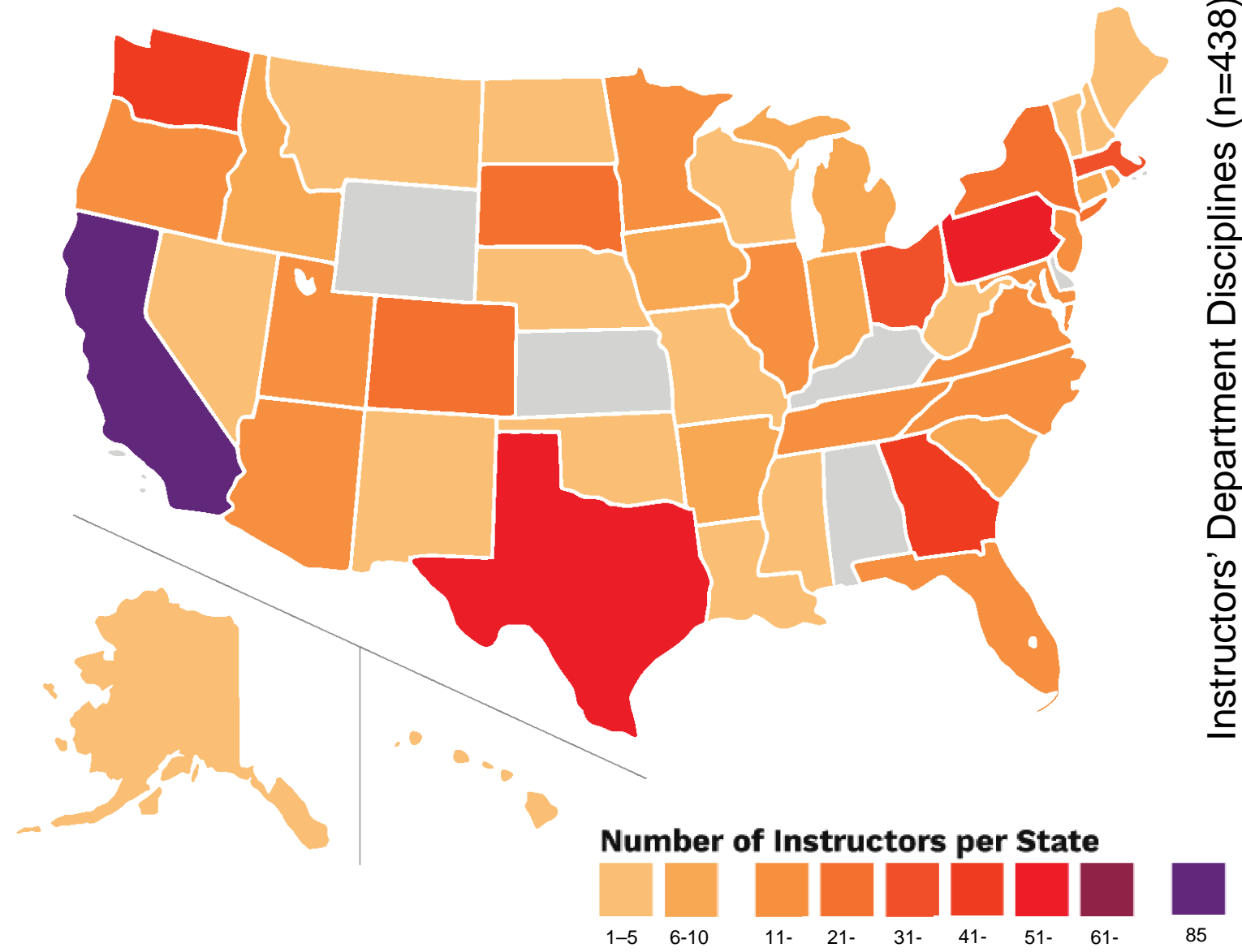
currently 33 modules/courses in-progress or completed



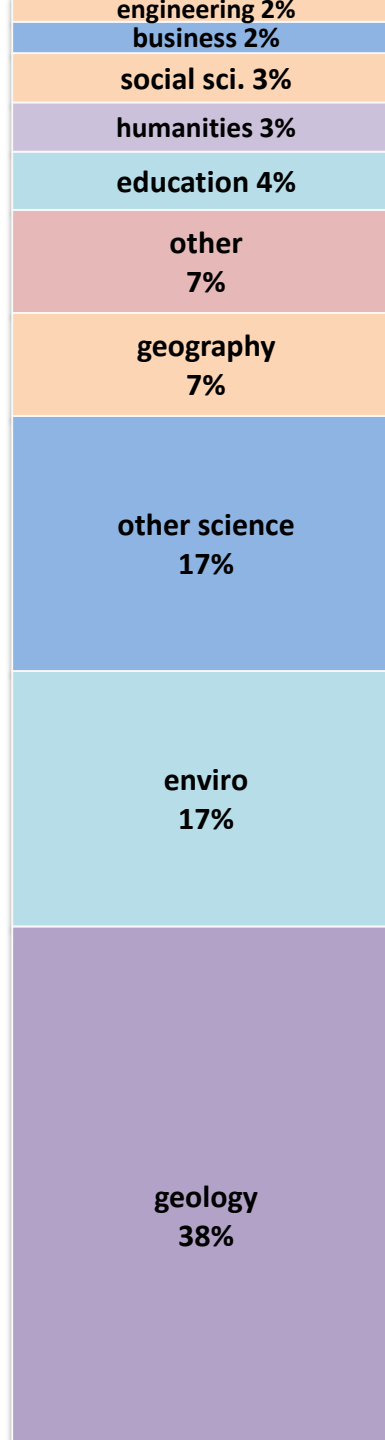


Courses Using ITG Materials

Includes 438 instructors teaching 718 courses
in 10 department disciplines in 45 states

