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Student Achievement in *Issues and Science*: A Two-Year Efficacy Study

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STUDENT ACHIEVEMENT IN *ISSUES AND SCIENCE*: A TWO-YEAR EFFICACY STUDY

RESEARCH INTO PRACTICE

SEPUP (Science Education for Public Understanding Program) is a science and engineering education program that has been designing innovative secondary science instructional materials with an issue-oriented approach for over 30 years. SEPUP materials put educational research into practice, drawing on seminal research studies from outside experts in the field and our own research with classroom teachers to inform our design and development.

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EXECUTIVE SUMMARY

This report provides findings from a two-year independent research study led by the University of California, Berkeley, to assess the effectiveness of the *Issues and Science (IAS), Third Edition Revised for the NGSS* program for middle school. This curriculum integrates real-world issues with disciplinary core ideas, crosscutting concepts, and science and engineering practices. Pre- and post-assessment **student data collected before and after instruction from 2024–2026 show statistically significant gains in students’ science content knowledge. Data also show students’ increasing appreciation for the usefulness of science and the relevance of the unit issues to their lives.** Qualitative data from post-unit teacher surveys support the quantitative findings, and document pedagogical strategies that led to student learning and engagement.

METHODOLOGY

Research Questions

In this study, we investigated the efficacy of the middle grades NGSS-aligned curricular materials, *Issues and Science* authored by the Science Education for Public Understanding Program (SEPUP) and published by Lab-Aids. Below are the research questions that guided this work:

1. What are the impacts of SEPUP curricular materials on student learning and views of science?
2. How does the use of the SEPUP curricular materials impact teachers’ pedagogical approach to teaching science?

Teacher and School Demographics

This study included 20 unique middle school teachers (grades 6–8) with a range of science teaching experience, from 2–29 years, and an average of five years teaching the *Issues and Science* curriculum. The teachers were located across eleven school districts in nine states (Figure 1), with representation across urban, suburban, and rural schools. Approximately half of the teachers taught at schools qualifying for Title 1 funding. Teachers’ classes comprised a broad range of student needs and characteristics. Most teachers reported that approximately 10% (or less) of their students were classified as multilingual learners (MLL). Additionally, half of the teachers stated that one quarter of their students have IEPs or 504 plans.

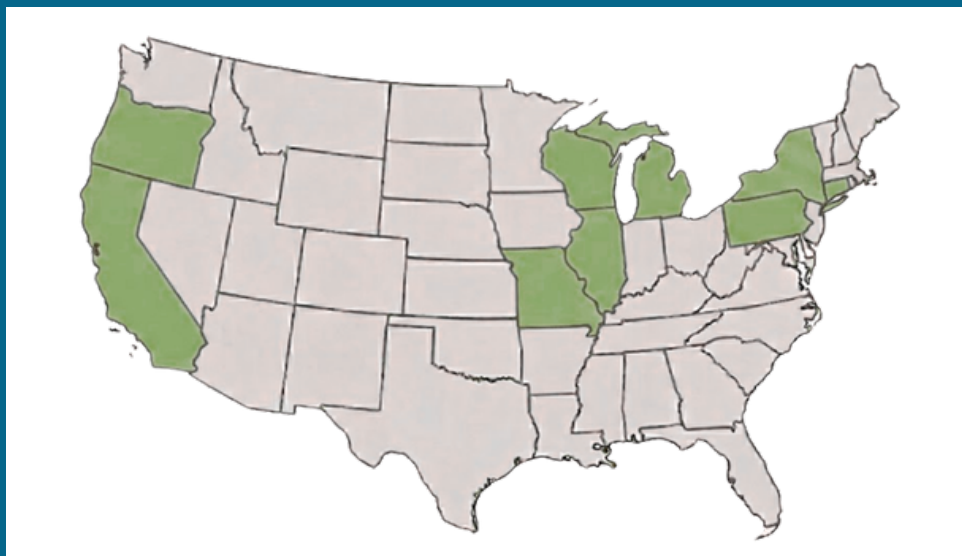


Figure 1: States represented by teachers in this study: CA, CT, IL, MI, MO, NY, PA, and WI

Each teacher taught between three and seven classes. Nine of the 17 units from *Issues and Science* were included in this study: *Body Systems*, *Ecology*, *Energy*, *Evolution*, *Chemistry of Materials*, *Chemical Reactions*, *Geological Processes*, *Weather and Climate*, and *Land, Water, and Human Interactions*. (One teacher, while using an IAS unit in his seventh grade classroom, implemented the *Ecology* unit from SEPUP's high school biology program, *Science and Global Issues, Biology*, in his eighth grade classroom for this study).

Data Collection and Analysis

To assess gains in science content, prior to launching a unit of the teacher's choosing, each teacher administered a multiple-choice assessment to their students. Each assessment contained between 18–22 items. Upon completion of the unit, teachers administered an identical assessment to their students. Post-instruction scores were compared to pre-instruction scores for each student, and results were combined and analyzed to yield the results reported below. Data from students who assented to this study were included in the analysis of results.

