



Structured supplemental instruction leads to increased student learning in Introductory Biology

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Introduction

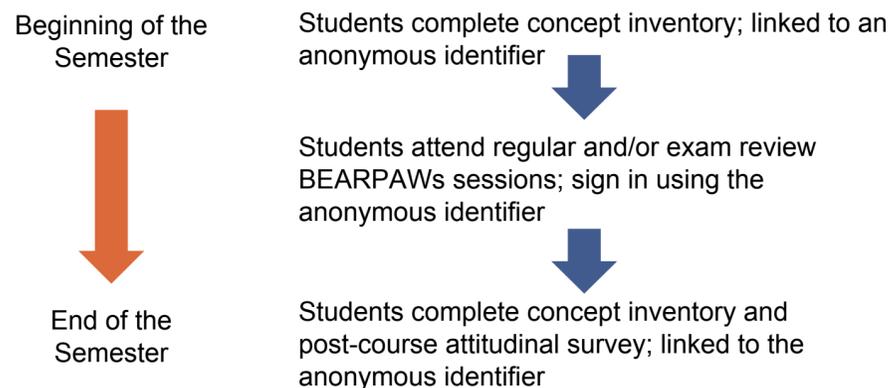
Supplemental Instruction (SI) has been implemented on campuses across the globe, helping students not only pass, but excel in historically difficult classes¹. As of 2016, Mercer University has held SI sessions for classes including Calculus, Physics, General Chemistry, and Organic Chemistry. No SI sessions were offered for Introductory Biology classes, despite many students struggling to pass the courses. SI sessions have proven to be powerful learning tools in areas such as mathematics and chemistry, but are implemented less often in biology courses². In response to the need for an SI program for Introductory Biology students, we created Biology Educational Achievement Resources: Peer-Assisted Workshops (BEAR PAWs) as a resource for students to seek further instruction from a student who has previously mastered the biology course. During the course, students were offered two types of BEAR PAWs sessions.

Table 1. Description of the two types of BEAR PAWs Sessions

Regular Sessions	Exam Review Sessions
<ul style="list-style-type: none"> Held several times per week by TA's; times and locations vary each day 	<ul style="list-style-type: none"> Held a few days prior to each scheduled exam in the course (4 times in the semester)
<ul style="list-style-type: none"> "Drop in" style sessions, similar to faculty office hours 	<ul style="list-style-type: none"> Scheduled on a specific date and time for 2 hours
<ul style="list-style-type: none"> No set agenda; students responsible for bringing questions related to material 	<ul style="list-style-type: none"> TA's set the agenda by creating an exam review "game" that aligns with the LO's and prompts retrieval practice in students.

We assessed the effectiveness of both types of SI. We hypothesized that student attendance at regular BEAR PAWs sessions will have a greater effect on student learning than exam review sessions, because students will need to assess their own understanding in order to formulate questions for the TA, thereby promoting metacognition.

Methods



To examine student learning throughout the course, we used performance on the pre- and post-course concept inventory to calculate normalized learning gains³(NLG). In order to determine which factors affect performance on the concept inventory, we performed a logistic regression analysis using performance on concept inventories and attendance at BEAR PAWs as fixed effects and anonymous identifier as random effect⁴. All data collection was approved by the Mercer University IRB (H1801029_01).

Results

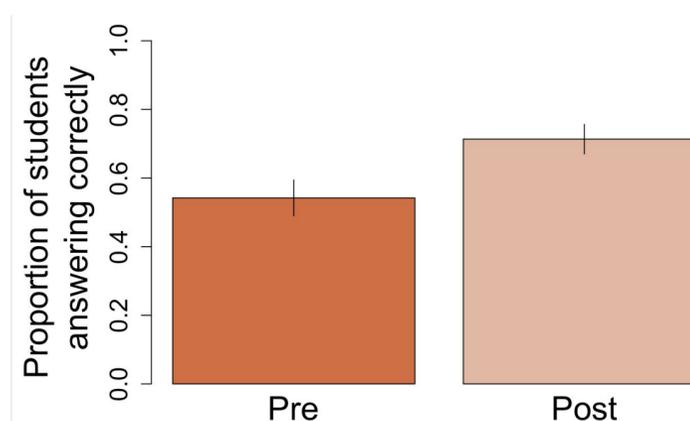


Figure 1. Proportion of students answering questions correctly on the pre-course vs. post-course concept inventory. Students are replicates (n=68). Students perform significantly better on the concept inventory at the end of the course ($p < 0.0001$). The average normalized learning gain for students in the course is 37.5%. Students were 2.16x more likely to answer a question correctly on the post-course concept inventory compared to the pre-course.

