



Promoting Students' Scientific Understanding with the Science Writing Heuristic



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Background and Objective

- ◆ The Science Writing Heuristic (SWH) is a writing-to-learn initiative that has been demonstrated to improve student understanding of disciplinary science.¹
- ◆ The SWH asks students to respond to writing prompts that challenge them to reason about the evidence they produce as they work through a lab activity; this helps develop their understanding of scientific content knowledge.
- ◆ This project tested the impact of the SWH on the writing performance of students enrolled in Biology 110: *Ecology and Evolution*.

Methods

- ◆ Six sections of Biol 110 included in this study were taught by the same instructor [Murray].
- ◆ One of the lab activities—the “goldenrod” lab, which challenges students to understand the ecology of a plant-herbivore system—was converted to conform to SWH procedures.
- ◆ Three randomly allocated labs were taught using traditional teaching methods; the other three labs were taught using the Science Writing Heuristic
- ◆ Students were assigned a formal paper to report the results of their goldenrod lab activities; these papers were scored (see below) independently by four raters for indicators of writing quality.
- ◆ Scoring agreement of raters was evaluated using the Cronbach's alpha test.
- ◆ Scores of students in “traditional” sections were compared to scores of students in SWH sections using the Pearson's chi-square test.



Photo Courtesy of Todd Wellnitz

Paper Scoring Scheme

- ◆ Student articulates both the plant response (or the fly choice) question and the trade-off question (growth vs. reproduction/inflorescence). (1 point)
- ◆ Student clearly articulates that t-test allows analysis of the difference between galled and nongalled goldenrod whereas correlation allows analysis of relationship between fluorescence and vegetation. (1 point)
- ◆ Student explicitly expresses that gallflies improve goldenrod fitness or flies choose more fit plants – they explicitly articulate which of the three hypotheses their data supports. (1 point)
- ◆ Student offers alternative explanation that uses data logically. (1 point)
- ◆ Student clearly articulates that t-test allows analysis of the difference between galled and nongalled goldenrod correlation allows analysis of relationship between fluorescence and vegetation. (1 point)
- ◆ Student clearly expresses that there is no evidence for a trade-off between growth and reproduction – they explicitly articulate what claim(s) their data supports. (1 point)

Total points possible: 6

Results

Inter-rater agreement reached 0.94. Although the scores of students enrolled in the SWH sections trended higher than those of students in the control sections (Figure 1), scores in the SWH were not significantly higher than those in control sections ($P = 0.07$). However, when students' papers were grouped in either a low-scoring section (scores of 0 to 3) and high-scoring section (scores of 3.5 to 6), we found that students in the SWH section were significantly more likely to have a “high-scoring” paper ($P = 0.04$) (Figure 2).

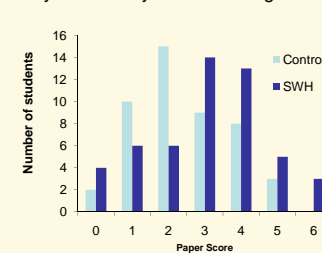


Figure 1. Comparison of mean paper scores (from 0-6 points) of students in SWH sections versus control (traditional) sections

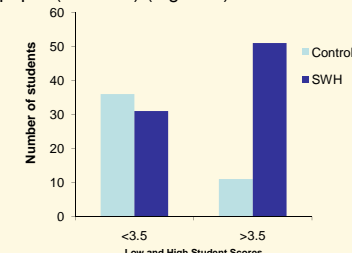


Figure 2. Comparison of number of students receiving a “high” vs. “low” mean paper score in SWH and control sections

Discussion

Although preliminary, our results suggest that students taught using the SWH have improved understanding of the scientific evidence they collect in lab activities compared to students taught with traditional lab methods. Also, students in the SWH section are more able to communicate that understanding of the relationship between evidence and claims in formal paper assignments.

Work cited

1. Hand BM. Cognitive, constructivist mechanisms for learning science through writing. In *Writing and Learning in the Science Classroom*. Wallace C, Hand B, Prain V eds. Dordrecht, the Netherlands: Kluwar Academic Publishers, 2004.

Acknowledgements

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