To assess students' attitudes about science (the importance of science and the relevance of the units' issues), students were asked additional questions on the post-assessment that were not scored. These questions asked students to retrospectively reflect on their attitudes prior to beginning the unit and then their current attitudes after having completed the unit.

To better understand the teachers' pedagogical approaches and reflections on the units they taught, each teacher completed a post-unit survey. The demographic data obtained from this survey were described above, and the qualitative questions were analyzed to look for emergent themes. Some of the qualitative responses were quoted and described in the analysis below.

RESULTS AND FINDINGS

Evidence of Student Achievement in Issues and Science

Students demonstrated statistically significant gains in science content knowledge upon completion of units in *Issues and Science* (Figure 2).

Students scored nearly 50% higher on post-instruction assessments compared to pre-instruction assessments, demonstrating the effectiveness of *Issues and Science* in promoting student learning of the content. These results held true regardless of district, school, or classroom, as well as content area (life, physical, or earth/space science), and setting (rural, suburban, or urban).

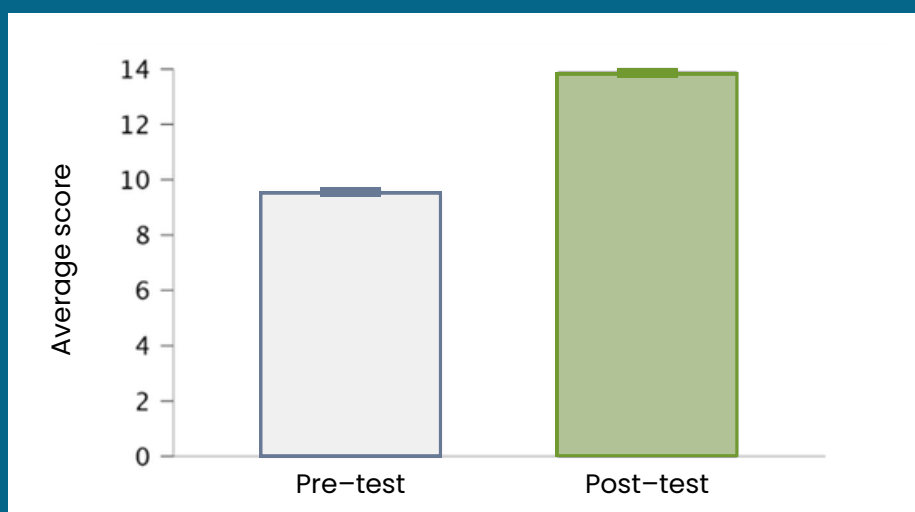


Figure 2: Students scored significantly higher after instruction using a unit from *Issues and Science* than before. ($p < 0.001$, n (number of students) = 2303, Wilcoxon paired sample t-test)

In the post-unit surveys, teachers discussed pedagogical approaches from IAS that supported this student learning. **Overwhelmingly, across the units, teachers mentioned that the hands-on activities led to the most student engagement.** Below are a few examples:

- While teaching the *Land, Water, and Human Interactions* unit, one teacher mentioned how, “They love cutting canyons and the wave maker activities every year...There are easy directions, but they also have some freedom with building and everyone is always excited to see what works. After Activity #7 I find I am always holding the model up and referring back to it. They really get it!”
- Upon reflection of teaching the *Ecology* unit, one teacher exclaimed, “The owl pellet lab is always fun and students love it. To see the **(ah-hah) moments with students when they realize this all relates to what is eaten and ecosystems is the best!**”

Teachers also mentioned other approaches that supported student learning, including whole class discussions. One teacher (who taught a few different units for this research), remarked how, “We use whole class discussions to help promote the class culture of learning and to help embrace making mistakes from which we can collaborate and revise.” Several teachers also reflected on the impact of the analysis items. For example, one teacher noted how, “Many of the analysis questions lend themselves for great discussion.” Another teacher, who taught a few different units and participated during most of the two year period of this research project, reflected on how these questions stimulate student thinking by stating, “Students are asked to work on the lab and then complete the analysis questions. Some of **the discussions I overheard were amazing!**” Several teachers also noted how useful the 4-2-1 collaborative learning strategy was during teaching – one teacher reflected on how she has used the “4-2-1 almost everyday since I learned about it.”

Usefulness of Science in Students' Lives

During the post-unit assessment, students were asked to what degree they agreed with the following statement both before and after the unit, "I think science is useful in my life." **Students expressed statistically significant, positive changes in their perception of the usefulness of science to their lives upon completing a unit in *Issues and Science*** ($p < 0.001$, $n = 2334$, Wilcoxon paired sample t-test). Before the unit, the average student response was between "disagree" and "agree." After completing a unit, the average student response shifted upwards to between "agree" and "strongly agree" (Figure 3).

Students' Interest in the Unit Issue

Similarly, during the post-unit assessment, students were asked to what degree they agreed with the following statement both before and after the unit, "I think the unit's issue [insert unit-specific issue] is engaging and relevant to me." **Students' interest in and perception of relevance of a unit's issue increased significantly upon completion of a unit in *Issues and Science*** ($p < 0.001$, $n = 2334$, Wilcoxon paired sample t-test). Prior to instruction, across all units, the average student response was between "disagree" and "agree" regarding the relevance of the issue. After completing a unit, the average student response shifted upwards to between "agree" and "strongly agree" (Figure 4).



