



SMALLab Learning

Research Summary

Overview

SMALLab Learning is grounded in years of empirical research conducted in K-12 schools and museums across the country. Faculty and graduate student researchers at Arizona State University principally conducted this research. Multiple government agencies and private foundations have supported this research including the National Science Foundation, the MacArthur Foundation, and the Kauffman Foundation. This research is published in international peer reviewed journals and conference proceedings, and constitutes a foundation of empirical evidence that embodied learning works. In three recent studies, researchers focused on the following questions:

1. How does student learning in *SMALLab* compare to regular classroom instruction?
2. Can *SMALLab* be successfully integrated with existing teaching methods and curricula?
3. Can embodied learning with *SMALLab* promote a truly student-centered learning environment?



This document summarizes three studies that demonstrate the positive impact that embodied learning can have on student achievement and student/teacher discourse in the classroom:

1. *Study 1*: Student Achievement with Chemistry Titration Scenario
2. *Study 2*: Student Achievement with Geology Layer Cake Scenario
3. *Study 3*: Student Discourse with Geology Layer Cake Scenario



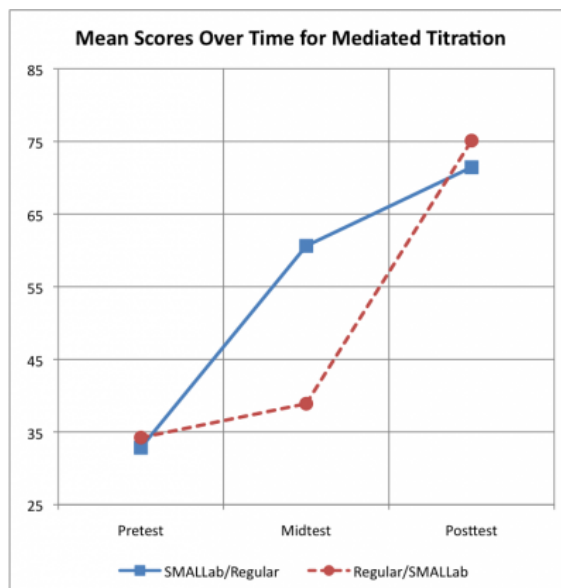
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Study 1: Student Learning with Chemistry Titration Scenario

Research Question: How does student learning in SMALLab compare to regular classroom instruction?

Method: We worked with students and their teacher in an urban public high school setting. Multiple classes were randomly assigned to receive either SMALLab or Regular Instruction first. A waitlist control paradigm was used. Students took the midtest and then order of intervention switched; the classes received the second intervention – either Regular Instruction or SMALLab. We held content and teacher constant. Over the six days of the study students took the content test three times: pretest, midtest and posttest.

Results: Student learning gains were significantly higher after the SMALLab learning intervention when compared to regular classroom instruction. The graph shows student's mean scores changing over time.



This table shows the mean scores, the standard deviation (in parentheses) and the effect sizes (ES) for this study. The bolded effect sizes are after the SMALLab intervention.

Group	n	Pretest	Midtest	Mid ES	Posttest	Post ES	Overall ES
1 (SMALLab/Reg)	16	32.83 (18.19)	60.62 (32.65)	1.09	71.44 (25.17)	.37	1.78
2 (Reg/SMALLab)	35	34.23 (13.04)	38.89 (18.23)	.30	75.11 (19.37)	1.93	2.52

References: Tolentino, L., Birchfield, D., Megowan-Romanowicz, M.C., Johnson-Glenberg, M., Kelliher, A., Martinez, C. (2010). Teaching and learning in the Mixed-Reality Science Classroom. *Journal of Science Education and Technology*, Volume 18, Issue 6, 501-517.



