



# Do InTeGrate materials increase scientific understanding among women?

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## ABSTRACT

InTeGrate geoscience teaching materials were developed to link societal challenges to geologic concepts in order to improve Earth literacy in undergraduate students. These curricular products span topics from mineral resources to climate change to natural hazards. InTeGrate modules take the form of engaged, student-centered learning opportunities, and can easily be implemented into flipped-style classrooms. The InTeGrate Research Team implemented three modules in a single geoscience course for the Fall 2016 semester, in eight different colleges and universities. Here, we evaluate the impact that these learning materials had on female students by analyzing pre- and post- course standardized test results (GLE – Geoscience Literacy Exam) and written responses to modules and summative assessments. We supplement the learning metric data with surveys of attitudinal changes towards environmental concerns and the importance of sustainability on both student actions and career aspirations. We compare the results to a control group of students that did not receive any InTeGrate materials within their geoscience courses. Our results can be used to examine if women can increase their scientific (and geoscience) literacy due to pedagogical and curricular changes, along with shifting their perspectives regarding the need for sustainability in their lives. By identifying how these changes impact female students, we may be able to narrow the gender gap in STEM fields.

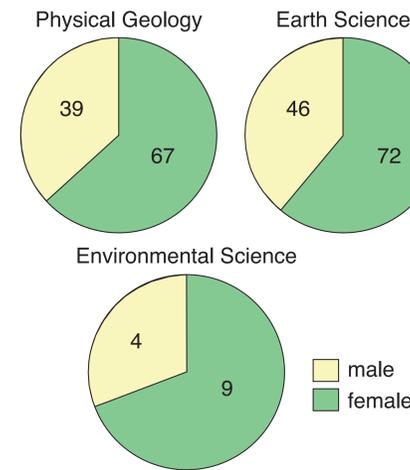
## A SEMESTER OF INTEGRATE

### Experimental Design

- Eight faculty at 2-yr and 4-yr institutions across the US.
- Faculty teach a combination of physical geology, earth science, and environmental science courses.
- Implement three modules of InTeGrate materials, or 6-9 weeks of InTeGrate materials.
- Administer IAI (InTeGrate Attitudinal Instrument)
- Administer pre and post course GLE
- Administer 2 essays (systems thinking and interdisciplinary)
- Evaluate the materials and the impact upon the students.

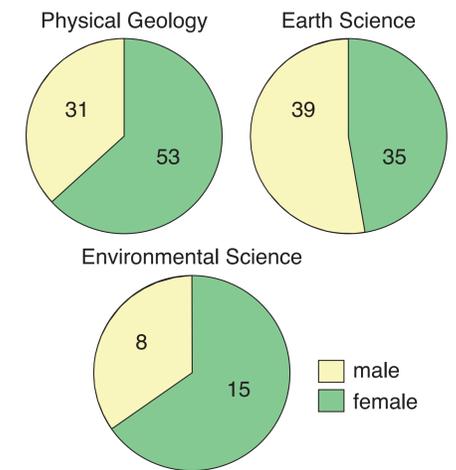
### Fall 2015 “Control Group”

- No InTeGrate materials used
- Students with paired GLE, essay, and IAI data



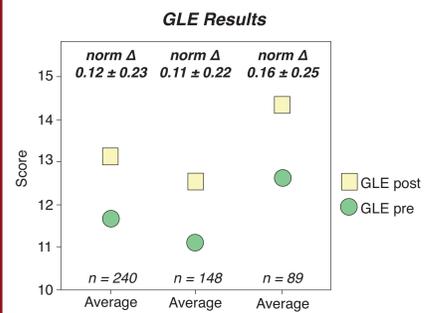
### Fall 2016 “Treatment Group”

- InTeGrate materials used
- Students with paired GLE, essay, and IAI data

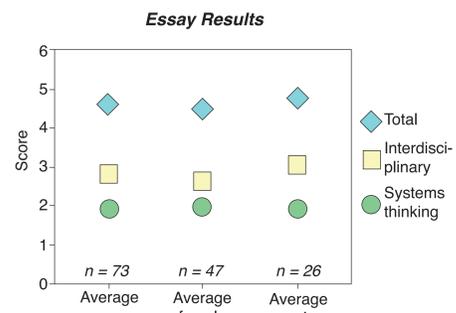


## RESULTS

### Fall 2015 “Control Group”

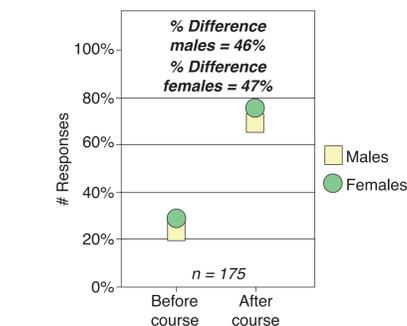


Female students are learning in introductory geology courses (13% improvement), but GLE results do not improve as strongly as the results of male students (14% improvement).



