Hybrid BIOL 110L

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Design: Fall 2013 through Summer 2014
Implementation: Spring 2014 and Fall 2014
Analysis and Final Report: Spring 2015

Introduction

BIOL 110L, Biology: Basic Concepts and Biodiversity, is the three-credit lecture component of an entry-level survey course for biology majors and other majors that require biology in their curriculum. It also fulfills a general education (GN) requirement. For biology majors, BIOL 110 bridges the gap between high-school or introductory college-level science classes and the 200-level core biology courses (BIOL 220W, 230W, and 240W) by providing foundational knowledge and fostering the development of study habits and critical thinking and analytical skills. The BIOL 110 student population includes learners of diverse backgrounds—some students have taken Advanced Placement Biology; others, a year of high school biology; and still others come with little prior classroom experience with biology or chemistry—and delivering the requisite content in a way that effectively engages all learners presents an instructional challenge. I proposed a hybrid redesign of this web-enhanced course in hopes of stimulating more advanced learners while more firmly supporting those with limited previous exposure to biology. The redesign should also encourage learners to work independently, increase flexibility in student schedules, and help prepare students for higher-level science classes delivered in hybrid or online modalities.

Project Design

Course Format Redesign:

The original web-enhanced BIOL 110L, as taught in Fall 2013, delivered content through textbook reading assignments and classroom lectures. I provided copies of PowerPoint slide decks for each lecture through ANGEL. Assessments included weekly online quizzes in ANGEL, in-class exams, and a comprehensive final exam.

Professional development programs such as the eLearning Academy and the Berks Learning Technologies Certificate program prompted me to propose a hybrid redesign of BIOL 110L as a TLI Grant Project. While the application was under consideration, I implemented a series of changes to the course (Phase 1, described below) in the Spring 2014 semester. The TLI Grant was awarded in January 2014, and plans and materials for a second set of changes (Phase 2) were developed during Spring 2014 and Summer 2014; these changes were incorporated into the course in Fall 2014.

Phase 1 (implemented in Spring 2014): BIOL 110L was taught as a traditional web-enhanced course (no reduction in seat time). The primary change to the out-of-class content delivery involved

the adoption of Pearson's online homework system, MasteringBiology. Students completed weekly assignments in MasteringBiology, including interactive learning activities and low-stakes assessments. I also modified the format of classroom sessions by adding i>clicker student response questions, class-wide discussion questions, and group-based learning activities. In addition to the weekly quizzes, unit exams, and comprehensive final exam, final grade determinations also included components for class participation and homework.

Phase 2 (implemented in Fall 2014): I developed a plan for hybridizing the course in consultation with Amy Roche, Instructional Designer. Main features of the plan were as follows:

- Out-of-class delivery of content used textbook readings and MasteringBiology homework as well as brief narrated PowerPoint lectures (created with the help of Mary Ann Mengel, Instructional Multimedia Designer) and other short videos from the textbook publisher or identified from the public domain. As a result, students were exposed to key concepts through one or two or even three different learning activities before they entered the classroom.

- Classroom activities were structured similarly as in Phase 1, but took into account this level of prior exposure. Some material in the course was presented exclusively outside of the classroom; other topics presented out of class were used as a foundation upon which classroom learning activities were built.

- To help guide students through the various resources, I posted a weekly agenda on ANGEL that detailed all learning activities and my recommended schedule for completing the activities. A list of learning objectives accompanied this agenda, and those objectives covered exclusively by out-of-class activities were clearly designated to students.

- Face-to-face instructional time was reduced from 41 fifty-minute periods in the semester to 30 periods. (Three remaining periods were reserved for in-class exams.)

- Guided by the experiences reported by Selvi Jagadesan and JoAnne Pumariega in their development of hybrid MATH 021 and MATH 022 courses, I added ten formal instructor-led review sessions. These review sessions were mandatory for students with a 70% average or less, recommended for those with a 70-80% average, and optional for other students—and covered both content that students were exposed to in class and content presented "exclusively" out of class.

- A discussion forum was offered in ANGEL for students to use primarily as a question-and-answer board and for enrichment conversations.

Curriculum Revision:

In conjunction with Phase 2 of the course redesign, I substantially revised the course curriculum, and so the topics covered in the Fall 2014 course differed significantly from those taught in the previous two semesters. The revised curriculum better matches the university course description and presents a wider array of topics as befits a single-semester survey course. (Many institutions use—as

Penn State did in years past—a two-course freshman biology sequence rather than the single survey course.) The curricular realignment compressed the existing content, which focused on basic concepts in biochemistry, genetics, cell and molecular biology, and evolution, into ten weeks and added an overview of biodiversity in the remaining five weeks. While I believe the curricular adjustment was important and warranted, this aspect of the design complicates comparison of the Fall 2014 learning outcomes to those of the Spring 2014 and Fall 2013 semesters.

Outcomes

Mid Semester Survey

An anonymous survey administered during the 7th week of the Fall 2014 semester (during implementation of Phase 2 of the course format redesign and the curricular revision) provided data about the students' academic standing and prior experiences with hybrid courses as well as the students' preliminary perceptions of the course.

