Flipped and Free: an inverted, active-learning general chemistry course using exclusively OER

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Abstract

Much attention has been paid to the efficacy of flipped, or inverted, classrooms where the lecture content is accessed online via videos outside of class and the in-class time is used for active learning activities. It has been demonstrated that teaching this method lowers barriers for students who are considered high risk due to a lack of background preparation for college. In addition, use of Open Educational Resources allow all students, regardless of financial situation, access to textbooks, homework, and other learning resources. During the fall 2019 term, two large (115 and 230 students) sections of general chemistry were taught in a flipped format using OpenStax:Chemistry 2e for textbook readings and suggested homework problems. Students were divided into 2 subgroups and each subgroup came to class for 2 of the 4 scheduled 50-minute periods to work on group assignments based on the assigned video modules in their assigned 4-5 person teams. Canvas learning management system was used for practice quizzes and exams. The question pools in Canvas were tagged with learning outcomes and the student learning mastery tool was used to inform students of their progress based on each specific learning outcome. Future work includes using Canvas question pools for graded homework problems (similar to Sapling but without the cost) and evaluating the teamwork component of the course.

OER Resources used

openstax™

Free, online textbook for general chemistry

Available in both **Traditional** and **Atoms-First**

Includes homework problems with and without solutions

canvas

Provided by the university (included in student fees)

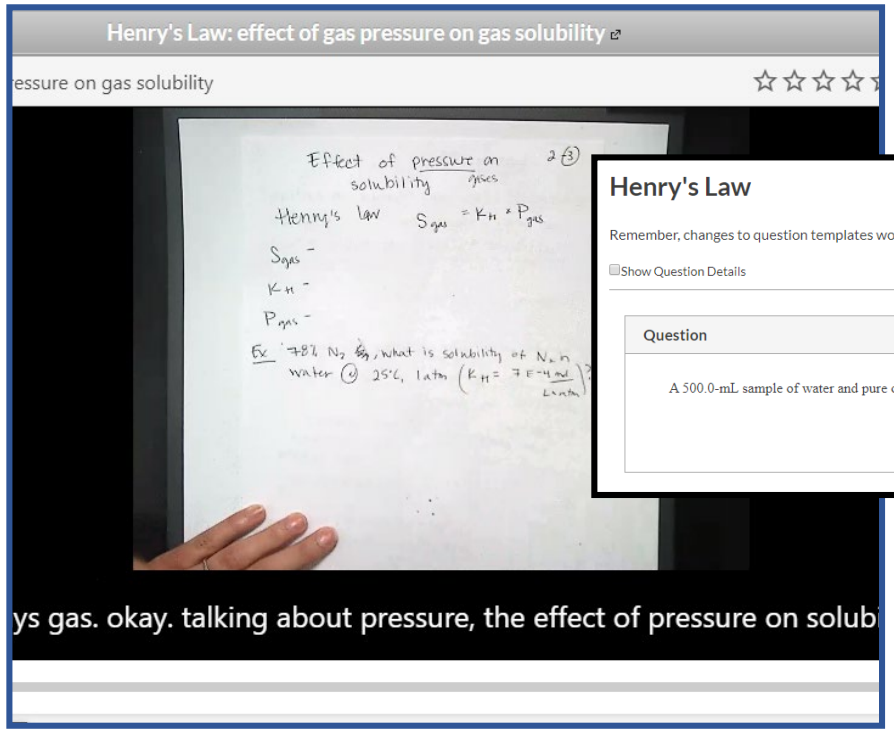
Modules include **videos**, **readings** from OpenStax, **suggested homework** (with answers, for practice)

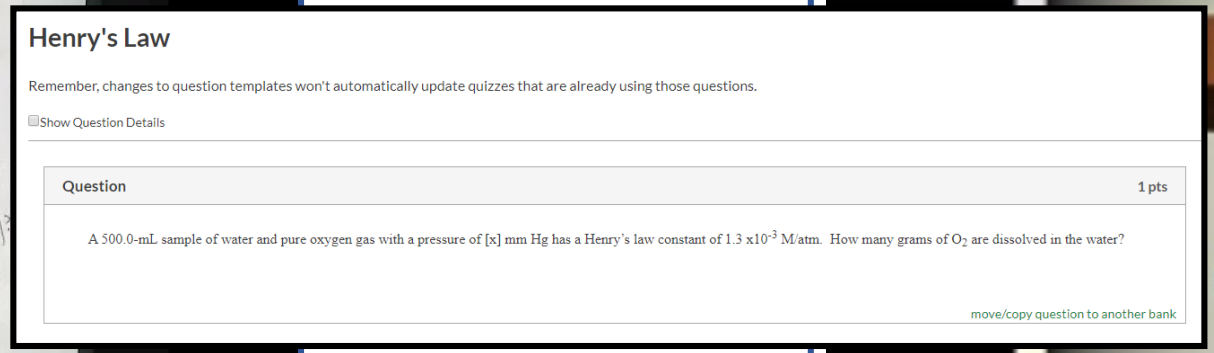
Quiz function used as **online homework** (problems without answers were added to Canvas with solutions-graded by Canvas)

