Assessment of the “Content-First” Approach in College-Level Organic Chemistry Workshops
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Introduction

Convoluted scientific terminology often hinders student scientific learning and understanding. Thus, presenting students with scientific material in the everyday vernacular may aid in their comprehension of the material. Brown and Ryoo (2008) investigated the effectiveness of this “content-first” approach while teaching fifth graders the topic of photosynthesis. They found evidence that teaching using this approach resulted in increased conceptual understanding in the students.

We modeled the present study after the aforementioned study by Brown and Ryoo in a college-level organic chemistry class. Students in organic chemistry workshops were presented with a short passage about pericyclic reactions followed by four questions aimed at assessing their comprehension of the material. While the control group received a textbook passage written in formal scientific language, the experimental group received an analogous passage that was rewritten in the everyday vernacular. We hypothesized that the latter group would perform better on the questions than the former group. Our findings revealed a small difference between the two groups in support of our initial expectations, but the significance of this difference is presently unknown. Future studies will help to validate or nullify these results.

Materials and Methods

Our study randomly administered the two types of reading comprehension passages and attached examination questions to students in Chemistry 203 (organic chemistry) workshops at the University of Rochester. Passage excerpts for the control group were taken from Organic Chemistry: Structure and Function (5th ed.) by Vollhardt and Schore, while the experimental group was inspired by everyday vernacular. We hypothesized that the latter group would perform better on the questions than the former group. Our findings revealed a small difference between the two groups in support of our initial expectations, but the significance of this difference is presently unknown. Future studies will help to validate or nullify these results.

Results

The two groups are labeled according to the relative level of difficulty of their reading comprehension passages: hard (control group) and easy (experimental group).

Average number of questions answered correctly in each group with standard deviation:

<table>
<thead>
<tr>
<th>Group</th>
<th>Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>1.33 ± 0.778</td>
<td></td>
</tr>
<tr>
<td>Easy</td>
<td>1.71 ± 1.07</td>
<td></td>
</tr>
</tbody>
</table>

Fraction of participants answering each question correctly (question numbers are indicated in parentheses):

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Hard</th>
<th>Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.25</td>
<td>0.29</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>0.42</td>
<td>0.50</td>
</tr>
<tr>
<td>4</td>
<td>0.42</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Discussion

The data indicate a slight improvement in reading comprehension for the experimental group relative to the control group. The overall average scores for each group were above one out of four correct responses which would have been expected based on chance alone. Nonetheless, the integrity of the values obtained is diminished based on the large standard deviations which describe a correspondingly wide variance in the data set. This problem can be mitigated in future studies by increasing sample size so as to decrease random error.

Moreover, a higher fraction of participants in the experimental group answered each of the four questions correctly relative to the fraction of participants in the control group. This difference is most noticeable with respect to the last question.

With regard to the nature of the questions themselves, questions one and two seem to have been more inherently difficult for the participants to answer correctly. This might have been due to the fact that these two questions and not questions three and four included chemical structures among the possible answer choices. Accordingly, the first two questions required participants to visually employ the information they had read in the passage.

Finally, the largest fraction of participants in the control group got one question out of four right while the largest fraction of participants in the experimental group answered two out of four questions correctly. Nobody in the study was able to answer all four questions correctly. However, taken together, these data show that students who received a scientific passage rewritten in the everyday vernacular were slightly better able than students receiving the original scientific passage to answer questions aimed at assessing comprehension of the passage. Thus, the original finding by Brown and Ryoo that supported the effectiveness of the “content-first” approach in fifth graders may also apply to college undergraduate students. However, these results should be validated by future studies employing a much larger sample size.

Conclusion

The “content-first” approach is a groundbreaking teaching method that has proven successful in augmenting fifth-grade student learning comprehension of photosynthesis. Our study investigated whether this model would also prove successful at the college level in a first-semester organic chemistry course at the University of Rochester. Our findings indicate a slight increase in student comprehension within the experimental group when compared to the control group, but a diminished sample size yielded a wide variance in the data set. Accordingly, future studies will need to address sample size, statistical analysis, and question type to yield more conclusive results regarding the effectiveness of the “content-first” approach within the organic chemistry course. In conclusion, this approach seems slightly more successful in improving student comprehension than current teaching techniques and has the potential to become a valuable pedagogical tool pending the findings of future studies.

References