Demographic data from the 120 survey respondents (data aggregated from both sections of the course) indicated:

- 93.3% of respondents were "taking the course as a requirement for major" (vs. "for general education," "a minor or related field," or "other" reasons).
- 72.5% of respondents were first-year students; 25%, second-year; 0.8%, third-year; 1.7%, fourth-year.
- For 44.2% of respondents, the BIOL 110L class was their first hybrid or online course; 28.3%, second; and 10.8%, third. The remainder had already completed three or more hybrid courses.

The survey results revealed that students found value in nearly all of the designed in-class and out-of-class learning activities (Table 1). For all activities except the ANGEL discussion forums, at least 60% of survey respondents agreed or strongly agreed that the activity was valuable. Furthermore, the students' general perception of the course was also positive: 84.1% responded that the level of intellectual challenge and stimulation was good (23.3%) or very good (60.8%).

Table 1: Fall 2014 mid-semester survey of students' perception of the value of learning activities in the redesigned hybrid course. Reported are the percent of students in various levels of agreement with the statement "[The stated learning activities] are valuable." Data rows not adding to 100% included respondents who indicated that the learning activity was "not applicable."

Learning Activity	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
PowerPoints from In-Class Sessions	66.7%	26.7%	5%	0.8%	0%
Weekly Schedules in ANGEL	69.2	24.2	4.2	1.7	0
Face-to-Face Class Sessions	66.7	25.8	5.8	0	0
Learning Objectives in ANGEL	52.5	32.5	11.7	0.8	1.7

Learning Activity	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Optional Review Sessions	46.7	36.7	11.7	2.5	0
Online Lectures Created by Instructor	42.5	36.7	18.3	1.7	0.8
MasteringBiology Activities	36.7	41.7	15.8	5	0.8
ANGEL Quizzes	35.8	40.8	19.2	3.3	0.8
Interaction with Teaching Assistants	35	38.3	19.2	7.5	0
Textbook Readings	24.2	38.3	30	5.8	1.7
Optional Crash Course Videos	22.5	39.2	30.8	6.7	0.8
Bioflix Videos	19.2	41.7	33.3	5	0.8
ANGEL Discussion Forums	11.7	20	39.2	19.2	7.5

Student Final Grades

As judged by the students' individual final grade outcomes (Tables 2 and 3) and the overall GPA for each class (Table 4), student grades in the course neither improved nor declined with each phase of the course redesign and the curriculum revision. For instance, the intra-semester, section-to-section variability in overall GPA with Fall 2013, Spring 2014, and Fall 2014 semesters was greater than the variability across these three semesters. Although the proportion of students earning a final grade of D, F, or WN (late drop) decreased in Fall 2014 versus the previous semesters, this decline was not statistically significant (one-tailed Z-test, 80% confidence interval.)

Table 2: Distribution of final letter grades by semester (numbers of students).

		Original Web-Enhanced Fall 2013		Web-Enhanced Spring 2014		Hybrid, Revised Curriculum Fall 2014	
Letter	**GPA**	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
A	**4.00**	12	13	12	8	6	9
A^{-}	**3.67**	5	3	4	2	4	8
B^{+}	**3.33**	7	2	3	5	6	8
B	**3.00**	9	9	6	8	12	12
B^{-}	**2.67**	6	3	3	1	5	3
C^{+}	**2.33**	2	5	4	1	5	9
C	**2.00**	8	11	6	9	3	4
D	**1.00**	4	5	2	4	3	2
F	**0.00**	3	3	4	5	5	1
WN[1]	**0.00**	3	4	1	2	4	3
W[2]		1	1	1	1	0	0
Total		60	59	46	46	53	59

[1] late drop withdrew from course, late drop [2] withdrew from university

Table 3: Distribution of final letter grades by semester (percentage of total students).

	Original Web-Enhanced Fall 2013		Web-Enhanced Spring 2014		Hybrid, Revised Curriculum Fall 2014	
Letter Grade	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
A or A-	28.3%	27.1%	34.8%	21.7%	18.9%	28.8%
B+, B, or B-	36.7	23.7	26.1	30.4	43.4	39.0
C+ or C	16.7	27.1	21.7	21.7	15.1	22.0
D	6.7	8.5	4.3	8.7	5.7	3.4
F	5.0	5.1	8.7	10.9	9.4	1.7
D, F, or WN	16.7	20.3	15.2	23.9	22.6	10.2
F or WN	10.0	11.9	10.9	15.2	17.0	6.8

Table 4: Overall GPA for BIOL 110 classes by semester. A course-wide grade point average was calculated, according to the scale listed in Table 2, for all students in the class (row 1) or for all students in the class with a grade of C or better (row 2).

