

Abstract

The flipped classroom is a model that has gained a great deal of traction in both secondary and higher education chemistry classrooms over the past few decades.¹ While the results of this model are promising, many educators are hesitant to implement it due to unconvincing results or the long-standing precedent of the traditional lecture format. Indeed, the effectiveness of the flipped classroom has proved to be quite context specific. As such, implementations in many classroom contexts are valuable to explore its full potential. The current intervention aims to explore the implementation of the flipped classroom in a 30-student general chemistry class at a technical college. For the two-day unit on acids and bases, the class was flipped and assessed. In addition to assessing student attitudinal responses, learning gains assessments were designed to inventory what cognitive skills were acquired through each of the two major components of the flipped classroom (out-of-class content delivery and in-class problem solving), respectively. Results indicate little difference with respect to specific cognitive skills between the two assessments; however, students' ability to approach problem solving as well as confidence showed improvement after in-class sessions.

Definition from
Flipped Learning
Network, 2014

Definition of Flipped Learning

Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.



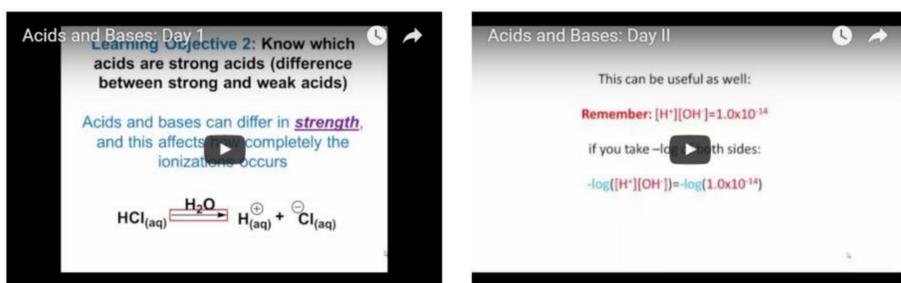
<http://www.flippedlearning.org/definition>

Elements of Flipped Structure

As defined by the Flipped Learning Network, a flipped classroom involves offloading what is traditionally regarded as "lecture content" to be accessed prior to class, while class time can be used to engage students one-on-one. As such, the structure involves two major components: out of class lecture material and in-class activities for student engagement.²

Out of class lecture screencasts:

In order for students to be prepared for in-class group problem-solving sessions, two screencasts were prepared as videos to be accessed on YouTube. Students were asked to watch the video before attending each day of class (and were assessed for accountability).

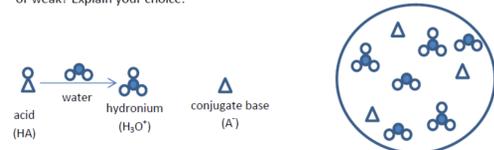


In-class group problem solving:

- Groups of four selected by the instructor
- Problem sets designed with questions that were intended to target different levels of Bloom's taxonomy (from lower order cognitive skills like knowledge retention to higher order skills like analysis and synthesis)³
- Questions were grouped by Bloom's level, with a description of what each skill involves.

Level 3: Application *Select, transfer, and use data and principles to complete a problem or task*

9. a. The following picture represents a molecular view of an acid, HA, in water. Is the acid strong or weak? Explain your choice.

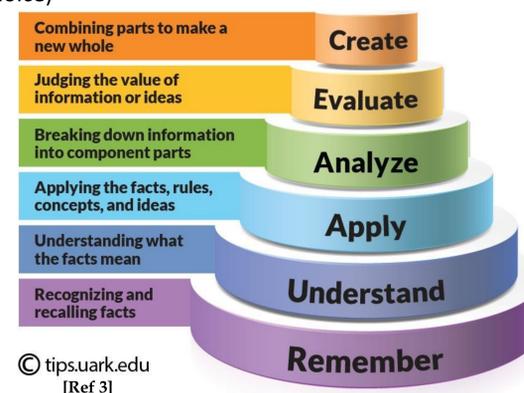


- b. What would the molecular view look like if it were the opposite choice from the question above?



Assessment:

- Intention of the assessment: to determine student proficiency at different levels of Bloom's taxonomy
- Assessment one: after the video screencast, over day one material
- Assessment two: after the in-class problem-solving session, over day two material
- The results of the assessments were not directly comparable but still yielded useful results as a snapshot of student ability at each juncture
- Rubrics were emergent from student responses and reflected four levels of proficiency (with the exception of the lowest order cognitive skills, which were multiple choice)



Key Results

- No clear patterns emerged in terms of dominant cognitive skills. Assessments taken after the screencasts were comparable to assessments taken after the in-class problem-solving session
- Students showed improvements in their ability to approach solving problems (calculation and direction-following errors decreased on the latter assessment)
- Conceptual errors decreased for questions at lower levels of Bloom's taxonomy but increased at higher levels
 - possibly due to the material becoming conceptually more difficult on the second day of the topic, especially at the analysis and synthesis levels
- Second assessment had significantly fewer students leave questions blank
 - may reflect improved self efficacy
- Student surveys cite instructor presence during problem solving as their favorite aspect of the flipped format
- Some students indicated difficulty retaining information from video to class activity
 - can be addressed by emphasizing note taking during screencasts or conducting mini-reviews at the beginning of class time
- Student response to group work was mixed, but some students indicated utilizing their groups later on as learning communities to work on other class work together
- Low-achieving students tended to have a more positive response than high-achieving students

1. Michael K. Seery, 'Flipped Learning in Higher Education Chemistry: Emerging Trends and Potential Directions', Chemistry Education Research and Practice, 16 (2015), 758-68.
2. Flipped Learning Network website. <http://flippedlearning.org/domain/46>
3. University of Arkansas Teaching Innovation and Pedagogical Support website. <https://tips.uark.edu/using-blooms-taxonomy/>