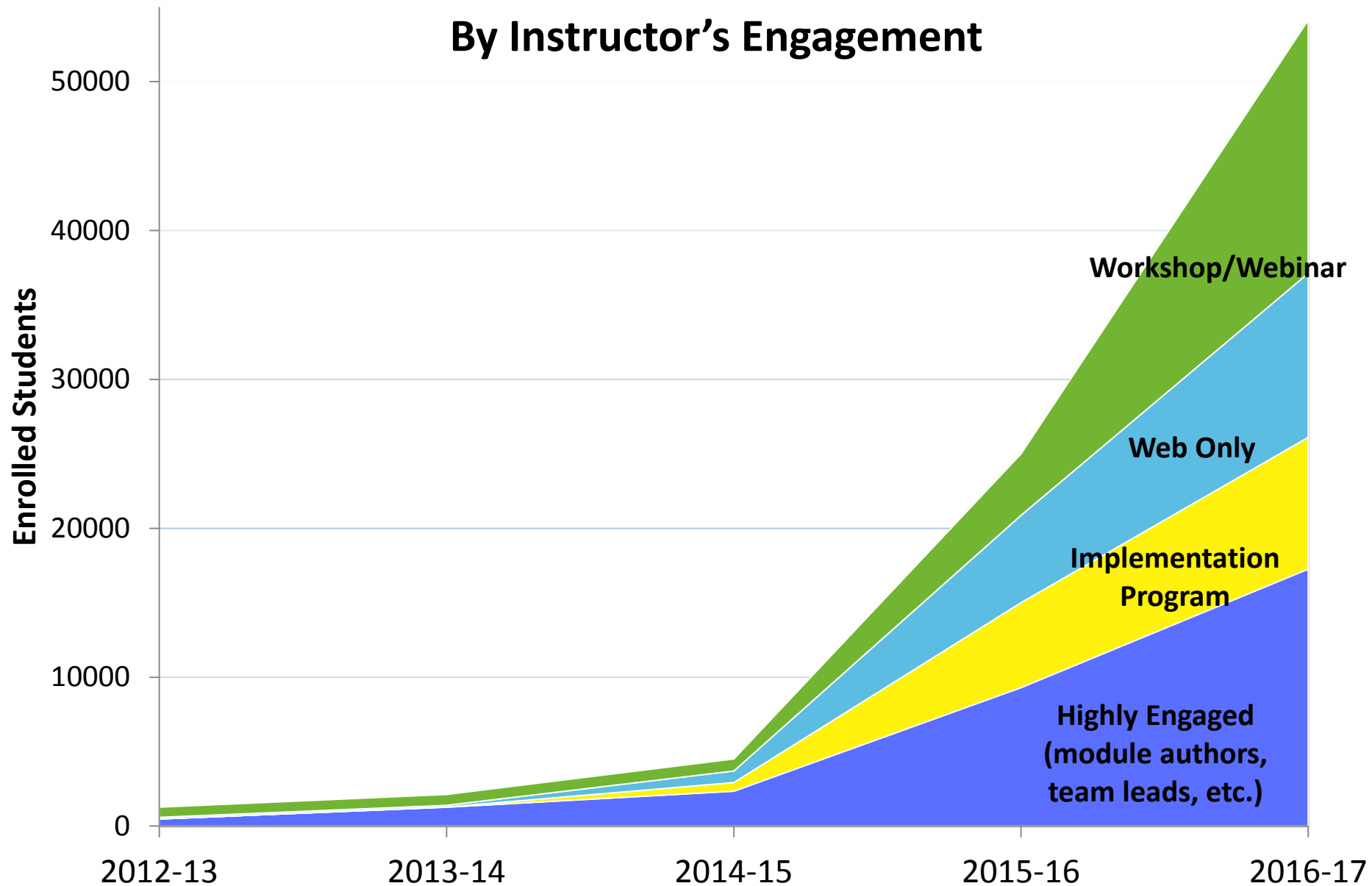


Instructors' Department Disciplines (n=438)





Total Number of Students Enrolled in InTeGrate Courses By Instructor's Engagement





A Systems Model for Transformation of Individuals, Institutions, and the Geoscience Community

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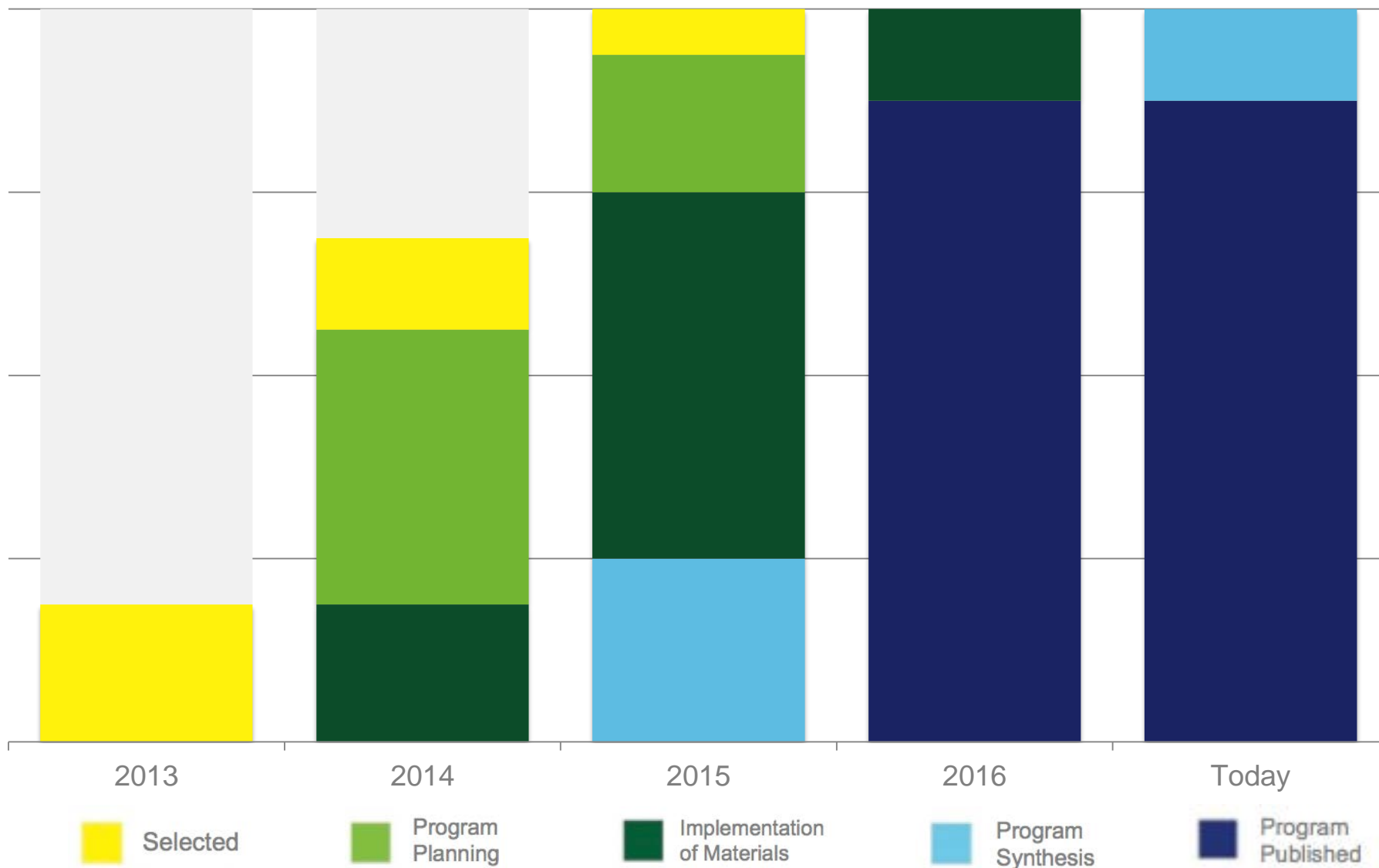
Program Evaluation





InTeGrate Implementation Programs Progress

currently 16 programs in progress or completed





Building a portfolio of examples

- Demonstrating programmatic changes
- Diverse approaches, grown organically from a variety of institution types
- Multiple solutions that are tailored to institutional culture
- There is no one size fits all. There are common elements



Implementation Programs

InTeGrate's work with its [implementation programs](#) has resulted in the development of 16 models of ways to bring geoscience to a diverse range of disciplines, institutions, and networks. This page can help others who are interested in applying some aspect of these implementation to their own context find information about how they might do so.

Lessons Learned

Many of the implementation programs worked to address similar or related issues in their contexts. This pages draw together lessons learned in these areas of high overlap among the programs.



Recruit and Support Diverse Learners



Teach Earth Across the Curriculum



Prepare Teachers to Teach Earth Science



Support Transitions to Workforce,
Transfer, and Careers



Make Change Happen

<http://serc.carleton.edu/91212>



Claflin University - CU InTeGrated!

Dr. Camellia-M Kantor (Project Lead)
 Dr. Anisah Bageara
 Dr. Deborah Laufferweiler-Dwyer
 Dr. Randall Harris
 Dr. Anthony Rizzuti
 Mrs. Cynthia Duncan-Joseph
 Mr. Rodney Hudson
 Dr. Gloria McCutcheon
 Dr. Mihail Kantor

Summary

Lead by a group of nine motivated faculty and staff, the program managed to expand on CU's institutional efforts and to show our commitment to sustainability and leadership among other HBCUs from across the country. Through curriculum infusion, faculty development, and community actions we are proud to have managed to initiate and strengthen our sustainability actions. We started by bringing together faculty from several different departments who infused two weeks of InTeGrate content from the "Map Your Hazards" module. We continued by increasing our environmentally responsible green policies and our leadership role in the community. We are now proud to stand together as one strong force motivated to help our students, faculty, staff and community mitigate the effects of climate change through enhanced Earth Sciences knowledge and awareness!



Program Goals:

1. Increase Earth literacy among underrepresented minority undergraduates at CU;
2. Equip minority students with basic interdisciplinary knowledge and skills to enable professional responses to community issues related to climate change;
3. Increase the numbers of minority students interested in Earth Sciences careers and the quality of their preparation and;
4. Strengthen faculty capacity to incorporate learning about the Earth at CU.

Program motivation

Claflin University (CU) is a fairly small HBCU located in a predominantly rural area of the Southeastern U.S. The University plays an important role in the community, having served as a leader in initiating and conducting environmental activities (recycling efforts, learning, research, service, administrative operations) in past years. It has affirmed its commitment to grow, lead, innovate, and inspire other HBCUs and foster a community that sustains environmentally responsive practices.

Still, even within the University, students' interest in and knowledge of Earth Sciences has been limited. The Environmental Science major struggles to attract and retain its students. While the Biology major has one of the largest student body at CU, students' career plans rarely include areas related to sustainability. Most importantly, students majoring in non-STEM fields have almost no exposure to Earth Science content except for a few Geography electives.

