Phenomena in High School Chemistry

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Figure 1. Members of the AP Chemistry class speaking with Mr. Quackenbush after class.

Background

The laboratory in science education in the United States traces its origins back to Justus von Liebig's laboratory in Germany in the middle of the 19th century (Elliot, Stewart, & Lagowski, 2008). Since that time, while there has been reasonable consensus that the lab ought to play a central role in a good science education, there is not a consensus regarding what that value is or how to maximize it. Some have suggested phenomena-based learning as a promising way to increase student engagement and understanding.

This study was conducted at St. Monica Academy near Los Angeles, CA, from December 2019 – March 2020. The AP Chemistry class that participated in the study consisted of 14 juniors and seniors.

Research Question

What is the effect of using phenomenon as a precursor to lab activities?

Treatment

The treatment consisted of using a phenomenon activity before the treatment lab. Students were shown a phenomenon related to the concept being explored in the subsequent lab. Students made observations, asked questions, and formed hypotheses. In contrast, the comparison labs were not preceded by phenomena activities.

Data Collection

- Pre- and Post-lab content tests
- Teacher observations during labs and phenomena activity
- Post-phenomena and post-lab interviews
- Post-lab Likert-style survey

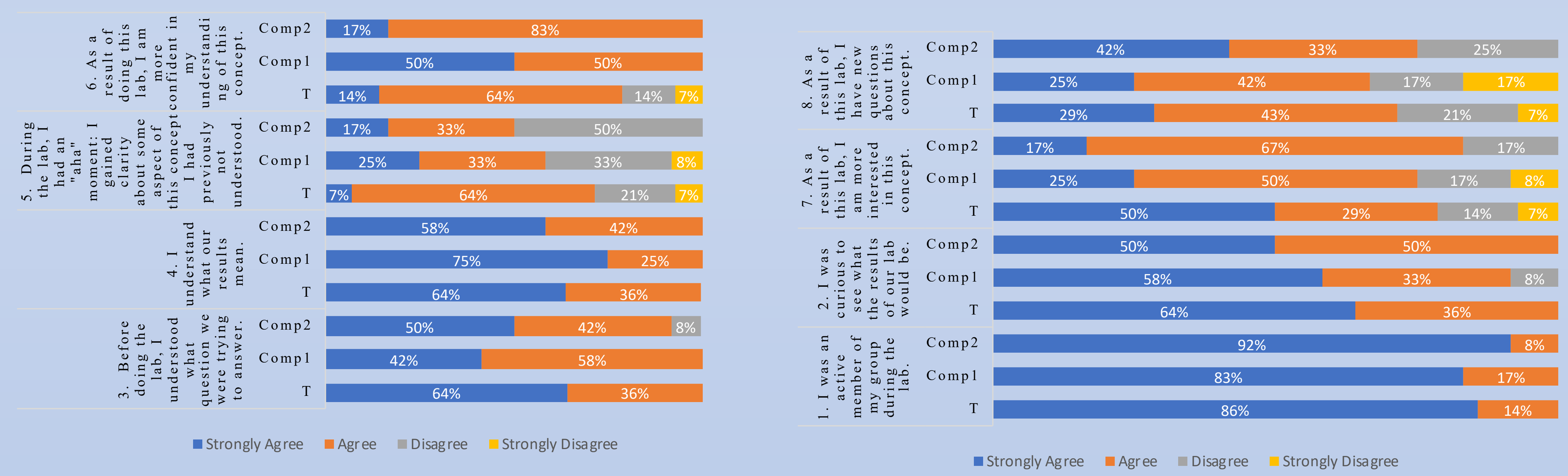

Figure 2. Student Engagement Survey results from the Treatment (*N*=14), Comparison 1 (*N*=12), and Comparison 2 (*N*=12) labs.

Results

- Normalized gain: significant difference between Treatment and Comparison 1, but not between Treatment and Comparison 2.
- Student Engagement Surveys: significant difference in response frequency on only one of 8 questions, and only between Treatment and Comparison 1.

