Hybridizing inorganic chemistry: Increasing student engagement by reserving lecture for high-impact practices

Rose Theisen, PhD and Jason Halfen, PhD
Department of Chemistry
University of Wisconsin - Eau Claire
OVERVIEW

- face-to-face teaching with the best features of online learning.
- A fully online course
- A fully face-to-face course
- A hybrid course is when some in-class sessions are completely replaced with online instruction.
- A flipped course is when the number of in-class hours remains the same, with content delivery and homework merely switching places.

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OVERVIEW

Hybrid course format allows for

• More interaction between students and professor
• More interaction between students
• More schedule flexibility for instructor and students
• Opportunities to use technologies that are available at home
OVERVIEW

• At the University of Wisconsin - Eau Claire, a hybrid course is required to have at least 25% of the course shifted to online instruction and activities.

• Last spring (2014) two undergraduate inorganic chemistry courses were redesigned using a hybrid format

• **Introduction to Inorganic Chemistry** - a 200-level course required for all chemistry majors and minors

• **Bioinorganic Chemistry** - an 300-level elective for chemistry and biology majors

• These were the first upper-level hybrid courses offered in our department.
OVERVIEW

In both courses:

• Outside of class, students completed a combination of online tutorials, videos, self-testing exercises, simulations and online discussion groups, which introduced students to foundational concepts.

• During face-to-face meetings, instructor lectures were replaced with group collaboration activities and application of concepts, which facilitated interaction among students and between students and their instructor.
OVERVIEW

This presentation will describe

1) implementation of this curricular revision

2) discuss lessons learned

3) address how well the revision achieved the goals.
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COURSE AND HISTORICAL PERSPECTIVE

• A one-semester, lecture only course that covers introductory inorganic principles. Primary areas of coverage: structure, bonding, and reactivity of transition metal complexes, solid state materials, main group compounds.

• A 200-level course to be taken before Physical Chemistry

• Enrollment has grown steadily from 30 students/yr in late 90s to >100/yr currently distributed across face-to-face and online environments.

• Audience = 60% chemistry majors, 25% allied sciences (physics, mat sci, bio, geology), 15% other.
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INITIAL ONLINE OFFERING AND OBSERVATIONS

Developed 100% online course in 2013

• Offered as a 4-week summer course.

• Content and structure paralleled face-to-face course. Included ~12 mini lectures (6-12 minutes) to introduce new topics, with bulk of content from textbook reading and some limited web resources.

• Also had several active discussion groups (peer-to-peer Q&A, virtual office hours, instructor-led discussion) that helped students to remain engaged.
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INITIAL ONLINE OFFERING AND OBSERVATIONS
Two problems identified with 100% online course:

(a) pace of course somewhat aggressive for the online environment

(b) limited opportunities for exposure to course materials from other, outside perspectives.

Results:

• Marginally successful: 50% W rate after 1 week.
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EVOLUTION OF HYBRID COURSE

Developed hybrid course in Spring 2014

• Goal: use online environment to present majority of content and to reserve face-to-face meetings for discussions, development of relationships between content pieces, other high-impact teaching/learning methods including group problem solving, model usage.
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EVOLUTION OF HYBRID COURSE

Hybrid Schedule for 75-min, 2x/week lecture-only course

• 1 face to face (75 min) and 1 online meeting per week.

• All face to face meetings recorded and distributed by YouTube to entire class.

• Online 50% / Face-to-Face 50%
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EVOLUTION OF HYBRID COURSE

Hybrid Offering

In addition to video lectures from online course, more web resources were added which significantly enhanced outside of class activities:

- provide additional perspectives on content.
- Also made use of MIT's OpenCourseWare for additional lectures and solved problem sets

Course material was restructured into three inter-related modules: Structure, Bonding, and Properties and Reactivity.

- This allowed for more discussion and bridging between topics
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EVOLUTION OF HYBRID COURSE

Student feedback (to instructor and to CETL):

- Students loved the high-impact teaching/learning practices during face to face meetings.
- Use of models and group work very helpful in developing understanding of core concepts.
- Appreciated flexibility in digesting bulk sections of content online.

Results:

- Significantly decreased W rate (5%), 5% D/F rate.
SUCCESSFUL HYBRID OFFERING LEADS TO ENHANCED ONLINE COURSE

Offered 100% online course summer 2014

• Using lessons learned from online and hybrid courses
  • Extended to 8 weeks vs 4 to deal with pace issue
  • Enhanced content using materials developed for hybrid course and also used hybrid course's recorded lectures to help provide students with access to important student-led discussions

Results:

• Combination led to much reduced W rate (12.5%) and 0% D/F
SUCCESSFUL HYBRID OFFERING LEADS TO ENHANCED ONLINE COURSE

Conclusion:

- Hybrid and online offerings can go hand-in-hand, with content pieces and lessons learned from one course format helping to improve and enhance the other format.
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COURSE AND HISTORICAL PERSPECTIVE

• A one-semester, lecture only course explores the biological chemistry of the transition metals, including metalloprotein structure and function, small-molecule synthetic modeling systems, metal ion trafficking in biological systems, and the uses of metals in medicine.