Therefore, the major problem this project aimed to address was little or lack of exposure to Earth Sciences content that has inevitably lead to almost no interest in sustainability related careers among minority students already severely underrepresented in these fields.

Table of Contents

Improving Programs

Improving Teaching and Learning

Making Change Happen

Program Team

The implementation showcases:

Curriculum Development
 Diversity/Inclusion

Interdepartmental Collaboration
 Professional Preparation

<http://serc.carleton.edu/142649>



Claflin University - CU InTeGrated!

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Summary

Lead by a group of nine motivated faculty and staff, the program managed to expand on CU's institutional efforts and to show our commitment to sustainability and leadership among other HBCUs from across the country. Through curriculum and other efforts, we are proud to have managed to initiate and sustain a program that brought together faculty from several different departments to develop the "Map Your Hazards" module. We continue to expand our policies and our leadership role in the community. We are motivated to help our students, faculty and staff through enhanced Earth Sciences knowledge.

Program Goals:

1. [Increase Earth literacy among](#)
2. [Equip minority students with b](#)
[related to climate change;](#)
3. [Increase the numbers of minor](#)
4. [Strengthen faculty capacity to](#)

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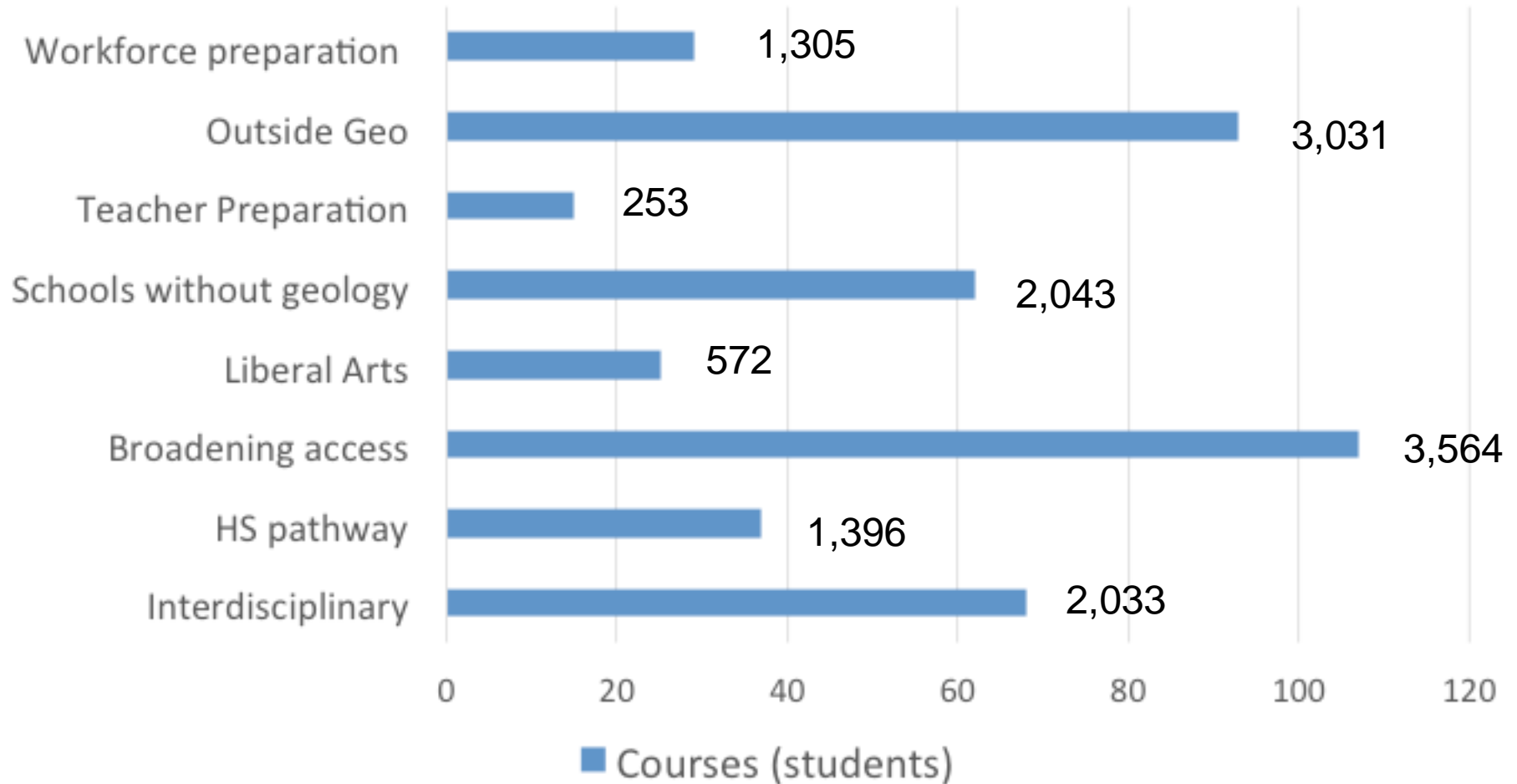
Claflin University (CU) is a fairly small HBCU located in a predominantly African American community in the Southeastern U.S. The University plays an important role in the community (as a leader in initiating and conducting environmental activities, research, service, administrative operations) in past years. It has grown, lead, innovate, and inspire other HBCUs and foster a culture of environmentally responsive practices.

Still, even within the University, students' interest in and knowledge of Earth Sciences has been limited. The Environmental Science major struggles to attract students. While the Biology major has one of the largest student body, it rarely include areas related to sustainability. Most important, non-STEM fields have almost no exposure to Earth Sciences or Geography electives.

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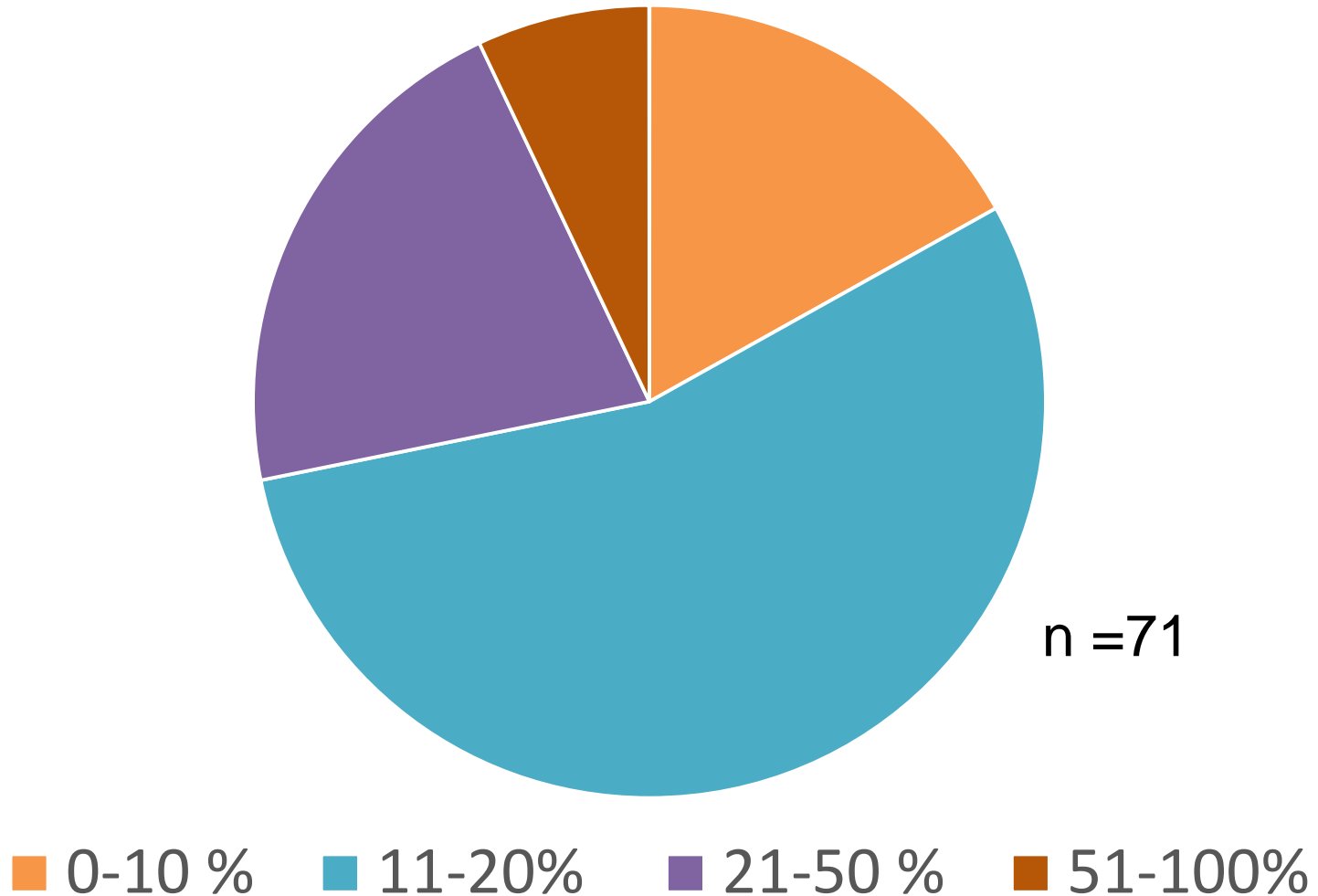


