Comparison of student success between high-interaction and low-interaction classroom designs in an introductory Biology course

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Background

- The traditional method of instruction in higher education is typically lecture-based and requires low levels of interaction from students.
- Active learning (interaction) is widely promoted as a means to improve student knowledge acquisition and critical thinking skills in comparison to traditional approaches (no interaction) (Freeman et al., 2014).
- However, there is limited support for how the degree or level of interaction enhances student success.

Purpose of Study

- To compare the student success in a high-interaction section to a more traditional, low-interaction section of introductory Biology at a large southeastern university in Fall 2016.

Study Population

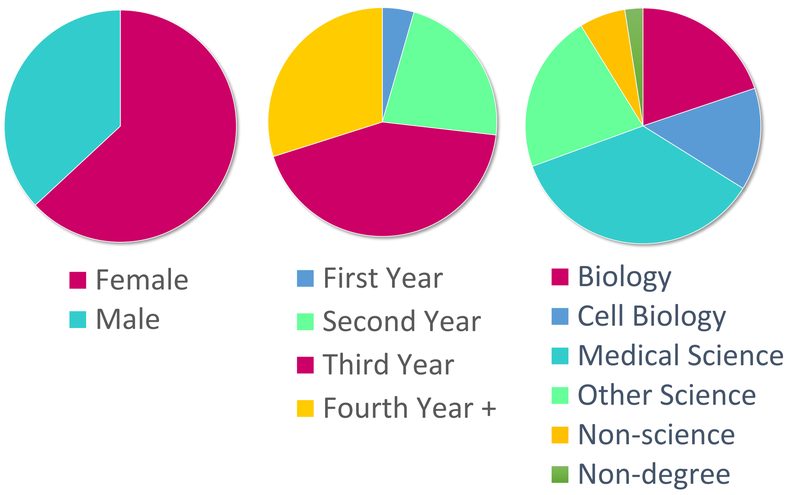

Fig. 1. The ratio between males and females (left), year of study (middle), and major category (right) for all of the students that agreed to participate in the study from both sections of BSC 2011 Biological Diversity.

Methods

	High-interaction	Low-interaction
Class Size	360	88
Number of Students in Study	295	68
Average Number of Clickers	17.8 ± 4.1	4.0
Average Evaluation Rank	4.01	4.21

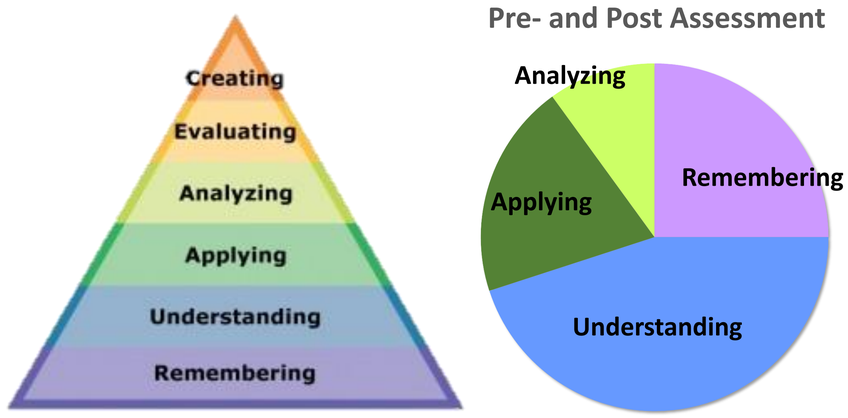

Fig. 2. The Bloom's Taxonomy hierarchy (Anderson et al., 2001) (left) used for ranking the pre-and post- assessment (n=20 questions) (right).

- Two sections of BSC 2011 Biological Diversity were taught in Fall 2016, one section with high-interaction (17.8 ± 4.1 clicker questions) and the other with low-interaction (4 Clicker questions).
- All students were given a 20 question pre-assessment on the first day of class. These 20 questions recurred on the final exam (post-assessment). The scores from these two assessments were then used to calculate the learning gain for each student.
  - $\text{Learning gain} = \frac{\text{post assessment} - \text{pre assessment}}{100 - \text{pre assessment}}$
- Gradebook data was only used for students who agreed to participate in the study in accordance with the IRB for human subject research.
- Learning gains were compared between sections with linear mixed-effect models with classroom design as a fixed effect and gender, level, and major as random effects (Fig. 3).

Results and Discussion

- The average learning gain was higher for students in the low-interaction section (Fig. 3).
- Students preferred the class with low levels of interaction (evaluation data not shown).
- The difference in class size is an important confounding factor, and higher learning gains could thus be a result of a learning environment that facilitated one class better than the other. To address this weakness, this experiment is currently repeated in BSC 2011 in Spring 2017 with two sections of comparable sizes.

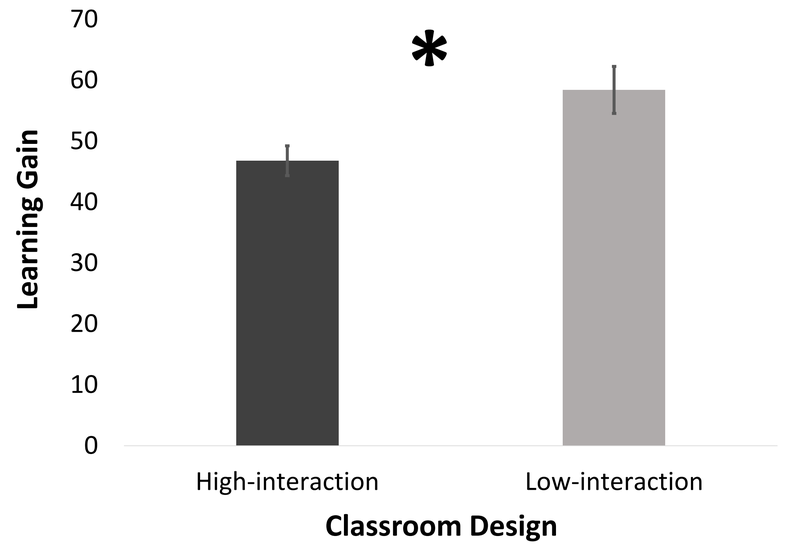

Fig. 3. The average learning gain for each classroom design, high-interaction (n=295) and low-interaction (n=68) (p=0.0086), with standard error of the mean bars.

References

Freeman, S., S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt, and M. P. Wenderoth. 2014b. Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences 111:8410–8415.

Anderson, L. W., and D. R. Krathwohl. 2001. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. Allyn & Bacon, Boston, MA.

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