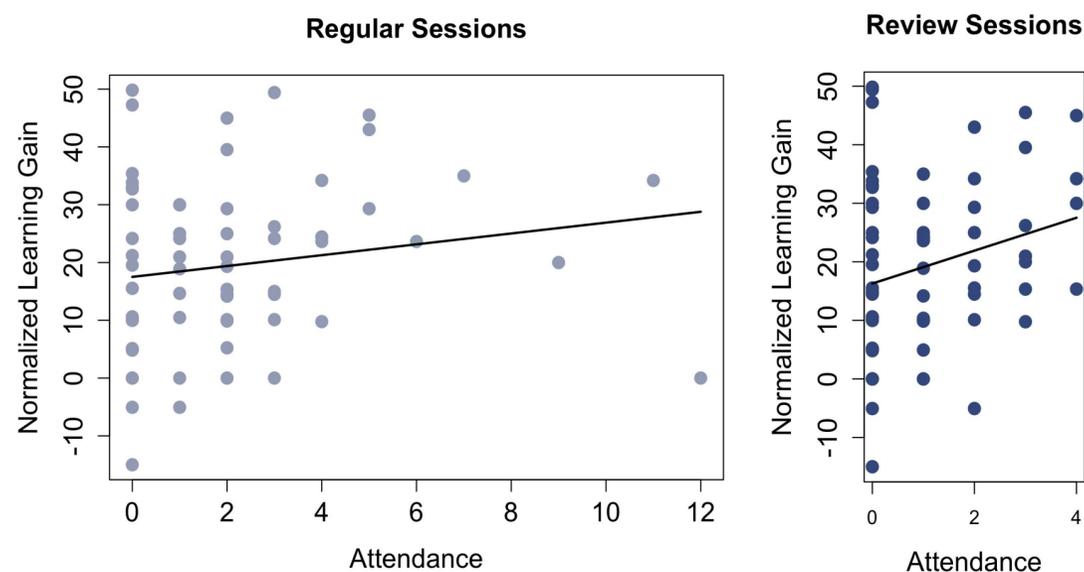


Figure 2. Attendance at Regular sessions (left panel). Equation is $y = 0.94x + 17.51$; the slope of the regression of y on x is not significantly different from zero ($p = 0.178$); $r^2 = 0.03$. Attendance at Review sessions (right panel). Equation is $y = 2.89x + 16.29$; the slope of the regression of y on x is significantly different from zero ($p = 0.04$); $r^2 = 0.06$. Each point is one student's normalized learning gain. The log odds of answering correctly on post-course concept inventory increased 1.14 times for each time a student attended a BEAR-PAWS review session.

Acknowledgements

We would like to acknowledge and thank Shivani Patel, Earl Ford IV, and Anjali Patel for serving as BEAR PAWs TA's. We also thank the students in BIO 211 at Mercer University, the anonymous referees that reviewed our abstract, and our respective institutions for providing financial assistance to attend this conference.

Table 2. Summary of student responses

56%	of the students attended at least one BEAR-PAWs session.
61%	of total BEAR PAW's attendance was at regular (office hours) sessions
30%	students rated Teaching Assistants outside of class as helpful or very helpful

Discussion

- Students learning gains were affected by attending BEAR PAWs review sessions, but not regular BEAR PAWs sessions. This indicates that structured SI sessions are more effective at increasing student learning.
- Our original hypothesis, that students who came to BEAR PAWs sessions would have higher NLG than students who attended just exam review sessions, was rejected.
- This may be caused by students inability to incorporate retrieval practice in their own study plans⁵. Structured SI sessions can be an opportunity for students to perform retrieval practice.
- Students did not connect their learning gains with attendance at BEAR PAWs review sessions

Recommendations

- SI sessions should be structured for students to perform retrieval practice, in order to make sessions more effective.
- SI sessions should include opportunities for student metacognitive reflection.
- SI sessions should be offered multiple times a week so that they are accessible by all students

References

- Congos, DH & Schoeps, N. 1998. Inside Supplemental Instruction Sessions: One Model of What Happens that Improves Grades and Retention. *Research and Teaching in Dev Ed* 15 (1).
- Crouch, CH & Mazur, E. 2001. Peer Instruction: Ten year of experience and results. *Am J of Physics* 69 (970).
- Hake, RR. 1998. Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *Am. J. Phys.* 66(1): 64-74.
- Theobald, R & Freeman, S. 2014. Is It the Intervention or the Students? Using Linear Regression to Control for Student Characteristics in Undergraduate STEM Education Research. *CBE Life Sci Ed* 13.
- Karpicke, JD, Butler, AC, & Roediger III, HL. 2009. Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? *Memory* 17(4): 471-479.