Implementation Programs





Proportion of course ITG material





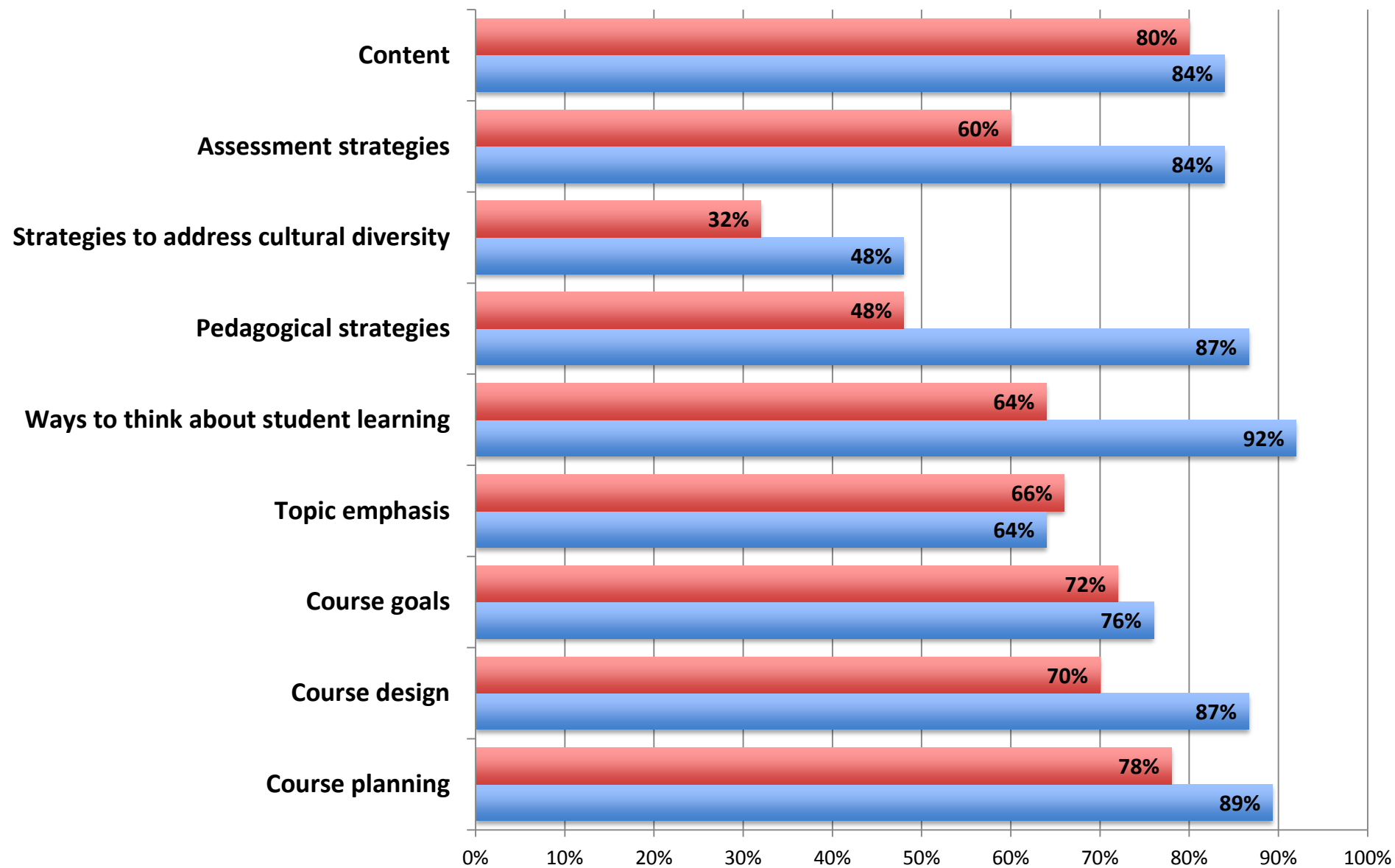
Adaptations

- Different format: LMS to online, web to paper
- New examples: local maps or cases
- Custom assessment: developed new rubrics, essays or exam questions
- Many examples of using part of a module, or combinations of parts from several modules to enhance or 'infuse' an existing course.



In what ways has your experience with the InTeGrate project influenced your teaching? And your interactions related to teaching?

■ Implementation Program Members ■ Module Authors





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HBCU Geoscience Working Group

Felicia Davis and Richard Schulerbrandt Gragg
Co-Chairs



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HBCU Geoscience Working Group

Vision

Black students are Earth literate systems thinkers, advancing environmental justice and climate solutions to mitigate societal impacts.

Mission

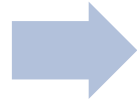
Promote geoscience literacy, education and research among HBCUs and the communities they serve.



InTeGrate HBCU Involvement

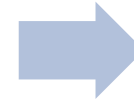
2015-16

- EJ Workshop
- Implementation
 - Savannah State
 - Claflin
- Course/Modules
 - Lead
 - FEWS



Rendezvous 2016

- HBCUs Meet
- Dialogue
- Consensus
- Goals
- Planning



HBCU Geoscience
Working Group

- NABG Conference
- GeoPaths
- Workshops
- Module Testing
- Rendezvous 2017



and more

NOTE: U.S. Virgin Islands has one HBCU university



RESULTS

- ✓ HBCUs are now represented and fully engaged in all aspects of the InTeGrate program
- ✓ Individual Faculty members benefit from workshops and collaboration positively impacting curriculum content & classroom delivery
- ✓ Expanded network of HBCU faculty knowledgeable about InTeGrate platform, curriculum materials and training opportunities now sharing with colleagues increasing participation and leadership (Deans) interest
- ✓ Rich collaboration across institutional types and disciplines
- ✓ Above all positive outcomes for HBCU students

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Measuring the impact of InTeGrate on student learning

Geoscience Literacy Exam

Interdisciplinary Problem Solving essays

Systems Thinking essays

InTeGrate Attitudinal Instrument

David Steer, Kim Kastens, Ellen Iverson, Lisa Gilbert



This work is supported by a National Science Foundation (NSF) collaboration between the Directorates for Education and Human Resources (EHR) and Geosciences (GEO) under grant DUE - 1125331



Geoscience Literacy Exam

Questions

- Developed for two purposes
 - Used to compare student populations pre/post
 - First order gauge content knowledge gain
- Set of 8 multiple choice questions related to major literacy documents (2 from each)
- Questions asked in pre/post mode to all InTeGrate student participants (n=2395)
- Two control populations (n=648)
 - Initial - University of Akron students in General Education Earth Science Courses from 2012-13 and Two-year College Students in 2014 (n = 286)
 - Recent - Research group in Fall 2015 (n = 362)



InTeGrate improves geoscience literacy exam knowledge compared to initial control

InTeGrate group ($n=2,395$; $p < 0.001$)

