

MasteringBiology with Knewton Adaptive Follow-Up

School Name Collin College, Plano, TX

Course Name General Biology I

Course Format Lecture and lab

Key Results When Knewton Adaptive Follow-Up was added, there was a statistically significant increase in end-of-semester student exam scores.

Submitted by

Rebecca Orr, Professor; Shellene Foster, Statistical Analyst

Course materials

Campbell Biology, Reece, Urry, Cain, Wasserman, Minorsky, and Jackson

About the Course

Collin College is a multicampus, two-year college in North Texas that enrolls approximately 27,000 students, 67 percent of whom attend part-time. General Biology I is taken primarily by students who intend to pursue a degree in the health sciences (e.g., nursing, dental hygiene, respiratory care, and surgical technology) or plan to transfer to a four-year institution. The course covers the fundamental principles of living organisms, including physical and chemical properties of life, organization, function, evolutionary adaptation, and classification. Concepts of cytology, reproduction, genetics, and scientific reasoning are also included. The course has lecture and lab components.

Challenges and Goals

Students who take General Biology I at Collin College come from a variety of backgrounds and have different skill levels and styles of learning; some are not college or course ready. Addressing the needs of this diverse group can be a challenge.¹

Professor Rebecca Orr has been using MasteringBiology for several years, but recently added Knewton's Adaptive Follow-Up (AFU) to her implementation as a way to help students

identify individual gaps in knowledge and remediate at their own pace and on their own time.

Implementation

Orr's use of MasteringBiology has progressed from an optional resource to a required component. In 2013, she published a study on the effect of online testing as a learning event in the introductory (majors) biology classroom using MasteringBiology to deliver required quizzes. Through detailed statistical analysis, the benefit of quizzing was demonstrated to be significant for students of diverse academic abilities.²

In response to the results of that study, Orr continues to require preexam MasteringBiology quizzes. The course consists of three different types of MasteringBiology assignments:

- **Prelecture reading assignments (untimed homework).** Ten-question, multiple-choice assignments designed to offer quick feedback regarding students' initial comprehension of course material. Students may request hints but are limited to two attempts. Diagnostics from these assignments help guide lecture discussion.
- **Practice assignments (untimed homework).** Chapter-specific tutorials, activities, BioFlix™, and misconception questions. Homework assignments require 30 to 60 minutes to complete. Students may request hints and they have multiple attempts.
- **Required quizzes (timed).** Designed to provide a snapshot of where students are in preparation for upcoming exams. Quizzes comprise original content that has been uploaded into MasteringBiology. Topics and wording prepare students for the types of questions that will be on the

¹Studies show that students who are not college ready face serious barriers to academic success. In Texas, 38 percent of students who are below the state readiness standard when they enter college graduate or are still enrolled in higher education after three years. This is compared to 57 percent of students who are college ready upon entry. 2013 Texas Public Higher Education Almanac, Texas Higher Education Coordinating Board, p. 13 (www.theccb.state.tx.us).

²"Increasing Student Success Using Online Quizzing in Introductory (Majors) Biology," Rebecca Orr and Shellene Foster, CBE—Life Sciences Education, Vol. 12, 509–514, Fall 2013 (<http://www.lifescied.org/content/12/3/509.full?sid=01bb2df8-239e-4c41-8406-bd40fc6e1d22>).

exams. To discourage group work, students randomly receive one of three versions of each quiz, and questions are randomized within each quiz.

The first MasteringBiology homework assignment is due by the end of the first week of class to encourage students to get registered in MasteringBiology, and, if necessary, make adjustments to optimize use of the platform. There are four exams each semester.

During summer 2013, Orr tested MasteringBiology's new Knewton Adaptive Follow-Up feature. AFU questions focus students on gaps in their understanding based on individual performance on a MasteringBiology parent assignment and, as such, vary from student to student. Preliminary results from the semester were published in *MyLab & Mastering: Science and Engineering, V. 4*.³

Summer 2013	Spring 2014
No Adaptive Follow-Up for exams 1 and 2	No Adaptive Follow-Up for exams 1 and 2
Optional Adaptive Follow-Up for the second two exam periods	Required Adaptive Follow-Up for the second two exam periods
Two sets of Adaptive Follow-Up	Three sets of Adaptive Follow-Up
Adaptive Follow-Up due two days after parent assignment	Adaptive Follow-Up due two days after parent assignment
Test-out set at 95 percent mastery	Test-out set at 95 percent mastery
Value set as extra credit added to homework portion of lecture grade	Value set as credit added to homework portion of lecture grade

Table 1. Study Implementation of Knewton Adaptive Follow-Up, Summer 2013 and Spring 2014

Results from that study indicated that student success may increase when AFU is used with MasteringBiology homework. To test this finding, Orr repeated the study in spring 2014 making the implementation changes shown in Table 1. Rather than optional AFU (as in summer 2013), AFU sets were required and the number of potential AFU sets increased from two to three.

