Science in Global Issues: An Integrated High School Science Course

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Project Goals

Science in Global Issues is a two-year integrated science program for grades 9–10. This sequence (see Figure 1) includes nine units: an introductory unit on sustainability, four biology units, two chemistry units, and two physics units. Students who complete the two-year program will have had the equivalent of a year of high school biology and a semester each of chemistry and physics.

Figure 1. Science in Global Issue Course Overview

	Unit Title	Content Focus	Sustainability Issue
Year One	Sustainability	Introductory Unit	What is Sustainability?
	Living on Earth	Biology: Ecology	Sustainable Fisheries
	EarthÕs Resources	Chemistry: Matter	Use of EarthÕs Resources
	Mitigating Risks from Waves	Physics: Waves	Earthquakes and Electromagnetic Radiation
	World Health	Biology: Cell Biology	Global Infectious Diseases
Year Two	Feeding the World	Biology: Genetics	Genetically Modified Organisms
	Maintaining Diversity	Biology: Evolution	Conservation and Biodiversity
	Generating Electricity	Physics: Electricity & Energy	Supplying Electrical Energy
	Fueling the World	Chemistry: Chemical Reactions	Alternative and Fossil Fuels

SGI Approach

SGI is based on SEPUP's issue-oriented instructional model and was developed through a backward design approach.

Key elements of SGI include:

- Learning goals based on the National Science Education Standards and key state standards
- Inquiry–based exploration of science
- The SEPUP/BEAR authentic embedded assessment system
- Learning experiences that engage students in personal, societal, and global issues
- Embedded literacy support

Overarching sustainability concepts that connect each of the SGI units include:

- The environmental, economic, societal, cultural, and equity considerations that contribute to the sustainability of a decision
- Perspectives on sustainability of different groups, such as developing and developed countries
- Indicators of sustainability
- Personal, community, and global aspects of sustainability
- Use of scientific evidence and the analysis of trade-offs to inform decisions related to sustainability

Results

Student Learning Data

Student Pre-test/Post-test Results

- Matched pairs have been analyzed for six units: four biology units and two physics units
- Tests included approximately 35 multiple choice questions and 5 to 8 short answer questions.
- For the biology tests (Figure 2) , student background information was collected and used to disaggregate results by subgroup (Figure 2). These results are presented for the complete test with all items.
- For the physics tests (Figure 3), sample sizes were not large enough to disaggregate by student group. Results presented are disaggregated by item type.

Figure 2. SGI Biology Pre-Post Effect Sizes

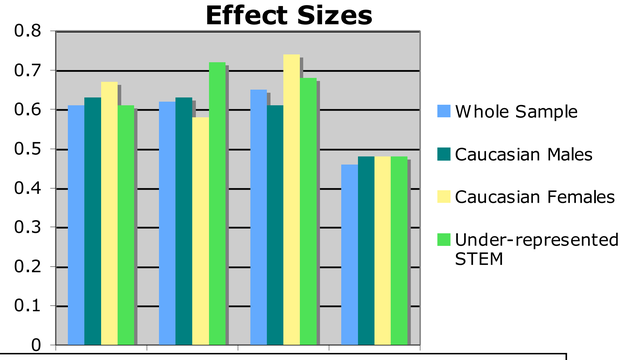
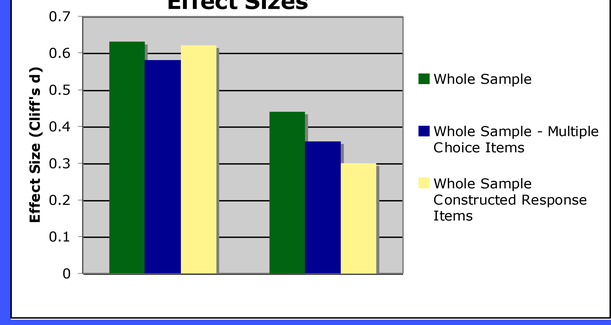


