

Mastering Biology educator study documents redesign to flipped classroom at Vincennes University

<p>School name Vincennes University, Vincennes, IN</p> <p>Course name Principles of Biology I and II</p> <p>Course format Lecture and lab, flipped classroom</p> <p>Course materials Mastering Biology with <i>Campbell Biology in Focus</i> by Urry, Cain, Wasserman, Minorsky, Jackson, and Reece</p>	<p>Timeframe Fall 2011–Spring 2014</p> <p>Educator Curtis Coffman, Associate Professor and Biology Department Chair</p> <p>Results reported by Betsy Nixon, Pearson Customer Outcomes Analytics Manager</p>
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Key Findings

- After implementing Mastering Biology as part of a four-year course redesign to a flipped classroom, students earned more As and Bs.
- After implementing Mastering Biology, students earned higher average final exam scores.

Setting

Vincennes University offers both two- and four-year degree programs and enrolls more than 15,000 students across multiple campuses. The main campus is located in a rural area.

About the Course

Principles of Biology I and II is a two-course sequence offering an integrated approach to the study of living organisms. Topics include genetics; cytology; respiration; photosynthesis; ecology; evolution; living-organism domains and kingdoms; plant morphology, physiology, and development; and animal morphology and physiology.

The students who take these courses are primarily pre-professional majors (i.e., premed, dentistry, pharmacy, physical therapy, and veterinary majors), in addition to agriculture, earth science, zoology, forensics, biotech, biology, and marine biology majors. The majority are full-time, traditional, college-age students.

Challenges and Goals

Associate Professor and Biology Department Chair Curtis Coffman found that students did not come to class prepared, which impacted how class time was spent. To promote that students take more responsibility for their learning and come to class with a better understanding of basic content, he redesigned the course to a flipped classroom. By assigning basic content to students prior to class, he could focus on active learning during class which would help students develop a deeper understanding of conceptual problems to help them succeed in future courses.

Implementation

The redesign was rolled out over a four-year period. The starting point was when Coffman attended a 2010 workshop for the National Association of Biology Teachers on lecture-free teaching by Bonnie Wood, professor at the University of Maine at Presque Isle, who wrote a book by the same title. Coffman developed pre-class worksheets to encourage students to prepare prior to lecture. Over a three-year period, he then collected active-learning exercises and case studies to incorporate into the class. In Fall 2013, he added Mastering™ Biology and preclass videos to ensure students were prepared for in-class activities. Pre-class work included the following:

1. 10–13 minutes of video that covered content to be discussed in class. The main sources of videos were YouTube, Crash Course Biology, and Bozeman Science.
2. A pre-class Mastering homework assignment, which may include BioFlix™, exercises, and quiz questions.
3. A paper-and-pencil assignment based on the textbook reading. Coffman created the questions, which were focused on important background information.

The new, flipped format provided students with the same information three different ways to address different learning needs and help students make connections. Students who completed the work came to class with an understanding of basic concepts and a recognition of what they didn't yet understand. Coffman used the diagnostic reports in Mastering to check for knowledge gaps and address misconceptions in class.

The following activities were utilized in class:

- Case studies
- Process modeling
- Group discussion questions
- Textbook data analysis and graphing for skills exercises

In-class activities came from sources including the National Center for Case Study Teaching in Science, The American Biology Teacher, and Coffman himself. These activities encouraged the development of critical-thinking skills and focused on conceptual learning of biology topics.

Assessments

- 60% Exams (five exams and a final)
- 25% Mastering Biology
- 10% Pre-class chapter outlines
- 5% In-class activities

Results and Data

Data for Principles of Biology I and II for the first semester Mastering Biology was in use indicated an improvement in student performance: the number of students earning an A or B in the course increased in both Principles of Biology I and II (figure 1); in the Spring 2014 Principles of Biology II course, in which the students had used Mastering in the Fall Principles of Biology I class, the A/B rate was 16 percentage points higher than the prior semester without Mastering. In addition, students earned significantly higher exam scores for both Principles of Biology I and II after using Mastering (figure 2). The final exam average for Principles of Biology I was notably higher than prior averages ($p=0.000007$), with the Principles of Biology II exam significantly higher than prior semesters ($p=0.019$).