	Original Web-Enhanced Fall 2013		Web-Enhanced Spring 2014		Hybrid, Revised Curriculum Fall 2014	
Category	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
All students	2.62	2.43	2.65	2.33	2.43	2.83
C or better	3.13	3.01	3.16	3.03	3.06	3.11

Student Rating of Teaching Effectiveness

According to end-of-semester Student Rating of Teaching Effectiveness (SRTE) surveys (Table 5), the first phase of the course redesign resulted in enhanced student satisfaction and perception of learning outcomes (95% confidence interval, one-tailed t-test; p=0.0062 for course SRTE, p=0.0022 for instructor SRTE). Movement to a hybrid format in the second phase of the course redesign and the revision of the curriculum neither decreased SRTE scores nor increased them further (95% confidence interval, two-tailed t-test; p=0.38 for course SRTE; p=0.35 for instructor SRTE). The SRTE surveys, however, were returned at a higher rate in the Fall 2014 semester as compared to Spring 2014 (95% confidence interval, Z-score = 2.022065, p = 0.022).

Table 5: Student Rating of Teaching Effectiveness: response rate (% of class) and course and instructor ratings (seven-point scale, 7 = highest)

	Original Web-Enhanced Fall 2013		Web-Enhanced Spring 2014		Hybrid, Revised Curriculum Fall 2014	
	Section 1	Section 2	Section 1	Section 2	Section 1	Section 2
Response Rate	42.1%	42.6%	40.0%	34.9%	44.0%	58.9%
Course Rating	5.70	5.43	6.33	6.08	6.14	6.00
Instructor Rating	6.14	6.22	6.83	6.69	6.80	6.55

Additional Observations

Through both phases of the course redesign, I observed greater student engagement in the classroom among both advanced and less-enabled learners, with higher quality class discussions, greater participation in group activities, and a more positive general atmosphere.

In the Fall 2014 semester, some students resisted the hybrid nature of the course. For instance, one respondent to the mid-semester survey stated, "I just would prefer more of a traditionally run course than a hybrid course, I feel as though I grasp the concepts better when taught by someone else than trying to teach myself." Approximately 15% of Fall 2014 SRTE respondents expressed a perception that the following changes would "improve their learning": "no online work," if the class would be "not hybrid," or if the course would include more face-to-face class sessions or review sessions.

Classroom attendance was higher during the Fall 2014 semester than in previous semesters (5.4 absences per student for the Fall 2014 semester versus 10.3 in Spring 2014, and 6.2 in Fall 2013.) Attendance at review sessions, even among those students for whom the sessions were optional, was also remarkably high.

Discussion

The first phase of the course redesign was implemented in the Spring 2014 semester and incorporated online homework as well as group work, clicker questions, and discussion questions in the classroom. These modifications yielded enhanced student satisfaction and perception of the instructional experience, a result consistent with Fall 2013 SRTE surveys, in which students expressed a wish for a "more interactive" course. The second phase of the course redesign, implemented in the Fall 2014 semester, did not yield additional enhancement in student perception of the learning environment as measured by SRTE ratings, but my own perception was that the hybrid design increased student engagement in the classroom in addition to stimulating student work outside the class, perhaps reflecting better student preparation and/or greater appreciation for the classroom activities.

Overall grade profiles did not improve or decline with either phase of the course redesign. Variability in grading practices (e.g., difficulty of exam questions, availability of extra credit

opportunities) may have promoted uniformity in grade distributions from semester to semester. In addition, semester-to-semester variability in the student population as well as the instructor's pedagogical development, could also mask differences in the learning experiences represented by each of the course designs. Interpretation of these results (student perception and grade outcomes) is further confounded by the curriculum revision, as the course content in Fall 2014 differed substantially from the content in the previous two semesters.

As we continue to refine this hybrid course, I'd like to improve some of the online materials by (1) generating additional narrated PowerPoints to increase coverage of basic concepts; (2) exploring alternative online homework systems (although many students praise the online homework as helping their learning, others expressed frustration with the questions and suggested "revamping" MasteringBiology); and (3) devoting additional attention to the ANGEL discussion forum.

My experience developing the hybrid BIOL 110L course offers several lessons, particularly for those designing and developing hybrid courses for early undergraduate students from diverse learning backgrounds:

- I adopted the strategy introduced in the hybrid MATH 020 and MATH 021 courses of offering in-class review sessions that were optional for "enabled" learners (those with a C average or better) and mandatory for less-enabled students. In practice, attendance at these review sessions (by both enabled and less-enabled learners) was quite high, and many students expressed appreciation for them. Since the review sessions cover both in-class and out-of-class content, including them offers a route by which students can more gradually transition from the mindset of a traditional face-to-face class to that needed for a hybrid class.

- Students appreciated the variety of learning activities by which the course content was presented in the hybrid course. Given the many course resources, timelines, and deadlines, the weekly agenda seemed an important organizational aid to students. This schedule requires significant advance planning from the instructor/course designer and is perhaps better suited for courses such as BIOL 110 that have a relatively prescribed curriculum.

- Many students approach the hybrid course with hesitation, and it's important to stress the benefits of hybrid courses: that they promote more active student learning; that they offer potential flexibility; and that they foster a more engaging learning environment and as a result are becoming increasingly frequent in higher education.

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