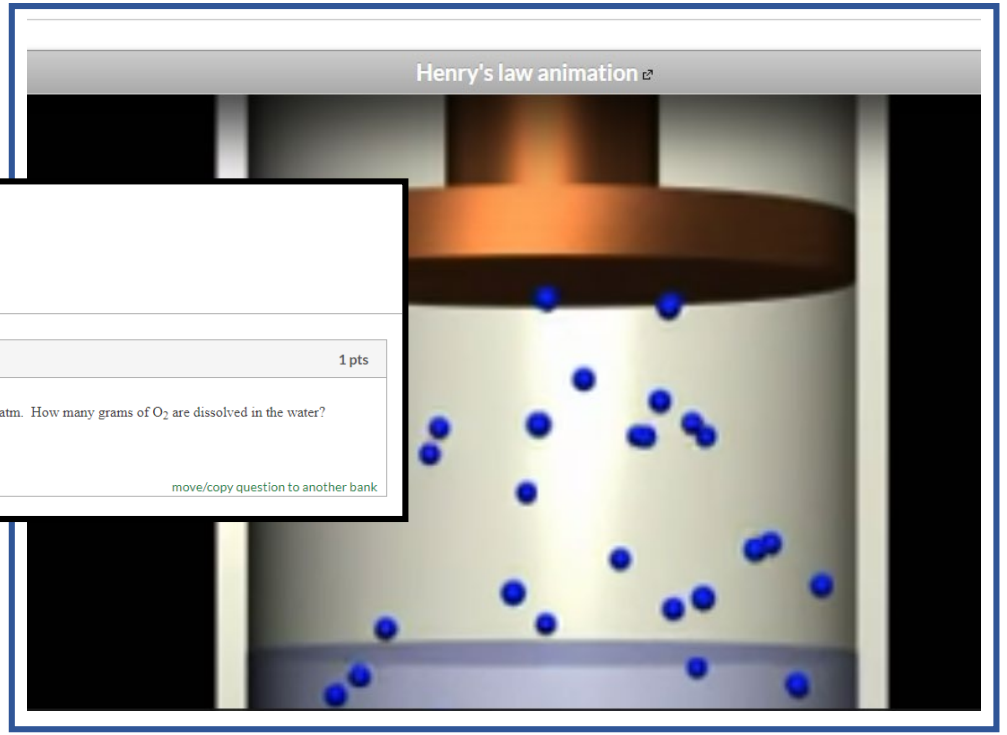
Course design

3-level model learning outcomes → Videos, Readings, Interactives (simulations, animations) → Assessments: Question pools on canvas (homework, exams), Group assignments

