Assessing the Flipped Classroom Model in Organic Chemistry II

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Introduction
Nuclear magnetic resonance (NMR) spectroscopy is a topic with which many Organic Chemistry II students struggle. The theory behind NMR can be difficult to grasp solely from lectures and static representations. Additionally, NMR spectroscopy is very much a problem-based discipline where students must apply their knowledge to solve structures of organic compounds. With these challenges in mind, we decided to assess a flipped classroom model for the NMR spectroscopy chapter of Organic Chemistry II.

At the completion of the module, students should:

- Know how nuclear spins are affected by a magnetic field
- Be able to determine the structure of a compound using NMR
- Be able to predict chemical shift trends
- Be able to interpret and predict simple and complex splitting patterns
- Be able to predict chemical shift trends
- Be able to assign peaks in an NMR spectrum to specific protons in a compound
- Be able to interpret integration of NMR spectra
- Use J values to predict geometric isomers
- Be able to determine the structure of a compound using NMR, given other pertinent information such as molecular formula

Methods

Pre-class preparation: video lessons

In-class learning: workshops

Animations

Khan-style Tutorial

Face-in-Picture View

Enhances student engagement by providing a more personal feel

Preparation: online homework (Sapling Learning) & student perception surveys

Fig 1. Results of online Sapling Learning homework. Number of times that students attempted questions of various difficulty levels. Difficulty level of questions was determined by Sapling Learning.

Fig 2. Students were asked to choose one of the four responses that best described their evaluation of the flipped classroom module.

Fig 3. Students were asked to rate their agreement with this statement: It is helpful to work problems when other students and the professor are available to answer questions as opposed to doing homework by myself.

Fig 4. Students were asked to rank the four components (lecture, working problems, asking questions, and getting feedback) as the most important to the least important use of class time.

Results

Homework Results

<table>
<thead>
<tr>
<th>Number of Attempts</th>
<th>Percentage of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25.5</td>
</tr>
<tr>
<td>1</td>
<td>26.7</td>
</tr>
<tr>
<td>2</td>
<td>23.3</td>
</tr>
<tr>
<td>3</td>
<td>9.7</td>
</tr>
<tr>
<td>4</td>
<td>2.3</td>
</tr>
<tr>
<td>5 or more</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Fig 4. Percentage of Students

In-video practice: 26.2%

Mini-lecture: 32.1%

Student Suggestions for Improvement

Future Work

Different way to measure student learning gains

Strongly decrease student resistance

Help students understand why this instructional technique is used

Instructments to the module

Conclusions

- No significant difference between control and experimental groups
- In contrast to the literature which shows that the active learning improves student learning
- Student perceptions indicated that at least half of the students did not like the flipped classroom model in Organic Chemistry course
- Student expectations and resistance to a different instructional may have played a role in the module’s effectiveness

References


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