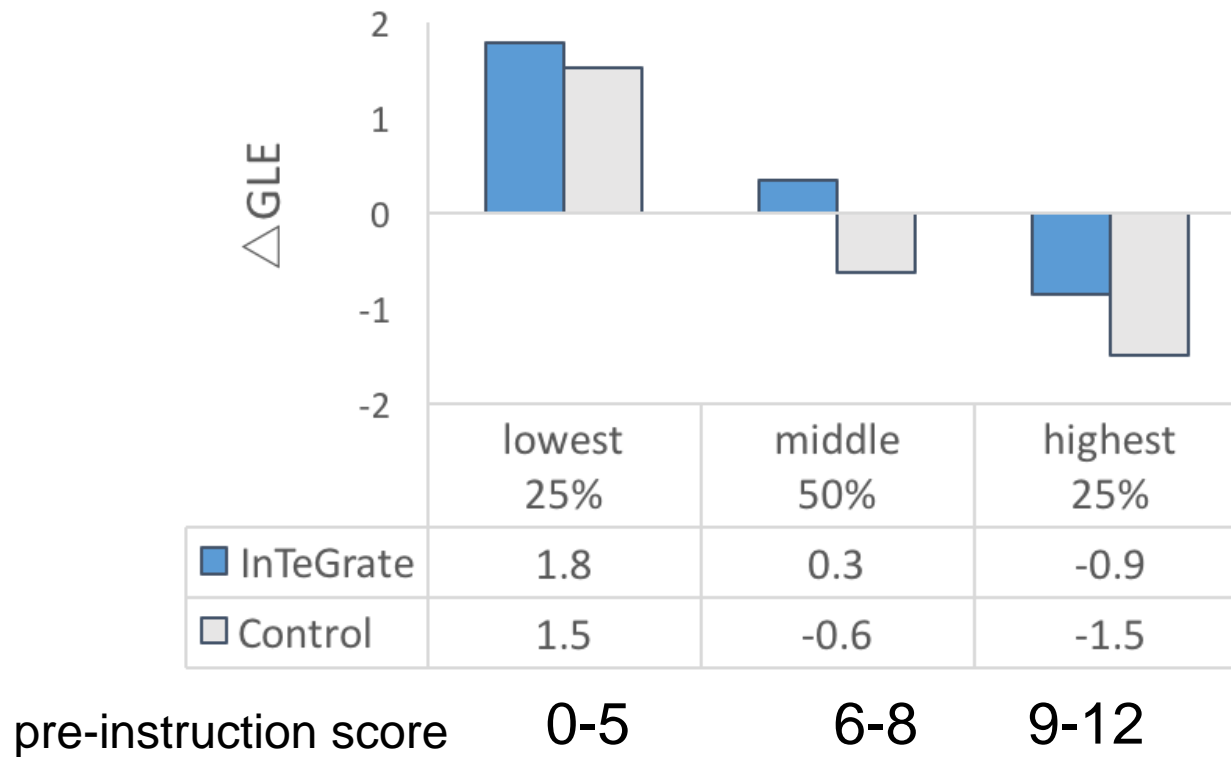
Yes - Significant gains on these questions
(+10% normalized gain)

Initial Control group without InTeGrate
instruction ($n=286$; $p=0.1$)

No significant gains



Geoscience literacy exam gains, by quartile





Focused Research Study (F'15-F'16)

Goals to investigate how:

- Student learning is affected by use of InTeGrate materials:
- Faculty who use InTeGrate materials shift their teaching practices

Three semester study design:

1. Fall 2015: “Regular teaching” and assessment collection
2. Spring 2016: Pilot redesigned course with ~18 units from six InTeGrate modules and assessment collection
3. Fall 2016: Repeat of Semester Two with revisions and assessment collection



Modules and Courses

Earth's Mineral Resources	Living on the Edge (Equakes & Volcanoes)	Env Justice & Freshwater Resources	A Growing Concern (Soils)	Climate of Change	Hurricanes and Natural Hazards	Course Type
X X X X		X X X X	X X X X	X X X X		EnvSci 1
		X X X X X X	X X X X X X	X X X X X X		EnvSci 2
X X X X X X	X X		X	X X	X X X X X X	EarthSci 1
X X X X X	X X X X X X	X X X X			X X X X	EarthSci 2
	X X X X X X			X X X X X X	X X X X X X	OcAtmCli
X X X X X X	X X X X X X	X X X			X X X	PhyGeo 1
X X X X	X X X X X X		X X X			PhyGeo 2
X X X X X X	X X X X X X					PhyGeo 3
X X X X X	X X X X X	X X		X X		PhyGeo 4



Systems Thinking essay

Question: A systems thinker can identify a system (a natural system, a human system, a linked human/environment system), understand how that system can be divided into interacting parts, and recognize that changes in one part of the system will affect other parts of the system.

- Give an example of a real-world system and describe its parts.
- Explain how parts of the system interact. Use systems concepts in your explanation (e.g., positive and negative feedbacks, equilibrium, rates, etc.).
- Using your example system, discuss how an effect in one part of that system can be influenced by multiple causal factors.

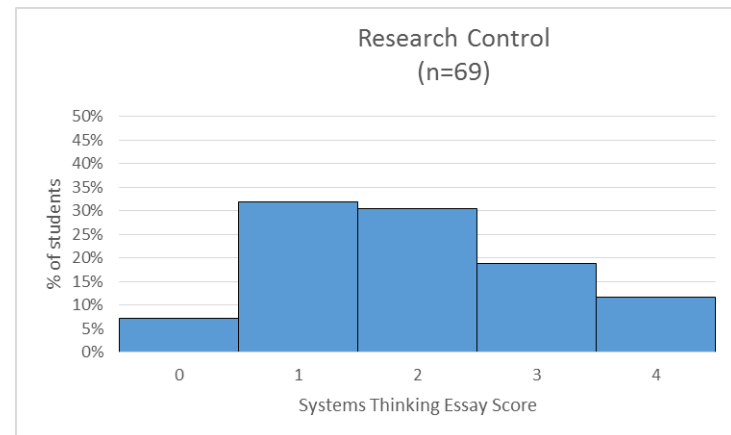
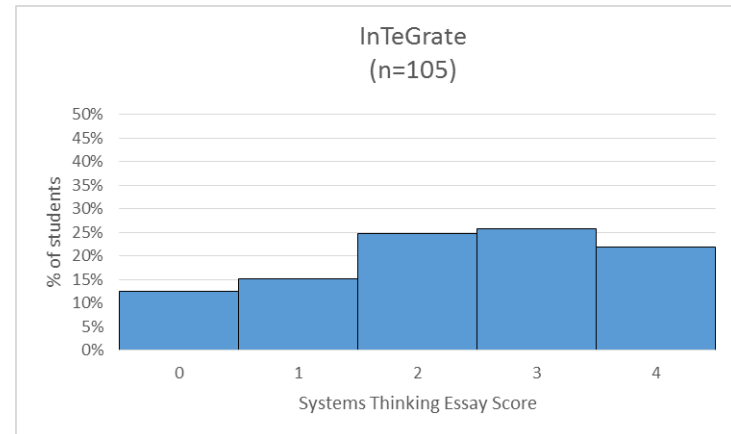
Rubric: (1 point each)

- Student correctly identifies and describes a real-world system including its parts.
 - Student correctly describes how a change in one part of the system, in turn, alters other parts of the system.
 - Student correctly explains how parts of the system interact using systems concepts such as feedbacks, equilibrium, rates, etc.
- Student describes how an effect can be influenced by multiple causal factors.



Systems Thinking Essay (research control)

**InTeGrate scores
are significantly
higher than control**
($p < 0.03$)





Said another way...

- Even when pre-, post-GLE questions, and Interdisciplinary Essay scores are not significantly different, **Systems Thinking Essay scores are significantly higher for students in InTeGrate classes compared to the research control group.**