1.1.2 Students will use Henry's law to calculate solubility, constant, or pressure



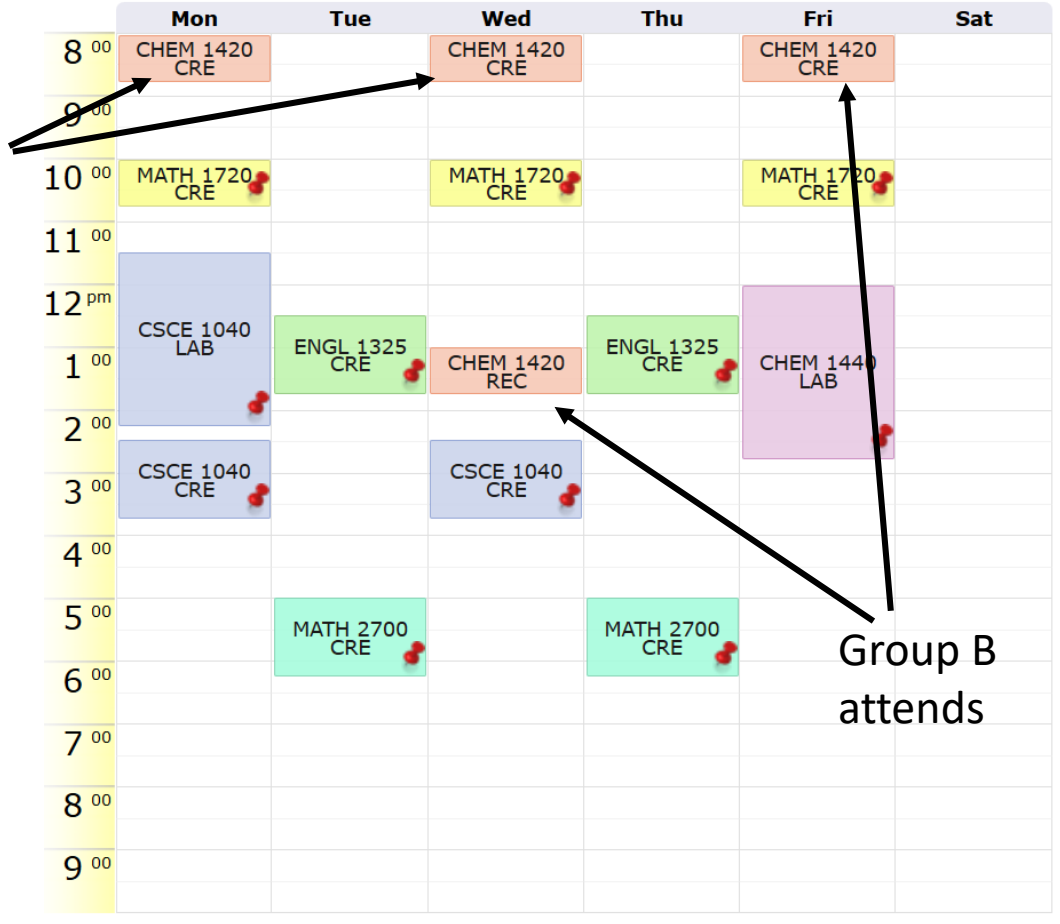




Course format

- Students see four 50-minute time slots on their schedules, but in this course they only attended 2 of those 50-minute time slots: M/W or W/F
- The outside-of-class work was reading, watching lecture videos, and taking notes
- The in-class work was exclusively group work on problem sets
- Groups are assigned by the instructor and generally do not change throughout the term
- Exams were delivered via Canvas in the Testing Center on campus

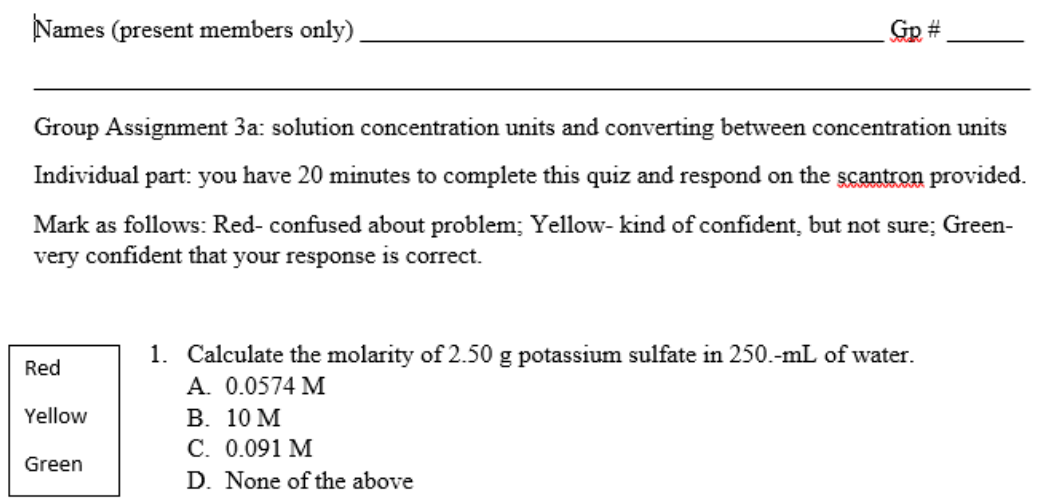
Group A attends



Group B attends

Teamwork component

Every week, students solve the problem set individually and submit their results via scantron and mark their confidence level (summative assessment with metacognition)



Names (present members only) _____ Gp # _____

_____

Group Assignment 3a: solution concentration units and converting between concentration units

Individual part: you have 20 minutes to complete this quiz and respond on the scantron provided.

Mark as follows: Red- confused about problem; Yellow- kind of confident, but not sure; Green- very confident that your response is correct.

Red

Yellow

Green

1. Calculate the molarity of 2.50 g potassium sulfate in 250.-mL of water.
   A. 0.0574 M
   B. 10 M
   C. 0.091 M
   D. None of the above

Next, students form their groups of 4-5 and make the solution set for the assignment with guidance from TA, instructor, and student leaders (formative assessment)

Preliminary data

Historic data (baseline):

	CHEM 1410		CHEM 1420	
	Enrollment	DFWI Rate	Enrollment	DFWI Rate
Summer 2016	108	33.3%	93	30.1%
Fall 2016	1592	31.9%	323	46.8%
Spring 2017	596	51.5%	950	15.6%
Summer 2017	95	17.9%	90	28.9%
Fall 2017	1609	33.7%	270	28.5%
Spring 2018	620	55.0%	814	23.2%

Overall, for both 1410 section taught Fall 2019, the D/F/W/I rate was 25.9%

Results and Discussion

The reduction in D/F/W/I rates is promising, but not as dramatic as reported.[1] Required attendance and participation was a factor in the higher D/F/W/I rate for the 8AM section (33%) compared to the 12PM section (22%).