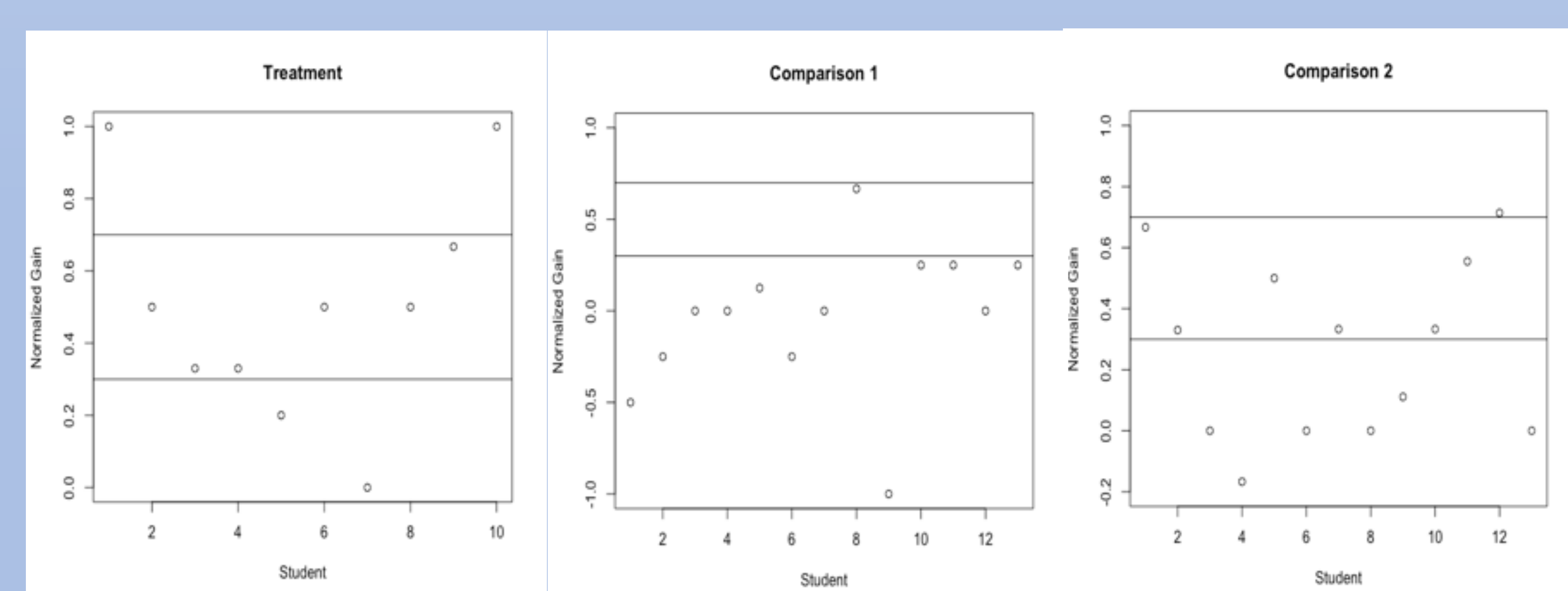

Figure 3. Scatterplot showing normalized gains from the Treatment Kinetics (N=10), Comparison 1 Calorimetry (N=13), and Comparison 2 Titration (N=13) content tests.

Conclusion

Although this study did not conclusively show a universal benefit of a phenomena-based lab pedagogy , its effectiveness in at least one instance suggests its potential. As well, the implementation of the study left the researcher, students, and colleagues convinced that phenomena-based lab instruction and a phenomena-based pedagogy more generally hold great promise.

Claim, Evidence, and Reasoning

The significant difference observed between the treatment and only one of the comparison labs suggests that, while effective, phenomena were not the only factors at play during the study. Differences in technical difficulty of the lab and the attendant variation in concept practice may help explain the discrepancy.

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Reference: Elliott, M. J., Stewart K. K., & Lagowski, J. J. (2008). The Role of the Laboratory in Chemistry Instruction. *Journal of Chemical Education, 85*(1), 145.