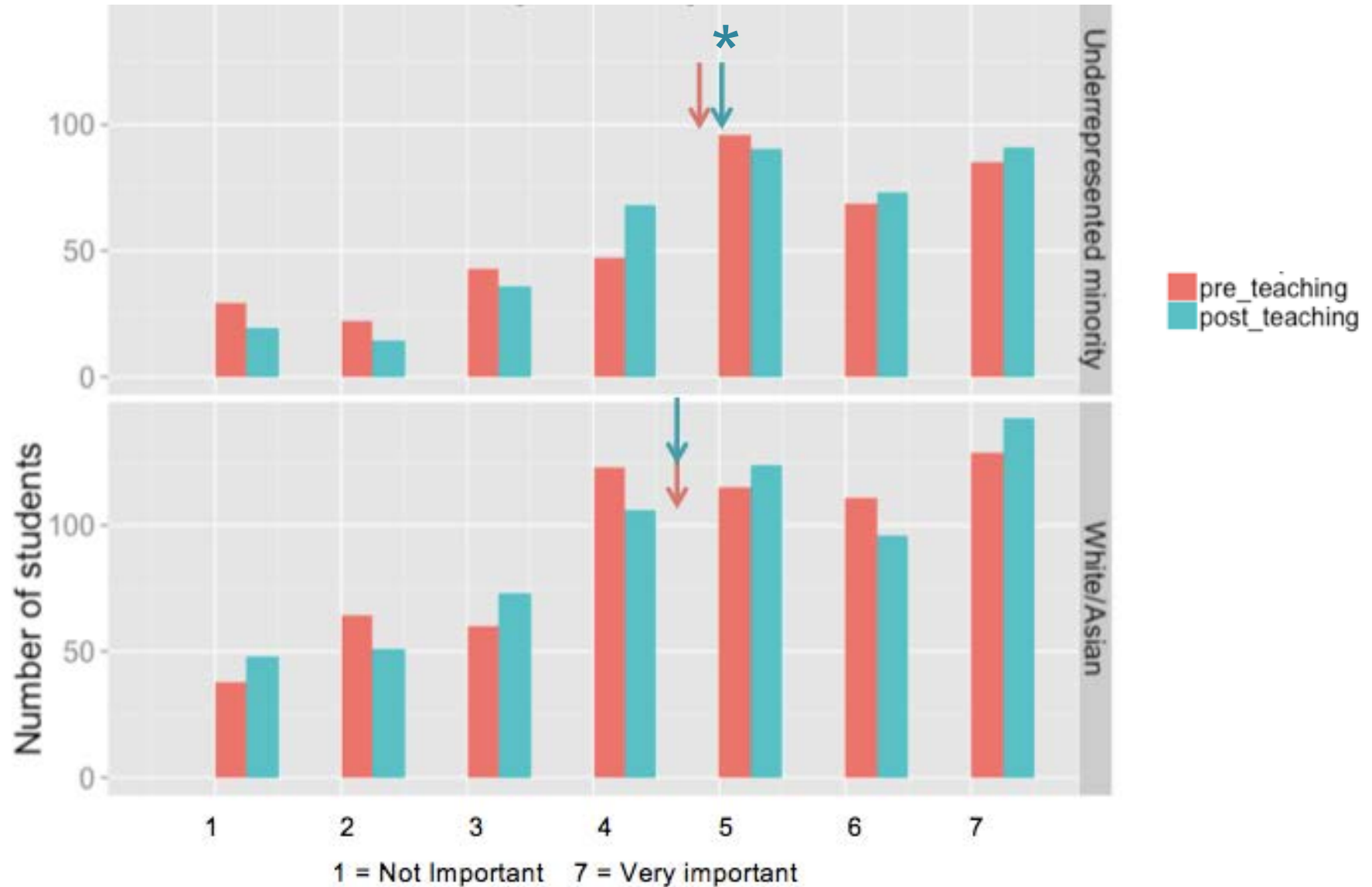


InTeGrate Attitudinal Instrument (IAI)

- Administered online pre- and post-instruction
- Used in pilot tests of new materials, some Implementation Programs, and the Research Team project.
- Probes:
 - Career interests and college major selection
 - Concern about environmental issues and motivation towards sustainability behaviors
 - Demographics
- Analysis is based on:
 - Pilot tests of 19 new modules and courses
 - 61 instructors
 - 1125 students who provided both pre- and post-instruction surveys
 - Students are 36% under-represented minorities, 59% female

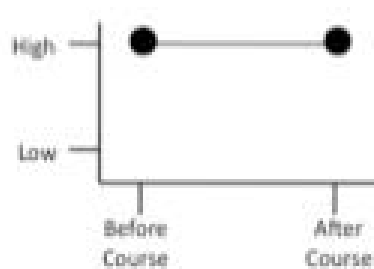


Item 3a: As you consider career directions after graduation, how important is it to you to do work in which you use your knowledge of the Earth and environment?
Please select one number: [Likert scale 1 = not important to 7 = very important]

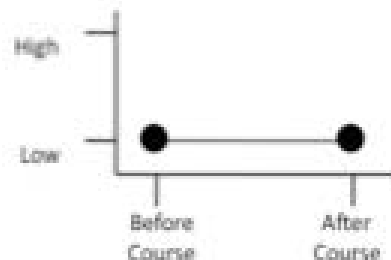




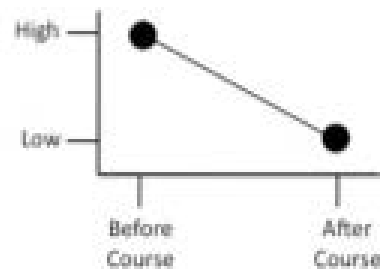
Item 4: Which of the following graphs most accurately depicts your level of interest in a career in Earth or Environmental Sciences before and after taking this course or studying this module?



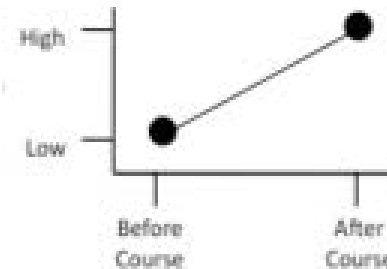
(a)



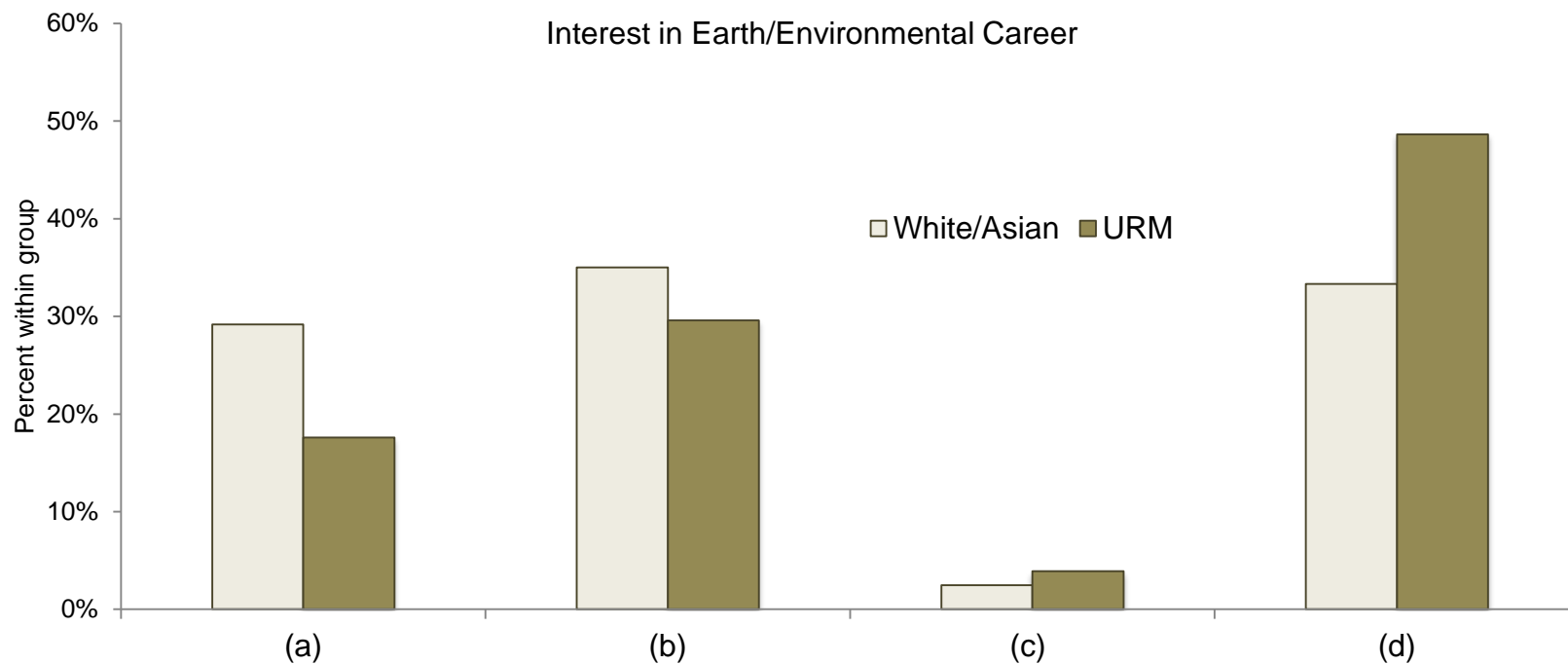
(b)



