

Using podcasts and in-class assignments in a large-enrollment introductory biochemistry class to promote deep learning



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Abstract

Traditional lecture-based teaching in large enrollment introductory biochemistry classes generally tends to encourage superficial learning. There is pressure to teach a large number of basic concepts in a short amount of time, and there are few opportunities for a single instructor to interact with hundreds of students in a meaningful and personal manner. In an attempt to overcome some of these limitations, I have introduced two new, interrelated components to the introductory biochemistry course at the University of Calgary. First, podcasts were developed to present a more in-depth treatment of topics previously taught exclusively through lectures. These podcasts provided students with a resource that allows students to learn at their own pace and to repeat portions when necessary, thus facilitating a deeper and more integrated learning process. Second, in-class case-studies and assignments provided interactive follow-up to the material presented during previous lectures and the podcasts.

BCEM 393: Introduction to Biochemistry

- Introductory biochemistry course given in second year of a four-year undergraduate degree
- Part of the “biocore” at the University of Calgary, which is a set of required courses that students enrolled in various majors in the biological sciences must take
- Current enrolment in BCEM 393 is 500 students
- 2 lecture sections and 22 lab sections (with 22 students per lab section)

Challenges to deep learning in BCEM 393

- BCEM 393 has long been seen by students as a memory-intensive course.
- Since it is a pre-requisite for many higher level courses, many topics must be covered in a short period of time.
- Many students admitted to doing very little work at home until a few days before each exam.

The Problem: Limited opportunities for interaction between students, and between students and the instructor are largely due to the lecture format and large class size.

The Solution: Enrich learning experience by introducing podcasts and in-class assignments to foster deeper and higher level learning focused on specific topics that many students find difficult to master.

Revising the course structure

Old

Students met with the instructor three times a week for 50-minute lectures.

Lectures incorporated case studies and clicker questions to try and encourage students to participate and apply concepts in class.

Students attended a three-hour lab session every two weeks.

Students completed six online assignments on their own.

New

Traditional lectures reduced to 31.

Five lectures have been replaced with in-class assignments.

Podcasts and Java applets were introduced to prepare students for the assignments.

No changes to lab schedule – incorporated elements of the assignment into the lab exercises.

Reduced online assignments to two.

In-class assignments

Topics of the in-class assignments were selected from those considered particularly difficult for students in previous years:

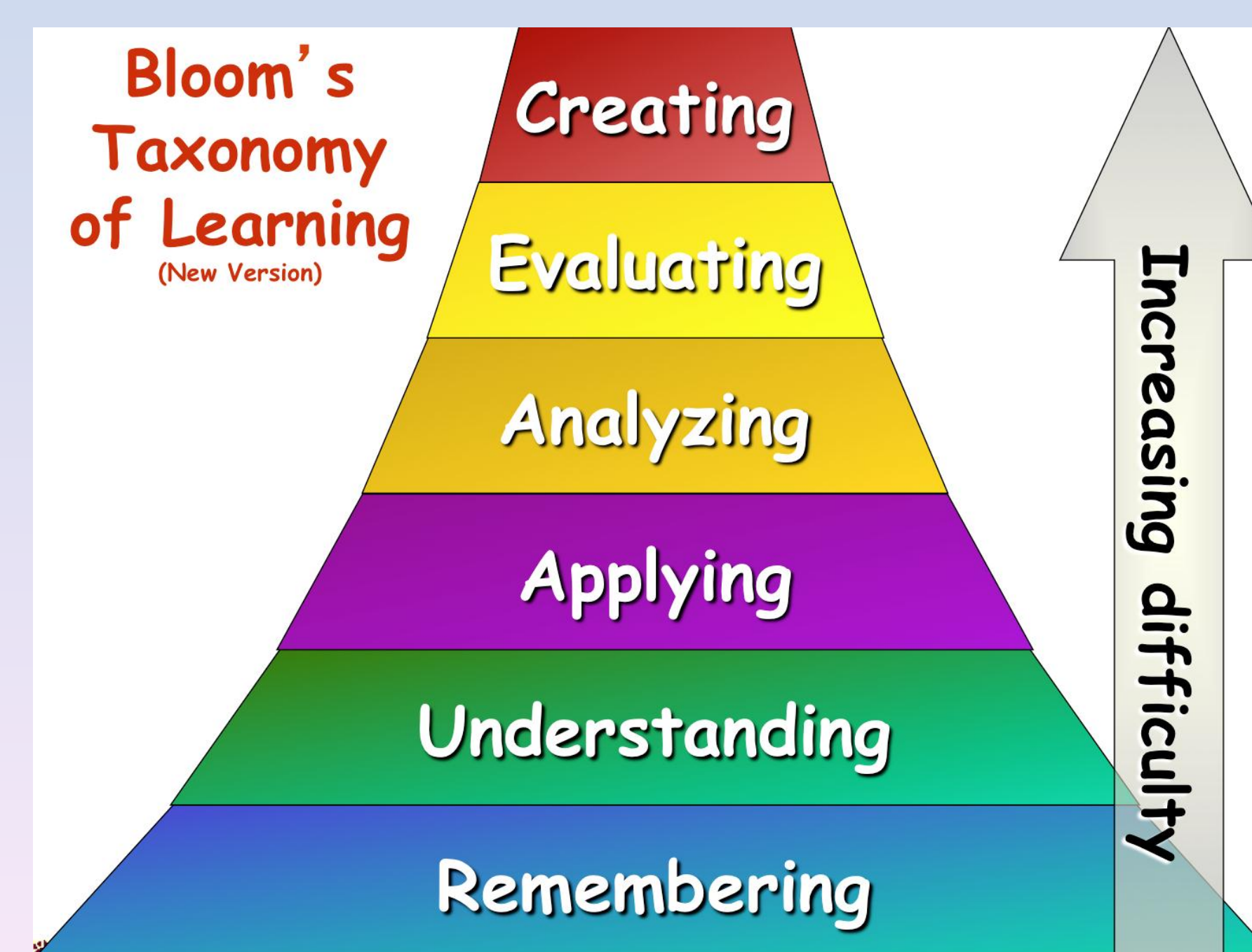
1. Effects of pH on amino acids and proteins
2. Protein purification
3. Enzyme kinetics
4. Carbohydrates and glycolysis/gluconeogenesis
5. Lipid structure and metabolism

