

A Modified Challenge-Based Learning Approach in a Capstone Course to Improve Student Satisfaction and Engagement †

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INTRODUCTION

Almost half of instructors at four-year institutions still lecture extensively, according to the most recent data from the faculty survey of student engagement. However, a recent meta-analysis of 225 studies of active learning approaches showed that active learning strategies significantly increase student learning and achievement (1). In my first offering of a capstone course for senior biochemistry students, evaluations of the course were lower than my historical average. The class focused on critical thinking and engagement of the primary literature, and students' comments suggested there was still too much lecture and the content was not relevant to their post-graduation plans. In an effort to increase student achievement and satisfaction with the course, I adopted a modified Challenge-Based Learning (CBL) design for the course in hopes that real-world problems would increase student interest and engagement, resulting in increased learning and satisfaction.

PROCEDURE

On the first day of class, students are introduced to the concept of CBL (2), an approach developed and championed by APPLE. In essence, CBL asks learners to choose a big question that is interdisciplinary and relevant at both a global and local level. Students and instructors jointly determine learning outcomes and the method of displaying competence in those learning objectives. After a brief introduction to this approach, students form two semester-long teams of approximately four students. These teams begin to brainstorm big ideas related to biochemistry that they would be interested in studying during the semester. As a class, we record all the options on a board and proceed to select four projects on which to focus. To do this, each student is given five votes to place in any combination on the proposed project list. This process is repeated until consensus is reached.

Students have selected to investigate topics such as genetically modified organisms, HIV, nanotechnology, bioprinting, influenza, and the role of alternative medicine, to name a few. The selected topics each become a unit and together comprise the content for the course. Each unit consists of a nine-class sequence (see Table 1) based on having two teams in the class. On Day 1 of each unit, the class jointly determines learning goals. Teams begin by discussing what they would like to learn from this unit. While I guide the creation of learning outcomes to ensure that some of the objectives cover relevant content at a depth appropriate for an upper-level biochemistry course, students create other objectives to explore the interdisciplinary nature of the problem. This approach is helpful as it allows students to grapple with the complexity of our world and practice critical thinking skills by weighing various arguments made by experts, the media, government, and the public. One example of this was our study of influenza in the spring of 2014. After teams brainstormed learning objectives, we distilled, modified, and strengthened their list as a class. That list was then shortened to the following five objectives for the unit:

- Be able to explain how this technology fits into the context of the current medical and technical knowledge and, through this, illustrate what critical advances were required for this technology to become a reality.
- Demonstrate an understanding of the ethical, political, and societal implications of the adaptation of this technology into our current medical treatment choices.
- Understand the biological underpinnings of this technology. Students will be able to explain at a molecular level the challenges researchers face as well as the success they have found.
- Be able to explain the barriers to adoption of this technology apart from the biological challenges. Adeptly discuss the governmental, societal, and technological processes that would prevent or slow its use.
- Form an opinion on the benefits and challenges of this technology as well as a possible time frame for its use.

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†Supplemental materials available at <http://jmbe.asm.org>

Once learning objectives are agreed upon, the teams spend four class periods working together to research, interview, and prepare a presentation showcasing their mastery of the learning outcomes (see Appendix 1 for a generalized rubric). During these work days, as an instructor I frequently sat in on team meetings and helped teams reach our set goals by serving as a facilitator of conversation, a recommender of resources, or a motivator to stuck teams. While CBL is designed to have students and instructors jointly determine the dissemination of their work, I chose to set a structure for dissemination at the beginning of the term. Student teams are asked to do the following for each unit: create an oral presentation of their research that demonstrates mastery of our agreed upon learning objectives; select and defend their choice of one primary literature article on the unit subject; and complete a peer and team evaluation at the conclusion of the unit. Additionally, students are asked to complete a project extension for one of the four unit projects during the term that expands their learning beyond our

classroom. This project extension aims to enrich our local community and could be education, advocacy, or outreach.