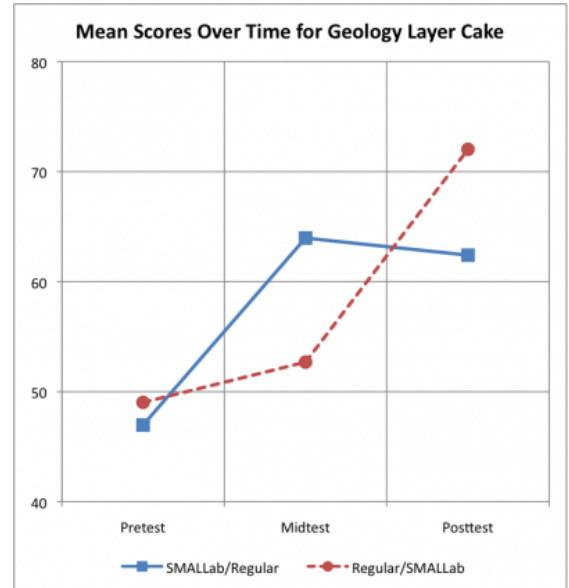
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Study 2: Student Learning with Geology Layer Cake Scenario

Research Question: How does student learning in SMALLab compare to regular classroom instruction with different students, teachers, and learning content?

Method: We worked with students and their teacher in an urban public high school setting. Again, classes were randomly assigned to receive either SMALLab or Regular Instruction first. A waitlist control paradigm was used. Students took the midtest and then order of intervention switched; classes received the second intervention –either Regular Instruction or SMALLab. We held content and teacher constant. Over the six days of study students took the content test three times: pretest, midtest and posttest.

Results: Working with a different group of students, a different teacher, and a different set of learning objectives, we still see that student learning gains were significantly higher after SMALLab learning when compared to regular classroom instruction. The graph illustrates that the same patterns hold as in the first study.



This table shows the mean scores, the standard deviation (in parentheses) and the effect sizes for this study. The bolded effect sizes are after the SMALLab experience.

Group	n	Pretest	Midtest	Gain	Mid ES	Posttest	Gain	Mid to post ES
1 (SMALLab/Regular)	37	46.97 (18.21)	63.97 (22.48)	18.00	1.44	62.41 (20.88)	1.56	-.09
2 (Regular/SMALLab)	39	49.03 (13.60)	52.69 (16.52)	3.65	.38	72.03 (19.42)	19.42	1.34

Reference: Birchfield, D., & Johnson-Glenberg, M. C. (2010). A next gen Interface for embodied learning: SMALLab and the geological layer cake. *International Journal of Gaming and Computer-mediated Simulation*, 2, 1, 49-58.

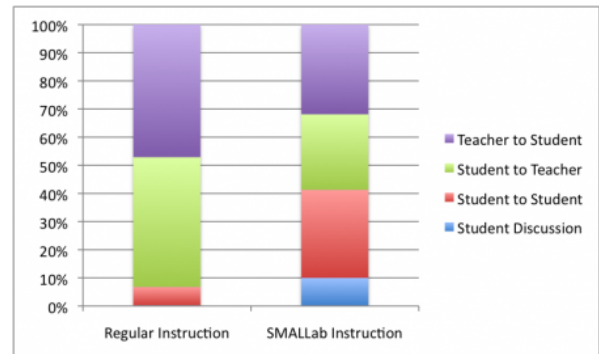


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Study 3: Student Discourse with Geology Layer Cake Scenario

Research Question: Does SMALLab learning lead to student-centered learning when compared to regular classroom instruction?

Method: Researchers videotaped learning sessions for groups of students and their teacher in SMALLab and in their regular classrooms. Researchers coded the types of verbal interactions that occurred throughout each of the learning experiences. Four types of verbal utterances were classified and compared: (1) teacher-to-student, (2) student-to-teacher, (3) student-to-student, and (4) student discussions. Elevated levels of student driven interaction are interpreted as evidence of a more student-centered learning environment.



Results: Student-driven utterances were substantially higher in SMALLab when compared to the same students learning with their teacher in their regular classroom. This chart shows the proportion of each type of utterance in each condition. There is a marked increase in the number of student-to-student and student-discussions during SMALLab. The full research publication provides additional details regarding changes over time.

Reference: Birchfield, D., & Megowan, M. C. (2008). Earth science learning in SMALLab: A design experiment for mixed-reality. *International Journal of Computer-Supported Collaborative Learning*, Volume 4, Issue 4, 403-421.

More Information

SMALLab Learning is a leader in embodied learning. We offer products and services for schools, museums, and the home. For details and pricing, please contact:

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