

Impact Assessment Study

Full Report

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Introduction

Environmental Science Journal for Kids (SJK) has published nearly 50 open source, peer-reviewed articles on environmental science topics, adapted for a young adult audience and accompanied by teacher resources to deliver effective instruction on each topic. The [website](#) received over 10,000 views per month in the last quarter of 2016. More than 500 teachers use its resources to deliver science instruction to thousands of students worldwide.

The mission of the journal is twofold: 1) to adapt cutting edge environmental research for school students and 2) to provide students with a better understanding of the scientific method in practice. At the start of 2017, the Journal's Board commissioned an Impact Assessment Study to measure whether it is succeeding in its mission. Specifically, the Journal claims that students who are exposed to its science articles develop a better understanding of the scientific process, including how to formulate a hypothesis, how to properly design an experiment, how to collect data, and how to interpret and report scientific findings. The Impact Assessment Study had to this claim.

In order to conduct the Impact Assessment Study, the Journal partnered with Environmental Science (ES) teachers in several different states. Teachers delivered instruction to students on an ES topic of their choice, using SJK resources in some sections ("Intervention" groups), and in others using a textbook or other direct lecture methods of instruction ("Control" groups).

The assessment sought to answer the question: are SJK articles, which cover experimental design in their Methods section, a more effective learning tools as compared to other instruction practices (lecture + news article) for students learning environmental science?

Partner teachers

- Dawn Pfaff, Mequon Thiensville ISD, Wisconsin - AP Environmental Science
- Lee Stover, Burke High School, Nebraska - AP, Honors, and regular Environmental Science (2 pairs of sections)
- Chantal Greffer, Colonia High School, New Jersey - AP Biology and Environmental Science

Lesson topics: [Plant communication](#), [Pollinator health](#), [Soil acidity](#), and [Marine biodiversity](#) (from SJK website). Each topic focuses on Experimental Design as a scientific method.

Methods

In order to assess impact on student learning outcomes of SJK experimental design lesson resources, we selected the Free Response Question 1D from the 2003 AP Environmental Science Exam as an assessment tool. This question asks students to design a controlled experiment based on data presented in a brief article, applying concepts of hypothesis generation and relevant data collection plans. The majority of students nationwide performed poorly on this question, with a mean score of 33%, according to the Student Performance Q&A published by the College Board. This report went on to state:

“Part (d) proved challenging to the majority of students, with many unable to earn any points... most [students] showed poor understanding of what a specific testable hypothesis is and how to properly connect that functional hypothesis with an experiment that could actually be carried out. Teachers are encouraged to provide as many experimental design activities as possible for their students throughout the academic year. These activities should include hypothesis development, designing experimental protocol, observation, and analysis.”

This assessment question is well suited to test our hypothesis that using SJK resources will lead to increased student understanding of experimental design compared to other instructional tools commonly used.

We used detailed instructions and teacher-specific spreadsheets to communicate and collect data from teachers. Given the instructions, teachers worked to ensure comparable class sizes and student ability level between control and intervention groups. (For example, in Ms. Pfaff's sections of AP Environmental Science, there were 20 students in each section and no notable differences in student composition according to her notes.) All students had been exposed to practice AP Free Response Questions quizzes earlier in the school year. Once class comparisons were established, teachers:

- Delivered instruction to each class on a chosen topic, using SJK resources in the “Intervention” sections and other resources in the “Control” sections.
- Administered the AP Free Response Question 1D from 2003 to all students
- Blind-graded all quizzes, so they were not aware which students were in the control and intervention groups, following detailed College Board grading guidelines
- Filled out note sheets to record irregularities, concerns, or additional insights on how the process unfolded in their classrooms
- Recorded results in spreadsheets

(see the Teacher's Guide in [Appendix A](#) for full list of study instructions given to teachers and the Assessment Quiz in [Appendix B](#)).

Results

The averaged results from the study are summarized in the table below. Section comparisons are assigned a number 1-4.

	Average score (out of 4 possible points)	
Section	Intervention	Control
1	1.85	0.42
2	1.3	1.5
3	3.47	2.67
4	3.24	2.5
Overall	2.47	1.77

Using a t-test on the sample, the observed results were statistically significant. We can reject the null hypothesis, that there is no relationship between sections, with above 99% confidence. In other words, if there was no difference between the control and intervention sections, there would be a less than 1% chance that we would observe the results we did.

These data confirm the hypothesis and indicate a 40% improvement in student performance on the assessment quiz among those taught with SJK resources compared to control sections. While this initial study included a small sample size (127 participating students), results are promising and worth further exploration to confirm that there is in fact a strong positive impact of SJK resources on student learning of the experimental design process.