Percentage of students earning an A or B with and without Mastering

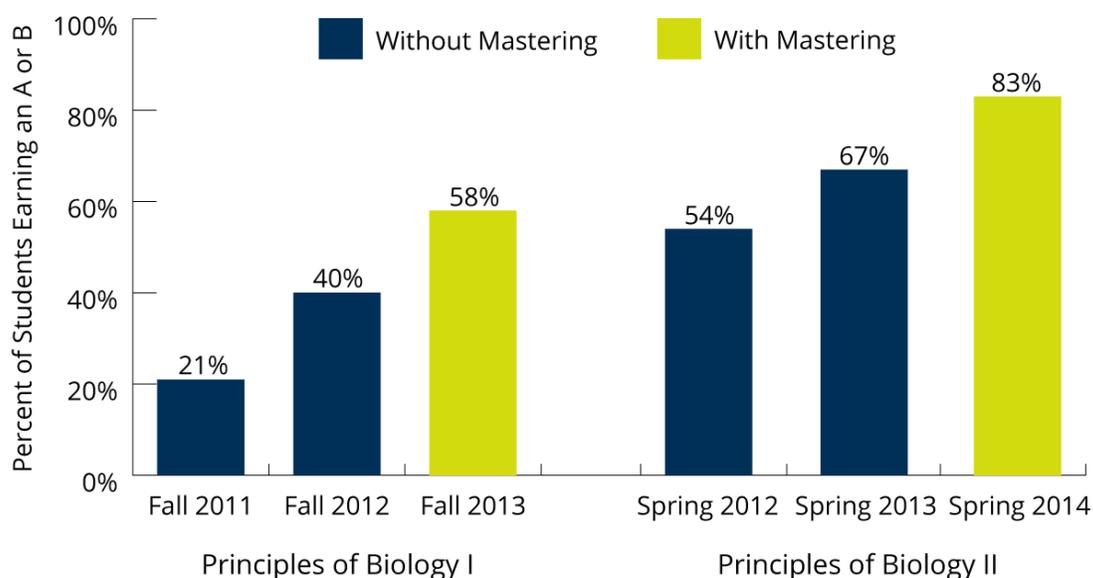


Figure 1. Percentage of Students Earning an A or B with and without Mastering, Fall 2011–13 and Spring 2012–14 (Fall 2011 ($n=50$); Fall 2012 ($n=43$); Fall 2013 ($n=52$); Spring 2012 ($n=35$); Spring 2013 ($n=33$); Spring 2014 ($n=41$))

Mean final exam scores with and without Mastering

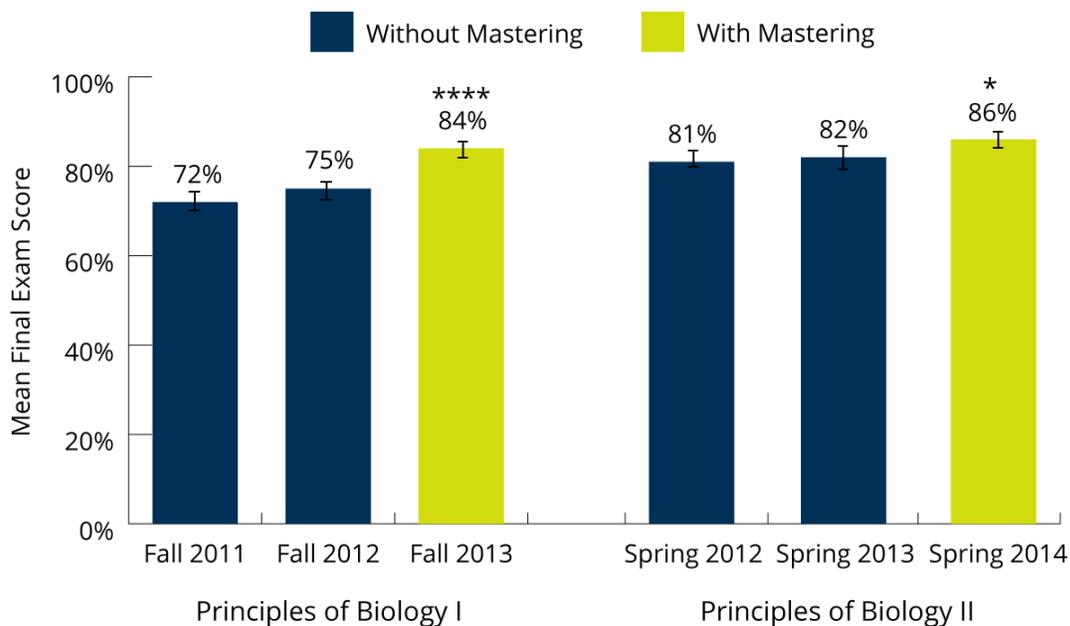


Figure 2. Mean Final Exam Scores with and without Mastering, Fall 2011–13 and Spring 2012–14; Fall 2011 ($n=50$); Fall 2012 ($n=43$); Fall 2013 ($n=52$); Spring 2012 ($n=35$); Spring 2013 ($n=33$); Spring 2014 ($n=41$) Error Bars = Standard Error, Significance $*p<0.05$, $****p<.0001$

The Student Experience

Students said that they enjoyed using Mastering and used it as a study tool to help prepare for exams. Prior to exams, students could often be found in the computer lab working on Mastering, reviewing homework, and using the study area resources. In addition, student evaluations on the overall class were much more positive after the redesign.

Conclusion

Coffman reports that since flipping his classroom and adding Mastering Biology, students came to class better prepared and understood what they knew and didn't know. In addition, topics were covered in more depth, which better prepared students for higher-level courses in the future.

According to Arthur Chickering and Stephen Ehrmann, "Learning is not a spectator sport. Students do not learn much just sitting in classes listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write reflectively about it, relate it to past experiences, and apply it to their daily lives. They must make what they learn part of themselves."¹ The flipped format does just that.

¹Chickering, Arthur W. and Ehrmann, Stephen C, "Implementing the Seven Principles: Technology as Lever," American Association for Higher Education and Accreditation Bulletin, 1996.