• First developed mid 2000s and is taught every other year. Upper level elective for chemistry and biology majors.

• Enrollment is capped at 22 students and fills quickly every semester it’s offered.

• Audience = 60% chemistry majors, 27% biology majors, 13% other (mat sci, etc).
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INITIAL OFFERING AND OBSERVATIONS

Offered 100% traditional lecture course in 2008, 2010 and 2012.

- Included instructor-driven lectures to introduce new topics, some limited web resources, and assigned readings from textbook and relevant journal articles.

- In 2012 had weekly in-class group activities that helped students to apply concepts learned from lecture and the reading assignments.

Two problems identified:

- students struggled with reading primary literature sources assigned for homework outside of class

- lecture-heavy course was tedious for instructor (and students)
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EVOLUTION OF HYBRID OFFERING

Offered Hybrid course format in Spring 2014

- Goals: use online environment to present majority of content, reserve face-to-face meetings for discussions, development of relationships between content, de-coding primary literature articles in small groups, other high-impact teaching/learning methods
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EVOLUTION OF HYBRID OFFERING

Hybrid Schedule for 50-min 3x/week lecture-only course

• 1 face to face and 2 online meeting per week for the first 6 weeks (review and background heavy)

• 2 face to face and 1 online meeting per week for the next 8 weeks (new bioinorganic concepts).

• The last two weeks were all face to face for student presentations.

• Online 37% / Face-to-Face 63%
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EVOLUTION OF HYBRID OFFERING

Hybrid Method:

- Created own online content using Camtasia software to record voice over Powerpoint presentations and uploaded videos to YouTube. Kept all lectures between 5-15 minutes long.

- Used notes and slides from previous semester, but did have to reformat for time and clarity - took two weeks before semester began to create four weeks of video content

- Created an associated online quiz after every online day to test concepts learned in video lectures. Heavily used UW-EC’s learning management system (D2L).
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Hybrid Method:

- During lecture, after briefly reviewing the online content, I assigned daily in-class activity which consisted of group problem solving exercises, reflection notecards, group and individual quizzes. I also gave mini lectures and discussed articles during class.
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EVOLUTION OF HYBRID OFFERING

Student feedback (to instructor and to CETL):

- Students enjoyed being able to watch and re-watch videos at their leisure

- Students liked having quizzes and course materials online in one place (D2L).

- Students liked being able to catch up with the professor once a week to recap important ideas and answer questions.

- Students appreciated the ability to go at ones pace. This part really captured the student’s interest!
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EVOLUTION OF HYBRID OFFERING

Difficulties with hybrid course (Student Feedback):

• The transition between online and face to face days was sometime difficult - helped to have a good review at beginning of F2F lecture

• Remembering in-class days and online days and assignment due dates was a challenge (daily email reminders were helpful)

• Students procrastinated until they had to do work rather when they should have done the work.
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EVOLUTION OF HYBRID OFFERING

Results:

- no significant increase or decrease in exam scores or overall average grade between traditional course (2012) and hybrid course (2014)

- DFW rate 0% for both courses
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SUCCESSFUL HYBRID COURSE

Lessons learned:

• Students perspective: While a good portion of the class is online, the professor was seen as very available for student questions and concerns. This is helpful for direction in a hybrid course.

• Instructor perspective: liked schedule flexibility, liked having more time to interact with students as opposed to talking at them, liked having more time to assist in them in decoding articles

• Conclusion: Hybrid offerings combine the best parts of online and face to face teaching
Did the revisions achieve the goals?

• While the numbers didn’t show increased learning gains for either hybrid course, there was not a decrease in learning gains, or an increase in D/F rates

• Both courses used online environment to present majority of content, reserve face-to-face meetings for discussions, development of relationships between content pieces, other high-impact teaching/learning methods including group problem solving, model usage.

• Both courses implemented more active learning strategies into the lecture part of the course which kept students engaged during lecture
Getting Started

• Start small
  •
  •
  • course
  • Ideas...

• Be an online student yourself
  • enroll in a Massive Open Online Course on edx.edu or coursera.org
  • to see what it’s like to be a student in an online environment
  • Get an idea of what your students are doing while watching your online content
  • Get an idea of what formats work for you and what formats don’t work

• Because there is no standard approach to hybrid courses - you can be creative and redesign your course so that it makes sense for the material covered
Can you hybridize your course?
Hybridizing inorganic chemistry: Increasing student engagement by reserving lecture for high-impact practices

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Rose Theisen, PhD and Jason Halfen, PhD
Department of Chemistry
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