CONCLUSION

The initial problem that motivated this approach was student course survey results. Course evaluation after the integration of CBL was very strong and in line with my historical average (4.5/5 as compared to 3.65/5 in 2011). It was also clear anecdotally from the in-class work days and the unit presentations that students were engaged in learning in ways I had not previously observed. In addition to the student course surveys, I recruited a colleague to come into my class three times over the course of the semester to administer a survey designed to gauge student satisfaction with the modified CBL design. In all but one category, the responses increased in favorability from the starting survey to the end-of-term survey even though students' initial impression was close to 4 out of 5 in many categories (see Fig. 1). In both surveys, many students commented that they appreciated the challenge that this course design produced. In both versions of this class—the standard form and the CBL model—my learning goal remained the same: I desired students to practice using and analyzing the primary literature, to form opinions, and to think critically. What has impressed me most is the positive difference in student engagement and satisfaction when I structured the course using a modified CBL approach.

SUPPLEMENTAL MATERIALS

Appendix 1: Oral Presentation Rubric

TABLE 1.
CBL unit structure.

Day	Activity
1	Create Unit Learning Goals
2	Primary Literature Team 1
3	Primary Literature Team 2
4	Work Day 1
5	Work Day 2
6	Work Day 3
7	Work Day 4
8	Team 1 Oral Presentation
9	Team 2 Oral Presentation

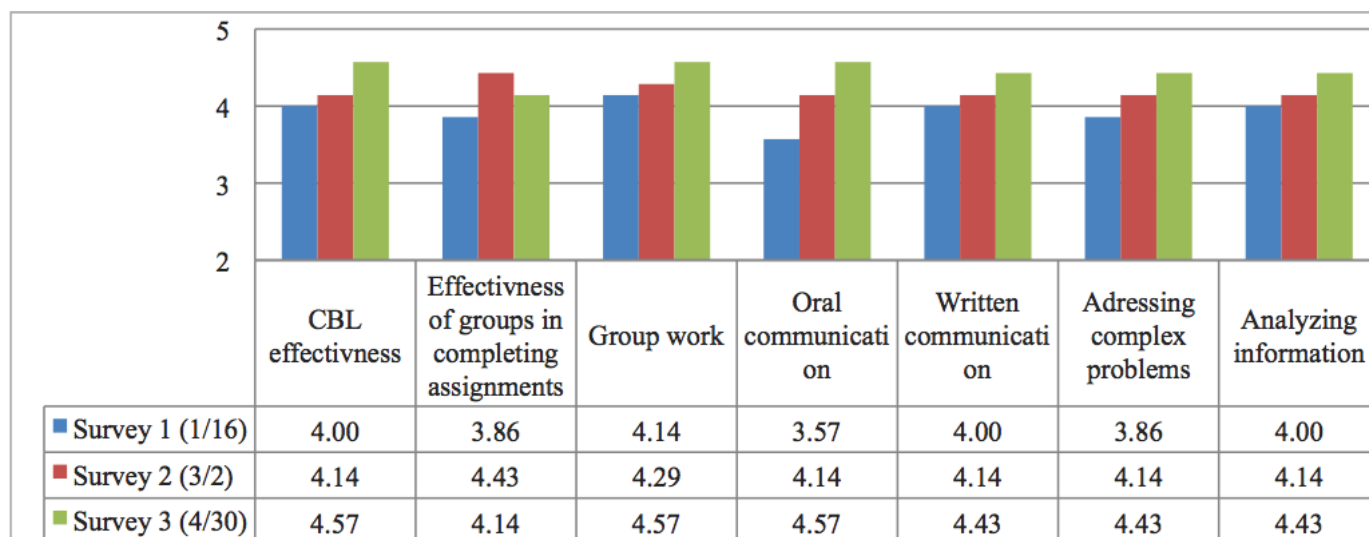


FIGURE 1. Student survey data measuring student satisfaction with CBL (first two columns) and their perception of the level of skill in a variety of areas as a result of the using CBL in class (last five columns). All results use a Likert scale with 5 being very strong and 1 being very weak (n=7).

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