Figure 3. Students perceived science to be significantly more useful to their lives upon completion of the unit compared to before starting the unit ($p < 0.001$, n (number of students) = 2334, Wilcoxon paired sample t-test).

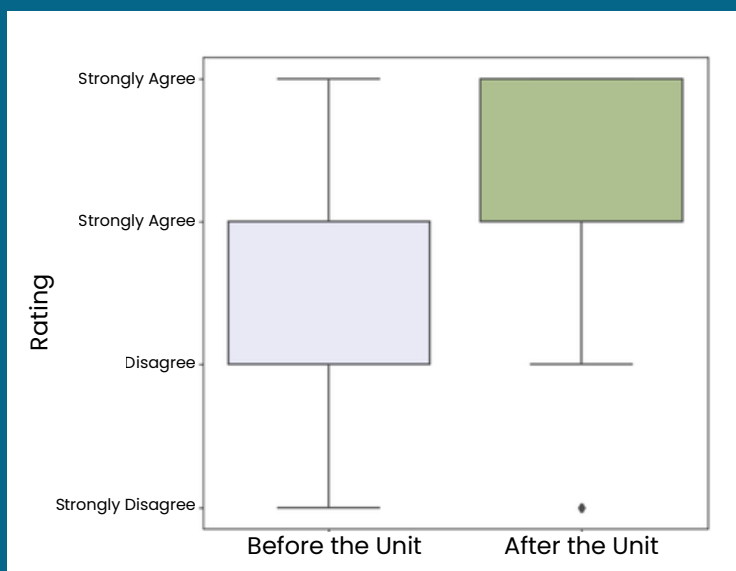


Figure 4. Students perceived the unit issue to be significantly more relevant to their lives upon completion of the unit compared to before starting the unit ($p < 0.001$, n (number of students) = 2334, Wilcoxon paired sample t-test).

Teacher Post–Unit Survey

Teacher comments from the post-unit surveys clearly resonated with the findings above. Across all units, teachers connected the *IAS* curriculum with students' experiences or local context in some way.

The following quotes illustrate how one unit (*Ecology*), when taught in different parts of the country and/or settings, can connect to students' lives:

- One teacher, who teaches on the west coast, noted, "We were in the middle of a multi-day rain storm and **students made strong connections** to the mini-landslides we were seeing to abiotic disruptions. As we also have wildfires often, many students discussed how those fires have destroyed ecosystems."
- A different teacher who teaches in a suburban district in the midwest, remarked about a unique connection during the *Ecology* unit with her students by stating, "Invasive species were easy to link to so many kids' lives. One student was talking about when she travels and how her food always gets checked. This helped me build a relationship with her."
- A teacher in a rural area on the west coast commented on the connection between the *Ecology* unit and students' lives by mentioning, "We discussed a lot about invasive plants. We are a farming community so **students understand how invasive plants are in our area.**"

The following quotes from three teachers in different states **illustrates how they connected physical and earth science units to their local context:**

- One teacher who taught the *Chemistry of Materials* unit noted a connection between a local creek and the content of the unit by stating, "We discussed [Name] Creek which is north of our school but in the [City] area. They are still cleaning up chemical waste from the Manhattan Project that has made its way into the waterways. Children grew up playing in the creek and are now at a 44% higher risk of cancer."
- After teaching the *Geological Processes* unit, one teacher commented on a connection between her state of residence and the *IAS* content by stating, "In the "Evaluating Site Risk" activity we were able to look at [State] and discuss whether or not we would be a viable option for storing nuclear waste. "
- After teaching the *Land, Water, and Human Interactions* unit, one teacher stated how, "We just built onto our school so we were able to relate to the process of how to pick a new location and mitigate erosion."

CONCLUSION

This research study shows evidence for the efficacy of the *Issues and Science* program for student learning and engagement across the middle grades. Positive knowledge gains and student engagement outcomes were seen in student data collected across eleven school districts across the west, midwest, and northeastern United States, for ten different science units. Teacher feedback also corroborates findings from student data, provides more insights into the pedagogical approaches that support student learning, shows how *Issues and Science* engaged their students, and how the units resonated with students' perceptions of relevance and local context. Taken together, **the findings from this research study: 1) show evidence of success for this middle school science program across the United States; and 2) are consistent with research from the field showing how a focus on socioscientific issues in science captures students' interest and improves students' understanding of scientific concepts** (Koo et al., 2024).

Reference:

Koo, B., Jackson, W., & Fisher, R. (2024). *The SEPUP Research Base: Evidence of Efficacy for the Issue-Oriented Approach* [White Paper]. The Lawrence Hall of Science, University of California, Berkeley. archive.lab-aids.com/sites/default/files/2024-11/SEPUP_Issues_White-Paper_11.8.24.pdf