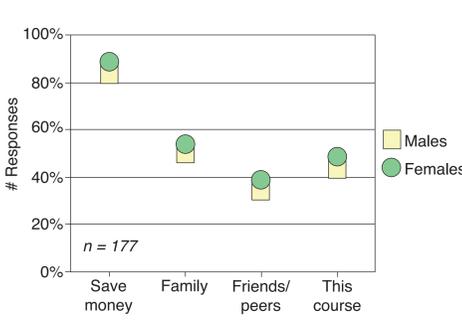
Males and females performed about the same on the systems thinking question, but males performed better on the interdisciplinary question.

### Degree of motivation to take action to create a more environmentally sustainable society.



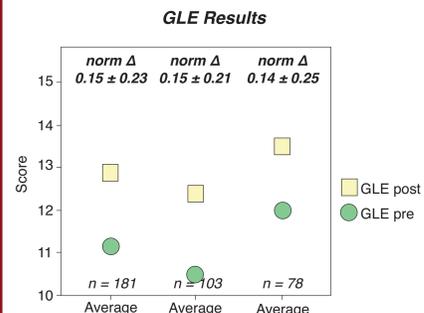
An equal number of males and females gained motivation for taking action in personal life and career towards a more sustainable society.

### Factors or sources that influence student's decision to perform environmentally sustainable actions.

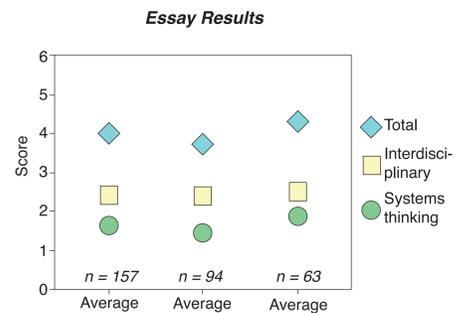


Males and females generally influenced by the same factors to the same degree when deciding on environmentally sustainable decisions, with saving money as the largest driver.

### Fall 2016 “Treatment Group”

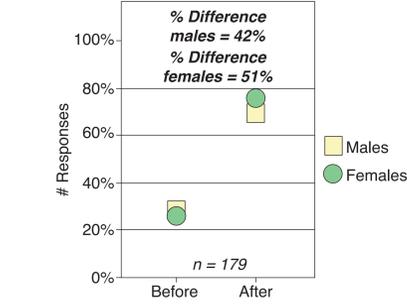


After InTeGrate materials, GLE scores of female students improve compared to courses without InTeGrate (19% improvement), and score difference between males and females decreases.



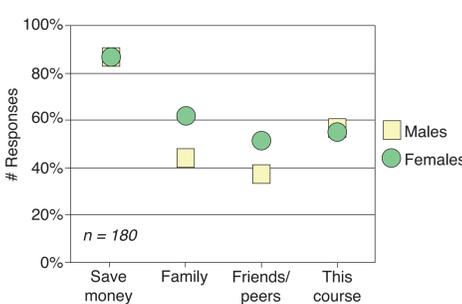
After InTeGrate materials, female student scores on the interdisciplinary question improved to match that of male students. However, average scores for female students were still lower than those of male students.

### Degree of motivation to take action to create a more environmentally sustainable society.



After InTeGrate materials, there was an increase in the number of females who were motivated to take action in personal life and career towards a more sustainable society.

### Factors or sources that influence student's decision to perform environmentally sustainable actions.



Although saving money remains high, females were more likely to be influenced by friends and family when deciding to perform sustainable actions. The geoscience course with InTeGrate also had a greater positive impact on sustainable decisions relative to the control semester for both males and females.

## CONCLUSIONS

- Relative to males, females scored lower on the GLE and essay in both InTeGrate and non-InTeGrate semesters.
- After InTeGrate materials, females had higher gains on both the GLE and the interdisciplinary essay question.
- Both males and females were influenced by a geoscience course to take action to create a more environmentally sustainable society. However, more females were motivated (relative to males) to do so after participating in a course with InTeGrate materials.
- Males and females are influenced by the same factors and to the same degree to make decisions to achieve an environmentally sustainable society.
- After InTeGrate materials, females are more likely than males to make decisions based on the influence by friends and family.
- We conclude that InTeGrate materials benefit females in their geoscientific understanding, increase their motivation to take action to create an environmentally sustainable society, and consider their social circles as one of their greatest influences in their decision making.
- Future development of InTeGrate materials should consider activities that include friends and family beyond the classroom to further engage female students with the geosciences.

## ACKNOWLEDGEMENTS

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