Conclusions

The results of this improvement-oriented program evaluation will be used to further develop and refine the lesson materials available on the SJK website dealing with experimental design. Expanding the range of topics covered that teach applications of the experimental design process will meet the recommendations of the College Board to increase student performance on test questions eliciting applied knowledge of setting up a controlled experiment. As SJK is shown to be a promising source of curriculum development resources on a topic requiring improved outcomes and teaching practices, further study should occur to validate and confirm results. Replicating this experimental setup in additional classrooms would be valuable, as well as longitudinal study of longer-term impacts on students using SJK resources over the course of an entire school year.

Appendices

Appendix A: Teacher's guide



Science Journal for Kids Impact Assessment Study

Teacher's guide

Thank you for participating in this study. Here is a step-by-step guide on how to conduct the study in your classroom. Sections in **BOLD** are to be completed by YOU (in discussion with the Journal's team).

1. Complete the [teacher's questionnaire](#) and your [sections table](#) (CUSTOMIZED LINK).
2. We will jointly decide which sections you will conduct the study in, which of them will be "intervention" and which ones will be "control"
 - a. **Intervention: section(s):** _____
 - b. **Control section(s):** _____
3. Select which SJ4K science articles would fit your curriculum best. You can see the choices below. Each of them offers a good example of an experimental design.
 - a. [Could this be a concrete solution to biodiversity loss?](#)
 - b. [How special do you have to be to live in acidic soil?](#)
 - c. [How do plants keep in touch?](#)
 - d. [Do bees get the flu?](#)
 - e. **Your choice:** _____
4. Identify a section in your textbook or an online science news article which covers the same (or very similar) content as the SJ4K article you picked. This will be the "control". Share it with us (which textbook, which chapter, which section, which concepts it covers). If you are having difficulties with that, let us know and we can help finding some external resources.
 - a. **Content for the control group:** _____
5. Create/customize a lesson plan for:
 - a. The SJ4K article you picked (each of them comes with an opening video and student assessment questions). Outline it for us.
 - i. **Intervention lesson plan:** _____
 - b. The "control" lesson. Please send us an outline of your lesson plan.
 - i. **Control lesson plan:** _____
 - c. Both the control and intervention lessons should include (or even start with) direct instruction on experimental design. The intervention lesson will then continue on to using the selected SJ4K article to illustrate the concept, while the control lesson will continue to some other science news article or book chapter.
 - d. Your lesson may span a couple of class periods to cover everything you want to teach.
 - e. Example outline: *Day 1: Opening video (5 min), Warm up discussion (10 min), Reading the article in groups of 3-4 students (30 min), Homework: finish reading*

the article and answer the questions, Day 2: Class discussion of assessment questions (20 min), Class discussion on the study's experimental design (20 min)

- f. Make sure you teach both the control and the intervention classes equally enthusiastically! :)
6. Select the best timing for the study based on your curriculum and academic plan. You will need 2-4 class periods (depending on your lesson plan): 1-3 for the instruction and one for the assessment (10-15 min quiz). Ideally, all the class periods should be in the same week. Let us know:
 - a. **Date(s) for the Intervention lessons:** _____
 - b. **Date(s) for the Control lesson:** _____
 - c. **Date(s) for the Assessment quiz:** _____
7. Give the Intervention and Control lessons. Briefly let us know how the classes went (e.g. how engaged were the students with the resources, any outstanding comments they made, any last-minute changes you had to make to the initial lesson plans, any feedback you'd like to share with us):
 - a. **Intervention lesson:** _____
 - b. **Control lesson:** _____
8. Prepare for the quiz.
 - a. Print [a quiz](#) for each of the students (adapted from APES FRQ from 2003)
 - b. Do warn the students that there will be a quiz. Do NOT tell them in advance that it will not be for a grade.
 - c. If the students have no experience with practice APES FRQ-s, give them a brief lesson on them. You could use [this slideshow](#) created by a fellow APES teacher. (You might have to modify it to fit your student population).
 - d. It is important that you anonymize the quiz even for yourself to avoid bias when grading it. Plan for that in advance. Some ways we can suggest (unless you already have a system in place):
 - i. Ask the students to write their student ID numbers on the quiz instead of names.
 - ii. If you already recognize your students' handwriting, have them write in their answers on a school computer (as long as you can ensure that they cannot cheat by using internet resources)
 - iii. We'd be happy to brainstorm other ways with you.
 - iv. Ultimately, you won't need to identify which student wrote which quiz response. However you will need to identify which student attended which class (intervention vs. control). And importantly, we would like you to be blind to this distinction during the grading process.
 - v. Please let us know how you chose to do that:
 1. **Method of anonymizing quiz responses:**

9. Administer the quiz
 - a. See how long will your students need for it (we suggest 10-20 min) but you can modify the time as needed, as long as all students get an equal amount of time.
 - b. Administer all quizzes (intervention and control classes) on the same day. If a student is absent, you may let them make it up shortly afterwards (as long as you feel confident that the student didn't talk to his/her classmates about what's on the quiz)
 - c. Let us know how many quizzes you administered in total:

- i. **Intervention class:** _____
 - ii. **Control class:** _____
- 10. Prepare to grade the quiz
 - a. Review the [College Board Scoring Guide](#) specifically for 2003, question 1, part D (page 4 in the linked PDF). You might want to print this page as you will need it as a reference in front of you during the entire grading process.
 - b. Review the [sample FRQ responses](#) College Board published as well as the [scoring commentary](#) about them.
 - c. Review the [Student performance Q&A](#) about question 1. It's illuminating.
- 11. Grade the quizzes
 - a. PLEASE be diligent and adhere to the instructions in the Scoring Guide strictly. As we will not see the quizzes ourselves, we completely rely on your integrity and precision in grading them for the quality of data in our impact assessment study. The entire study hinges on that.
 - b. APES graders find it useful to write in the points they assign on the quiz answers themselves (e.g. make a tick in the margin for each point earned)
 - c. Keep in mind that according to the Scoring Guide, the maximum number of points you can assign to question 1D is only 4. The guidelines are very strict and do not allow for partial points (so it's possible that many of your students end up with the exact same score). That's OK for the study as long as you are CONSISTENT in assigning those points to EACH of the students who took the quiz.
 - d. Once you have finished grading the quizzes and have assigned a score (as number of points out of the maximum 4) to each one, you will need to identify which quiz came from which class (intervention vs. control). Here you can use the anonymization method developed above.
- 12. Enter the data in the data table ([CUSTOMIZED LINK](#))
 - a. We do NOT want any student names or identifying information. The only two data points we want are:
 - i. Score on the quiz
 - ii. Which lesson did this student attend (intervention or control)
 - b. Let us know when you have completed the last step.
 - c. Please share additional feedback about the study-- how it went in each class and any unexpected or significant differences in student engagement-- or about SJ4K resources here:
 - i. **Feedback:** _____
- 13. Receive the Amazon gift card as a reward for your time and effort.

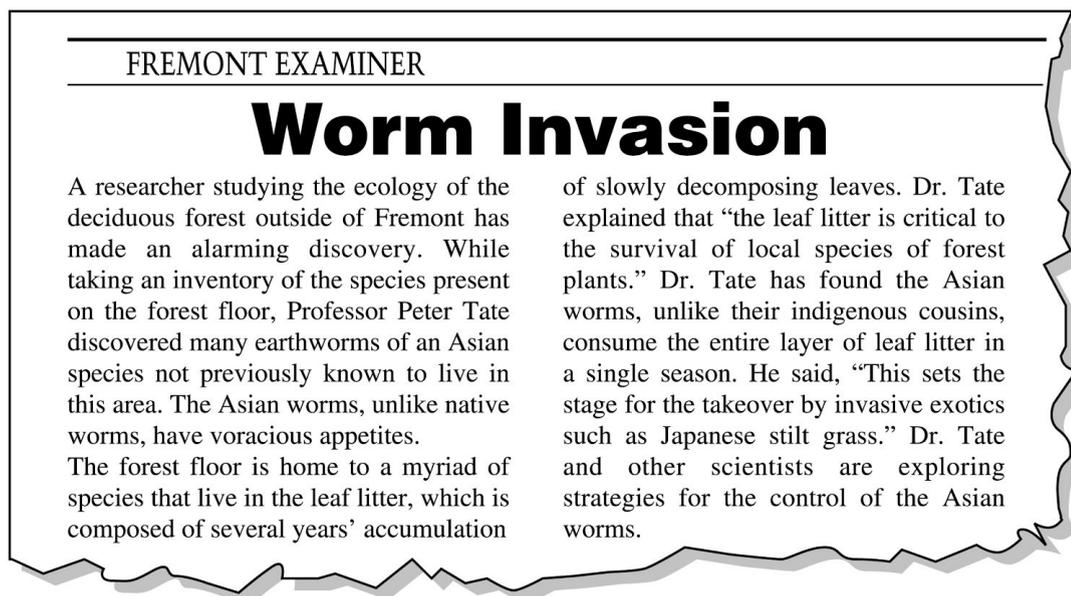
THANK YOU for helping us find out if *Science Journal for Kids* provides useful scientific resources to students. We hope that in the process, your students learned something useful about open inquiry and the scientific process of incremental accumulation of knowledge about the world.

THANK YOU for everything you do as a teacher. We can't think of more important people for building tomorrow's world!

Appendix B: Free Response Quiz

College Board Advanced Placement Environmental Science exam year: 2003
Free Response Question: 1, Part: D

Read the following article from the *Fremont Examiner*.



Design a controlled experiment to determine whether the worms, in fact, do change the forest ecosystem. Identify the environmental factor you will measure, and include the specific hypothesis you will test and the data you will collect.

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