Assessing the Flipped Classroom Model in Organic Chemistry II

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BOLD FELLOWS BLENDED & ONLINE LEARNING DESIGN FELLOWS
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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.

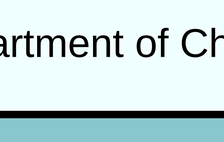
At the completion of the module, students should

- Know how nuclear spins are affected by a magnetic field
- Be able to predict number of proton signals expected from a compound given its structure
- 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

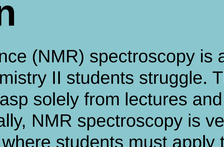
Pre-class preparation: video lessons

Face-in-Picture View
Enhances student engagement by providing a more personal feel[1]



Animations
Help to clarify concepts that are difficult to grasp from static representations

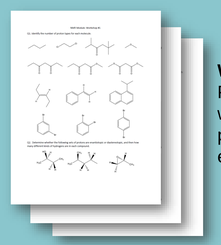
In-class learning: workshops



Khan-style Tutorial
Provides a personal feel due the natural flow of handwriting[1]

Length of videos
Short, concise videos within students' attention spans are more engaging and enhance learning [1,2]

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



Workshops
Provide students with hands-on problem-solving experience

Results

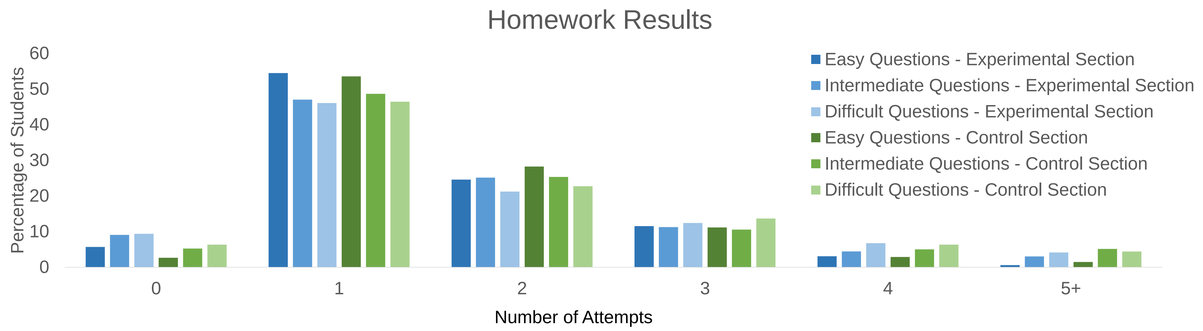


Fig 1. Results of online Sapling Learning homework. Number of times that students attempted questions of various difficulty levels. Difficulty level of questions was determined by Sapling Learning.

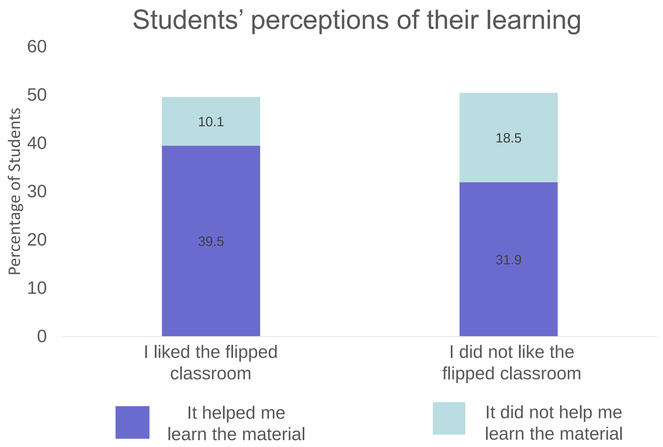


Fig 2. Students were asked to choose one of the four responses that best described their evaluation of the flipped classroom module.

"It is helpful to work problems when other students and the professor are available to answer questions as opposed to doing homework by myself."

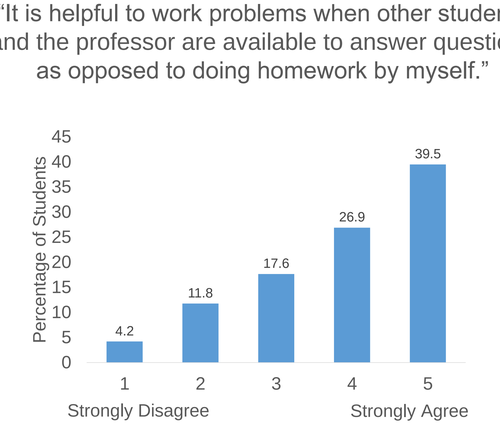


Fig 3. Students were asked to rate their agreement with this statement: It is helpful to work problems when other students and the professor are available to answer questions as opposed to doing homework by myself.

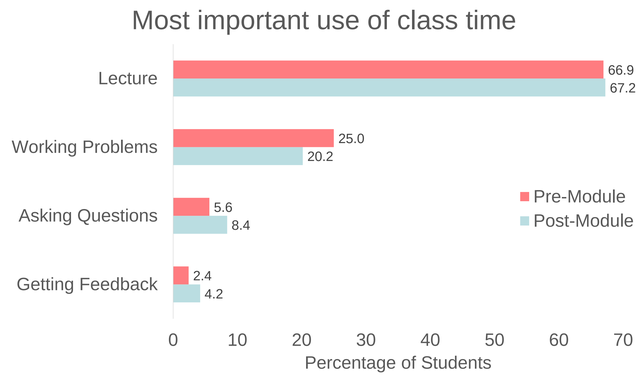


Fig 4. Students were asked to rank the four components (lecture, working problems, asking questions, and getting feedback) as the most important to the least important use of class time.

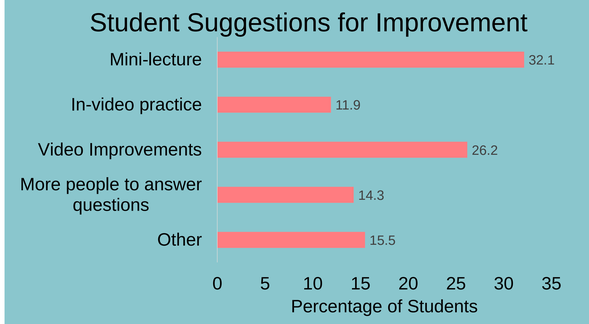
Representative open-ended student responses about the module
It forced me to learn the material ahead of time and then practice in class.
Harder to motivate myself to learn the material
Not having lecture in class. Class time almost felt wasted, *even when I learned things during that time*. [emphasis added]
My main criticism is that I don't see my tuition money at work in this type of classroom. I'm paying to be taught and in the flipped class it feels like I'm paying all this money for YouTube videos.

Conclusions

- No significant difference between control and experimental groups
  - In contrast to the literature which shows that the active learning improves student learning[3,4]
- Student perceptions indicated that at least half of the students did not like the flipped classroom model in an Organic Chemistry course
  - Student expectations and resistance to a different instructional may have played a role in the module's effectiveness

Future Work

- Different way to measure student learning gains
  - Stratify students in analysis
- Decrease student resistance
  - Help students understand why this instructional technique is used
- Improvements to the module



References

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2. Richard E. Mayer "Applying the Science of Learning: Evidence-Based Principles for the Design of Multimedia Instruction" *American Psychologist* November 2008; 760-769.
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