Figure 3. SGI Physics Pre-Post Effect Sizes



Teacher Feedback Data

Teacher feedback was collected using several instruments including Teacher background surveys, Activity surveys, Unit surveys and End-of-field-test surveys (Figures 4, 5, and 6)

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Figure 4: Biology TeachersÕ Comparison of SGI with other Curricula: Instructional Methods

Percentage of teachers who responded "frequently" or "very frequently" when asked the following questions about the SGIcurriculum materials vs. other curriculum materials (N=24)

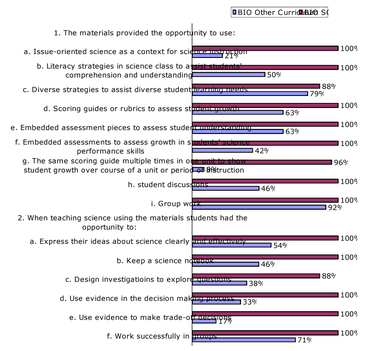


Figure 5: Physics Teachers' Comparison of SGI with other Curricula: Instructional Methods

Percentage of teachers who responded "frequently" or "very frequently" when asked the following questions about the SGI curriculum materials vs. other curriculum materials (N=12)

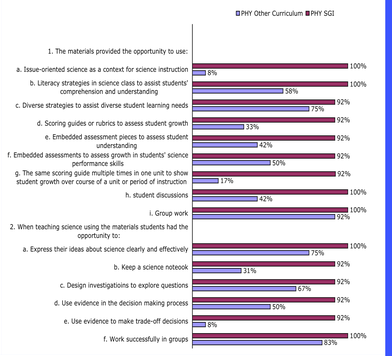
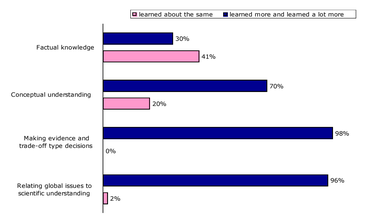


Figure 6: TeachersÕ Comparison of SGI with Other Curricula: Student Learning

Teacher responses to the survey question, "How would you compare student learning in SGI units with other units of the same topic in the following areas?" (N=52)



Conclusions

Student learning results

Effect sizes calculated for pre-post gain on students' test scores for each unit suggest large gains in student learning for all 4 biology units (Cliff's d≥.46) and moderate to large gains for the 2 physics units (Cliff's d=≥.44). For the 4 biology units, it was possible to conduct separate efect size analyses by three demographic groups as well—caucasian male, caucasian female and under-represented STEM. For each group, the effect size analysis showed large gains in student learning (Cliff's d≥.44). Furthermore, there were no significant differences between groups in their growth on the test as a whole, suggesting the curriculum is similarly effective for supporting learning in each group.

Small effect size Cliffs d = 0.147; medium effect size Cliffs d = 0.330; large effect size Cliffs d = 0.474 (Cliff, 1993; Romano et al, 2006).

Teacher Feedback Findings

The majority of teachers report that:

- They would teach the units again.
- Student engagement is moderate to high.
- Personal, societal, and global issues provide an opportunity for students to apply what they have learned and engage in critical thinking about how science and technology relate to their lives and their community.

Work in Progress

This course has been field-tested in a variety of classrooms throughout the United States with diverse groups of students. The units are currently being prepared for commercial publication in 2010.

Analysis of student performance on embedded assessments based on the SEPUP/BEAR scoring variables is in progress as part of the revision process.

- These assessments include variables related to scientific content, process, and decision making.
- In order to evaluate the impact of the issue-oriented approach, students' performance on the SEPUP Evidence and Trade-offs (ET) variable will be assessed within and across units.

For further information

Email Barbara Nagle at bnagle@berkeley.edu.

This project is funded by the National Science Foundation, grant number ESI-0352453.

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