(c)



(d)



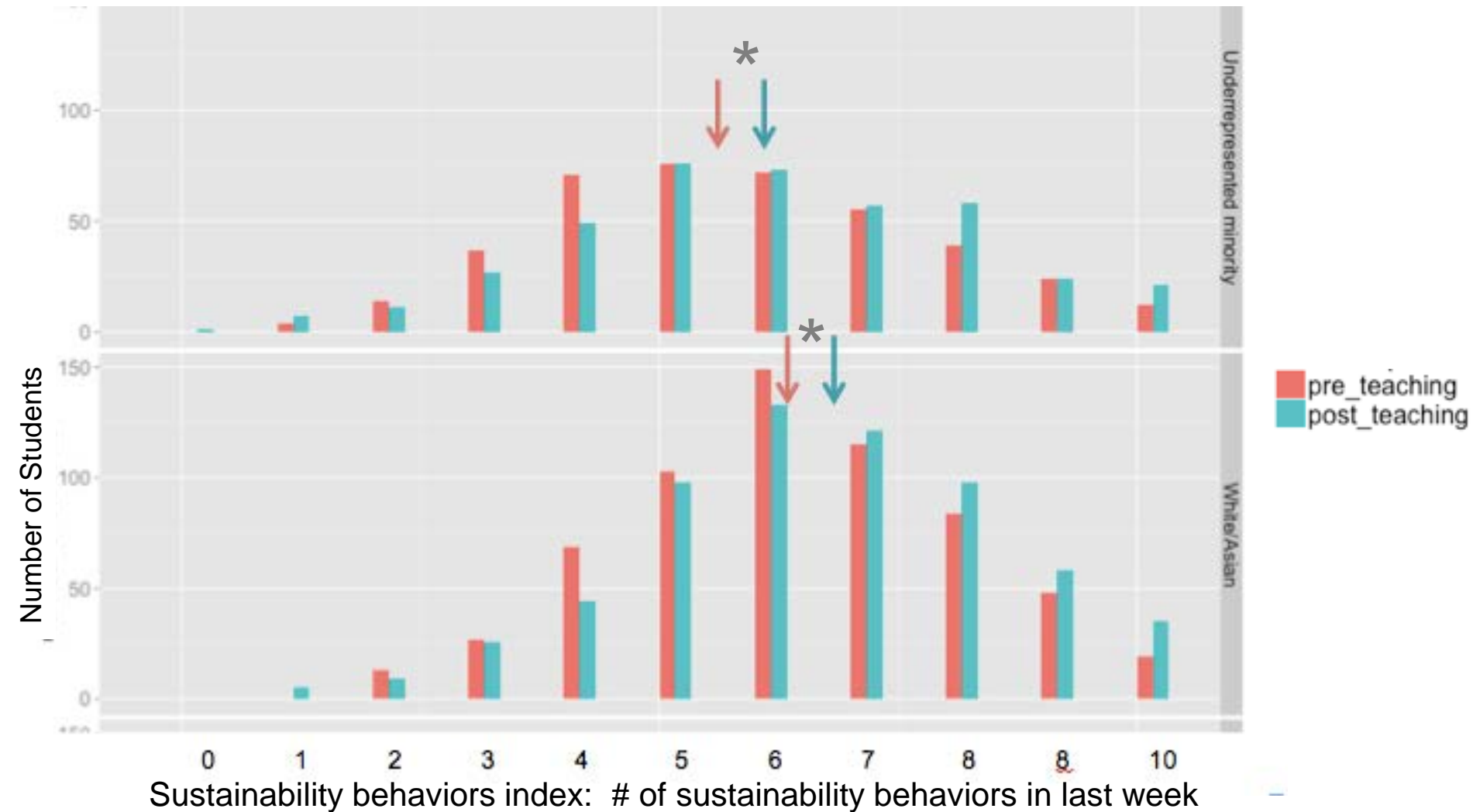


Item 6a: Please indicate which of the following you have done in the last week*

(mark all that apply):

() turned off the water while brushing teeth

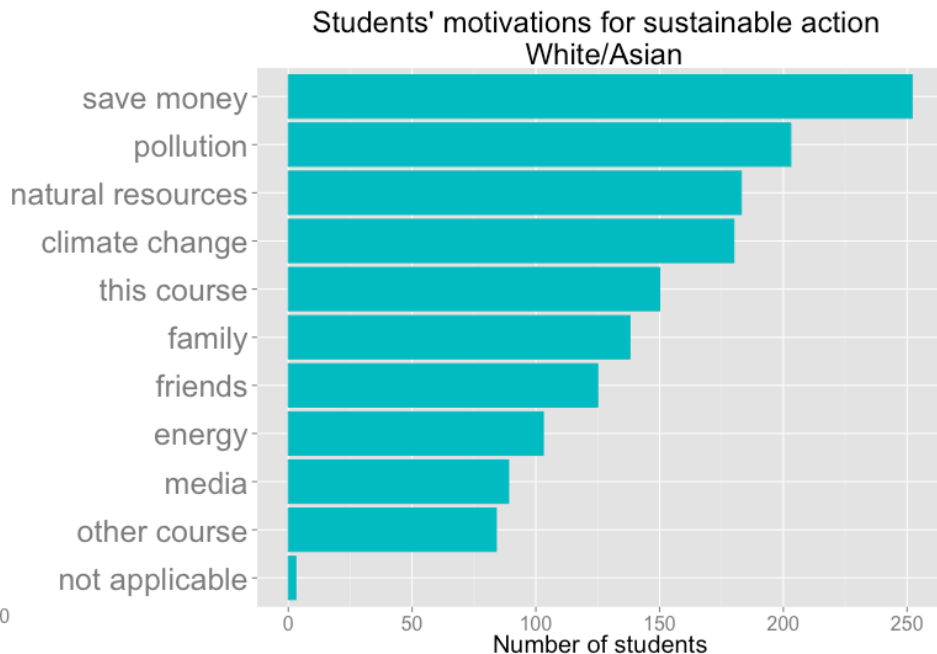
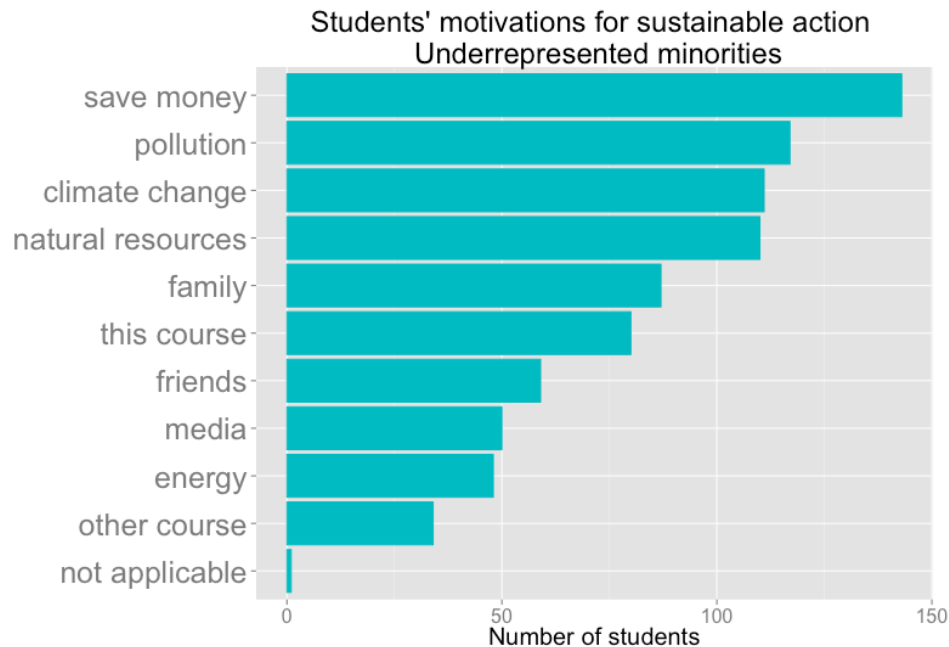
etc. ... total of ten behaviors



* Wording of question differed in 2012-2013 versus 2014-2015. Responses merged.



