Bio-Sphere: Solving 21st Century Problems and Enhancing Science Learning Through Digital Text, Simulations, & Design Challenges

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Goals and Objectives

- Help students understand central ideas and conceptual relationships in science
- Foster students' science understanding by engaging them in science and engineering practices and helping them to explore technological content to solve 21st century problems
- Implement units in rural and underserved areas

Biology Content Units

1. Make Your Own Compost!
- Reducing waste in landfills
- Energy transfer in ecosystems

2. Grow Healthy Plants!
- Sustainable agriculture
- Genetics and environmental impacts

Classroom Studies

Make Your Own Compost!
- 437 8th grade students in Wisconsin
- 96 7th grade students in North Carolina
- 26 pre-service teachers in North Carolina

Grow Healthy Plants!
- 207 7th grade students in Wisconsin
- 2 school districts

Data Sources

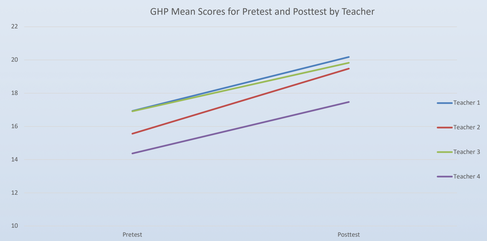
Pre and post science knowledge tests
- 26 questions for GHP, 31 questions for Compost
  - Memory, Understanding, and Application questions

Science practices test
- 21 total questions

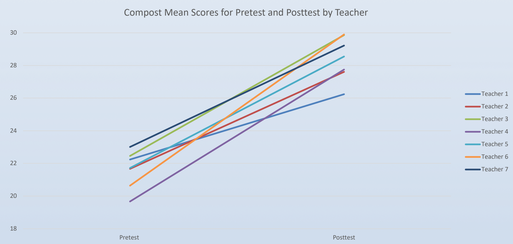
Student's science journals

Classroom audio and video

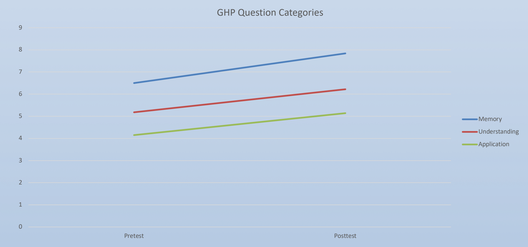
Results: Growing Healthy Plants!



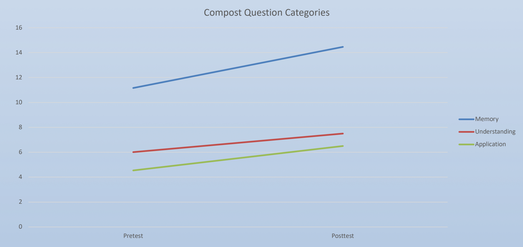
Results: Make Your Own Compost!



- Significant difference in pre-post scores for both units ($p < .0001$)
- Posttest > pretest for all teachers

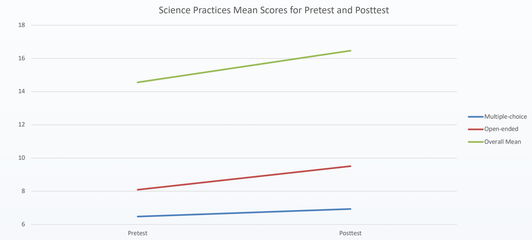


- Significant improvement for all three question categories ($p < .0001$)
- Effect size (Cohen's d): Memory (.733); Understanding (.652); Application (.669)



- Significant improvement for all three question categories ($p < .0001$)
- Effect size (Cohen's d): Memory (1.270); Understanding (.929); Application (1.015)

Results: Science Practices Test



- Significant difference in pre-post scores ($p < .0001$)
- Posttest > pretest for multiple-choice, open-ended, and total score

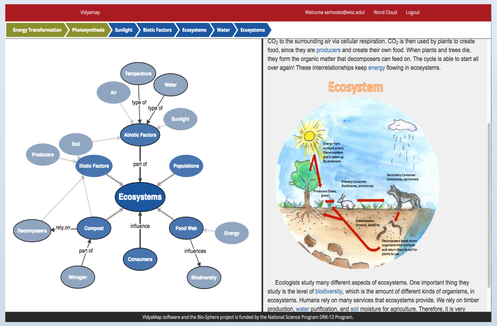
Students' Science Practices Pre – Post Sample Responses

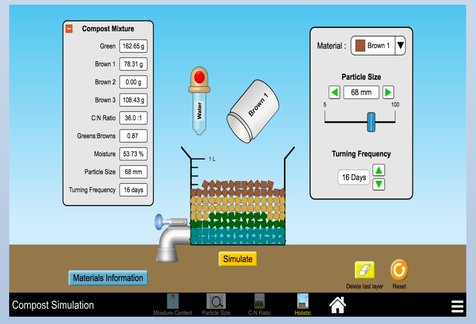
Question: "*How do scientists convince other people about their explanations for why things happen the way they do in the world around us? Explain your answer in as much detail as you can.*"

Pre	Post
"They tell us so we know what to expect."	"Scientist convince others by having other scientists try out the experiment. The cycle continues, the retry, retry, retry, and retry over and over again to see if the data in correct. Then, the science community releases information to the public about the discoveries."
"They give facts about their experiments."	"Scientists show results from their experiments to convince other people about their explanations for why things happen the way they do. The more results they have the more people are going to believe them."

Scaffolding Students' Learning

Epistemic Scaffolds for Learning from VidyaMap
- Examined the effect of epistemic reflection prompts on students' biology learning from VidyaMap
- Two classes given prompts for epistemic reflection, to encourage students to reflect on the epistemic role of VidyaMap
- ANCOVA results showed that students who received the prompts outperformed the comparison classes in their learning
- Positive correlation was found between students' levels of epistemic reflection and their science learning with VidyaMap
- Students with high epistemic reflection scores used VidyaMap as an epistemic tool
- Students with low epistemic reflection scores used VidyaMap to find information without using its epistemic features





Teachers' Role in Learning from Simulations and Physical Models
- Explored the mediating role that teachers play in helping students utilize multiple models
- Analyzed discourse from two teachers' classes to examine how they discussed the affordances of models
- We found significantly more discussion of the affordances and constraints of models in Teacher A's classes, while Teacher B focused more on discussing science content
- Teacher A's students used the affordances of the models to purposely engage in scientific thinking
- Teachers' talk about the affordances of different types of models seems to be important to support students' purposeful use of multiple models

NSF Grant #1418044