Weighting and marking of assignments

Marks from each assignment were only worth 1-1.5% to minimize stress on students.

The assignments comprised 6% of students' final grades.

About 100 assignments required 4-5 hours for the instructor to grade. Written feedback was provided to each group of students and a list of frequent mistakes was posted on Blackboard.



Reproduced from <http://blogs.setonhill.edu/games/2012/01/02/blooms-taxonomy/>

Example Podcast / In-Class Assignment: Effects of pH on amino acids and proteins

Most introductory biochemistry courses begin with an introduction to principles of acid-base chemistry and buffers.

These principles are very important to many different biological concepts such as protein structure, enzyme function, oxygen transport and metabolism.

Some student reactions to learning basic concepts of pH and buffers

Lack of relevance: "What does this have to do with real life?"

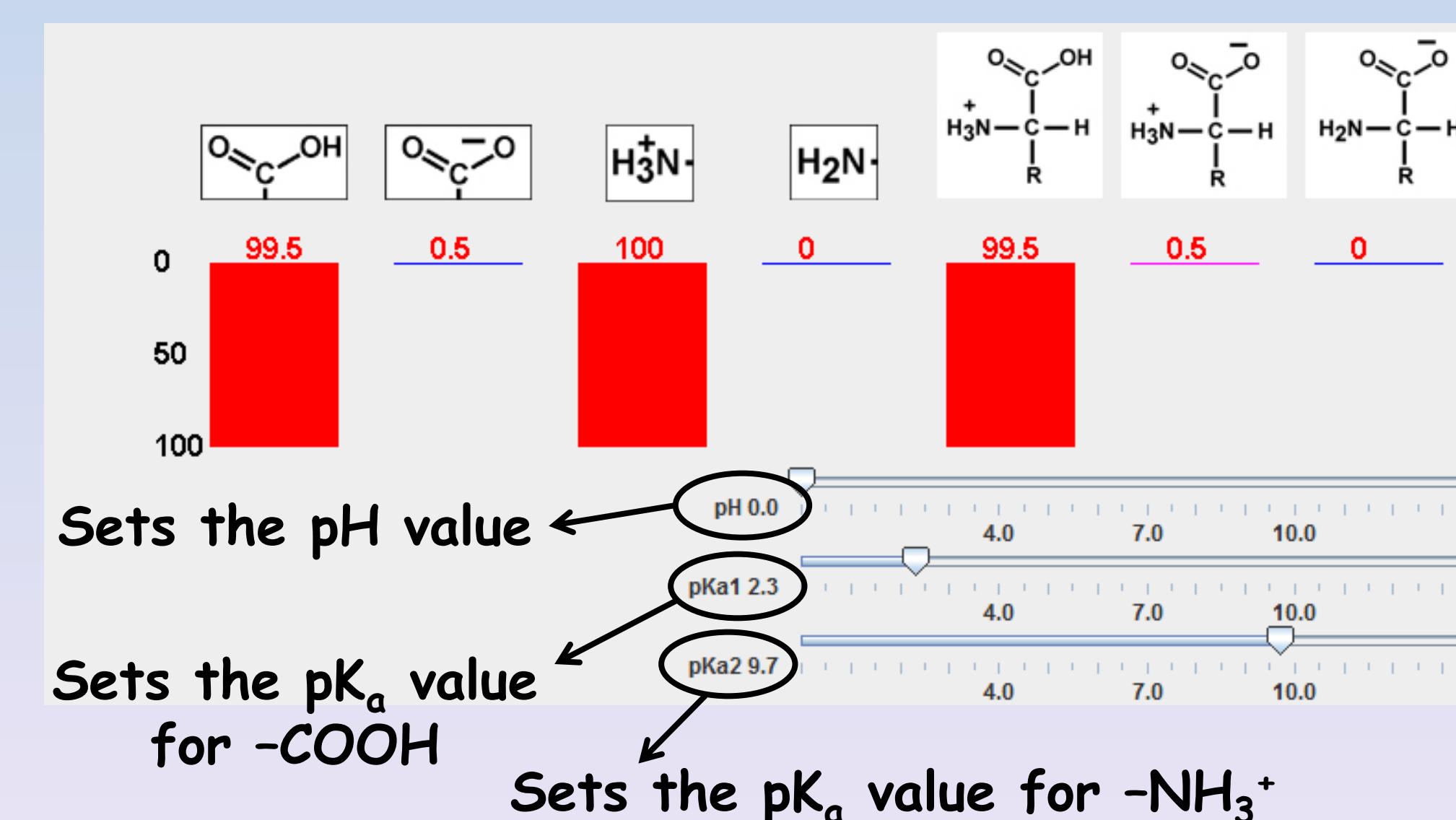
Bad previous experiences: "I didn't understand it in chemistry – why do we have to learn this all over again!"

It's easier to memorize examples rather than understand concepts: "I don't get it – I'll just memorize how to do the problems from old exams."

How can a podcast and in-class assignment help students learn about pH and buffers?

1. The podcast helps introduce the use of the “pH Ruler” Java applet as a tool for students to gain a more intuitive feel for the meaning of pH, acids, bases and buffers.
2. Students use the pH Ruler to “play detective” and solve a puzzle that requires them to master basic concepts of pH and buffers.
3. Exercise, accidental poisonings, blood pH control and bicarbonate buffers as treatments for poisoning provide real-life examples where acid & base concepts are critical for understanding what is happening – students see for themselves the real-life importance of pH and buffers

The pH Ruler Java applet



Barrette-Ng, I. (2011) BAMBEd, 39(4): 332-338

Some details on the pH podcast and In-class assignment