Item 6b. When you engage in behaviors such as those listed in the previous question, what factors or sources of information influence your decision to do so? (mark all that apply):

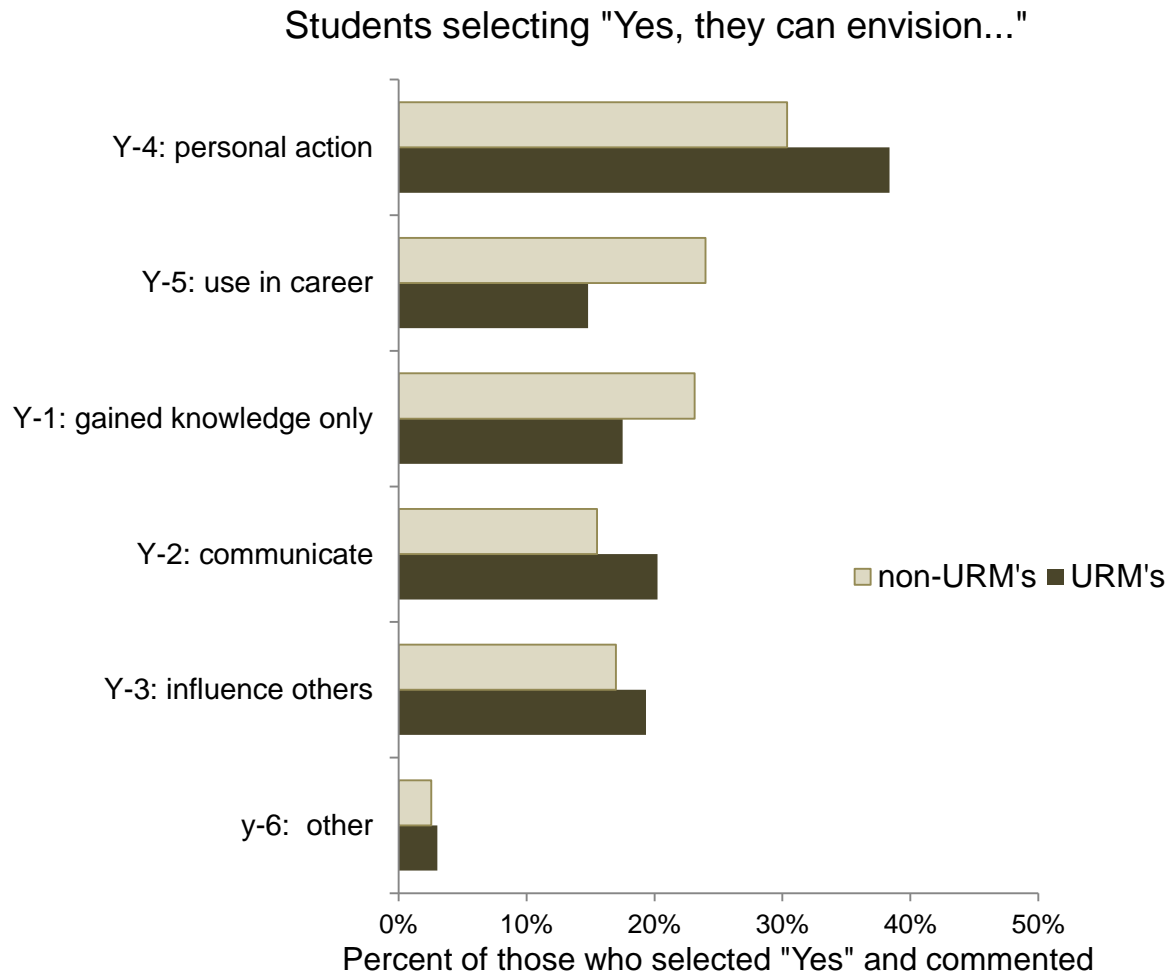




Item 8. As you think about your future, can you envision using what you have learned in this course to help society overcome problems of environmental degradation, natural resources limitations, or other environmental issues? () yes () no

If yes, how?
If no, why not?

YES: URM's: 88% non-URM's: 82%





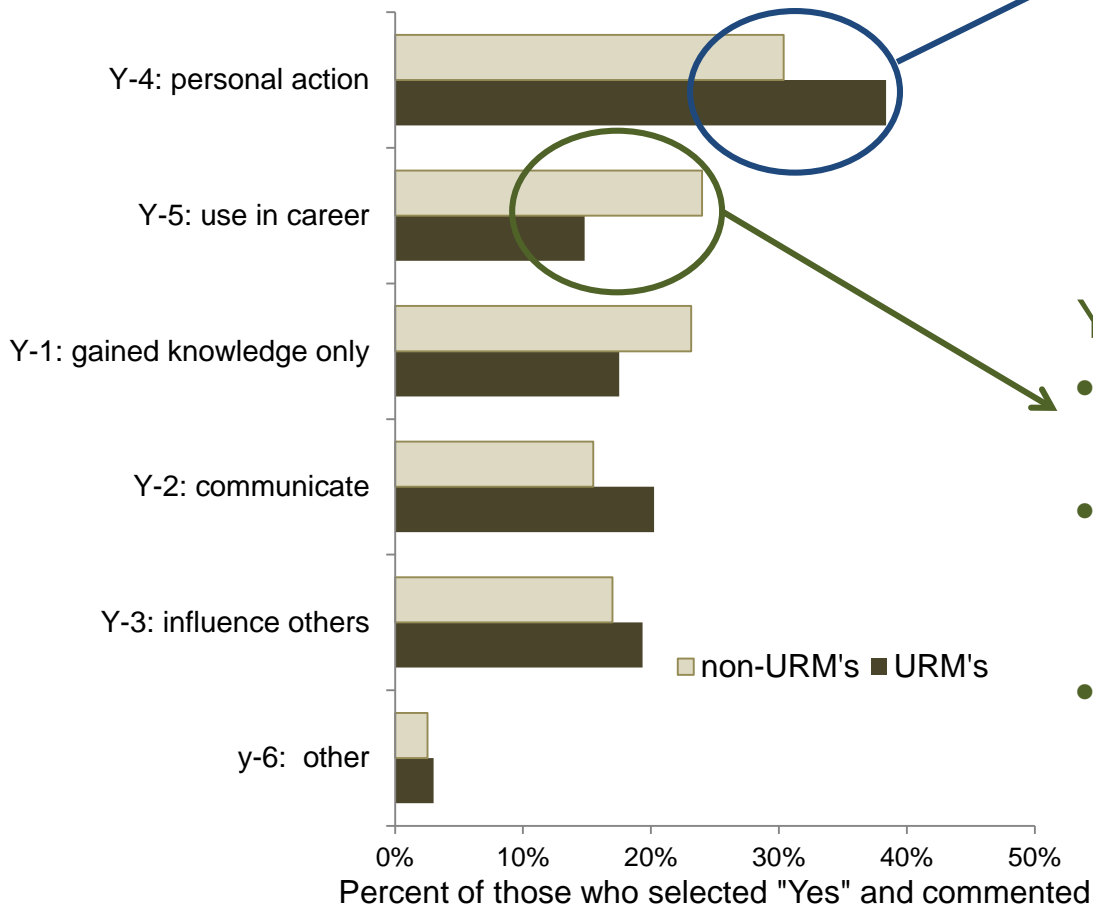
Y-4 examples from URM's:

- “recycle and save water”
- “...sustain my vegan diet”
- “start by carpooling...”
- “recycle more”

Y-5 examples from URM's:

- “I can use what I have learned and teach it in my future classroom”
- “Going into business, I can use this knowledge to transform the way business operates...”
- “I want to be a lawyer and after this course I’ve been interested in Environmental Law.”

Students selecting "Yes, they can envision..."





Generalizable Knowledge: About America's Youth

- Students come to college without the level of Earth knowledge called for in the geoscience literacy documents
- Students struggle with systems thinking and interdisciplinary problem solving
 -however, these skills are teachable
- More than half of students have some degree of interest in an Earth-related career and/or desire to work in an organization with sustainable business practices
- The strongest factor nudging students towards environmental sustainability is desire to save money
- Overwhelmingly, students can envision themselves helping society overcome environmental problems
 - Most envision personal or professional actions
 - Very few cite voting or civic engagement



Take Home Points

- Materials are valued and rapidly developing a following
- Interactions of materials development, implementation programs, dissemination and community engagement are working to support adoption and spread of effect
- Targeted partnerships are enhancing our reach into HBCU, Teacher Prep and Biology communities – could be scaled up.
- We have systems in place for large scale student learning studies- a work in progress

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