The first podcast and in-class assignment in the course Only worth 1% of final mark (nothing to stress over) Students were asked to work in groups of 3-4. Forty minutes of class time to complete the assignment.

Three case studies studied by the pH podcast and in-class assignment

1. Control of blood pH by bicarbonate buffer under normal physiological conditions and in the case of accidental poisoning with weak acid analgesics like aspirin
2. Structure and properties of monosodium glutamate (MSG) as a function of pH
3. Structure and function of plasma pH sensor proteins like the histidine-proline-rich glycoprotein (HPRG) as a function of pH

Example questions from the MSG portion of the in-class assignment

1. Draw the structure of glutamic acid in its most protonated form.
2. How many equivalents of base do you need to prepare MSG from glutamic acid? Draw the structure of MSG and show how it is formed from glutamic acid.
3. Draw the titration curve for E. Be sure to label your axes.
4. What is the pI of E? Show your calculations.

Did the podcasts and assignments help?

The effects of the podcasts and in-class assignments on student learning were assessed using two different measures:

(1) voluntary self-assessment surveys (Table 1); and

(2) performance on exams.

Table 1: Results from voluntary self-assessment surveys

Survey response	% of students in agreement
Working with other students improved learning	60%
Listening to podcasts improved learning	77%
Feedback from instructor and TA improved learning	73%
Variety of teaching approaches improved student success	72%

Performance on exams:

❖ 14 questions on two midterm exams and the final exams were directly related to the topics covered in the in-class assignments

❖ approximately 50% of students answered these questions incorrectly in previous years – approximately 10% of students answers these questions incorrectly

Acknowledgments

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