For all semesters in the study, AFU was not used for exams 1 and 2. For purposes of comparison, those scores were averaged and used to compare general student ability in a given semester.

In spring 2014, MasteringBiology homework was a streamlined version of the one assigned in spring 2013. This increased the item availability of questions for the AFU exercises. The same quizzes and exams were used in all semesters. For the third and fourth units in spring 2014, AFU assignments were added to each MasteringBiology practice assignment.

Based on her experience with Knewton Adaptive Follow-Up, Orr recommends the following best practices:

- Enable the test-out feature to motivate students to complete the MasteringBiology parent assignment.
- Carefully select what is added to the MasteringBiology parent assignment. Keep in mind that AFU sets for the current chapter are drawn from the same item library.
- Schedule due dates of future assignments so the Knewton adaptive engine can integrate consideration of future content prerequisites into current recommendations.
- Streamline homework assignments to account for total time to do the MasteringBiology parent assignment and the AFU sets (~15 minutes per set).
- Select items for the MasteringBiology parent assignment that specifically address ultimate learning goals.
- Sequester items you don't want in AFU assignments in an unscheduled assignment.
- When enabling AFU for an assignment that includes content from multiple chapters, be aware that the sets will be drawn from *all* material covered in the assignment. Inclusion of even one item from a given chapter results in the potential for all information prerequisites to that chapter being included in the set. If you skip a chapter or include only one section from a given chapter, temporarily sequester items from chapters (or portions of chapters) that you don't want included in AFUs.

Assessments

Course Grade

75 percent Lecture

25 percent Lab

Lecture Grade

80 percent Exam average

10 percent MasteringBiology quizzes (100 total points)

10 percent MasteringBiology homework (1,500 total points)

³http://www.pearsonmylabandmastering.com/northamerical/results/files/Mastering_Final_v4.pdf.

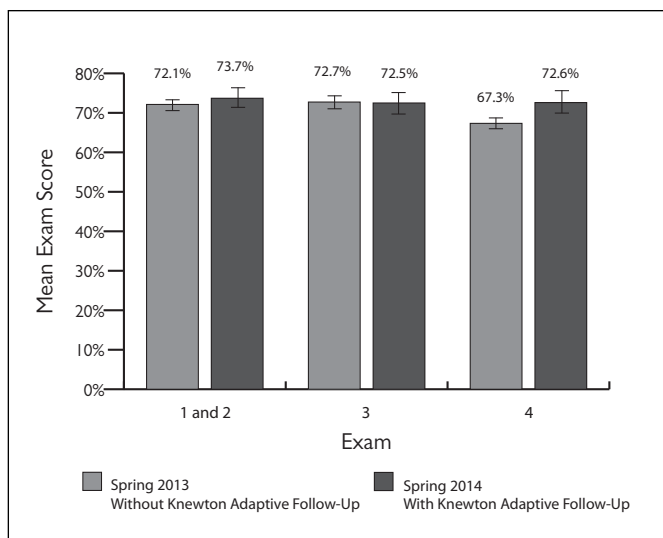


Figure 1. Mean Exam Scores before and after Implementation of Knewton Adaptive Follow-Up, Spring 2013 and Spring 2014 (spring 2013, $n = 121$; spring 2014, $n = 36$; Error Bars = Standard Error, exam 4, $p = 0.032$)

Results and Data

The summer 2013 study indicated that by exam 4 the gap in exam averages of those students who were offered Knewton Adaptive Follow-Up became pronounced. After making the changes in Table 1 in spring 2014, Orr reevaluated the results.

Figure 1 shows that offering Knewton Adaptive Follow-Up has a significant effect: student performance on exam 4 increased with the effect of exams 1 and 2 factored out ($p = 0.032$). Table 2 shows participation in Knewton Adaptive Follow-Up for summer 2013 and spring 2014.

The Student Experience

Student feedback has been positive.

- “I really like how [Knewton Adaptive Follow-Up] takes me back to the basics so I know where I need to study to build my strengths.”
- “Have [Knewton Adaptive Follow-Up] for all of the practices from the beginning of class.”
- “I originally thought that the [Knewton Adaptive Follow-Up] assignments were going to be a waste of time, but they are actually more of a benefit.”

Students report putting more effort into MasteringBiology parent homework because of the test-out option. According to one student, “Adaptive Follow-Up questions motivated me to learn the material better. I really think it’s just the idea of testing out of something that makes me feel smarter and

	Summer 2013 (AFU Optional)	Spring 2014 (AFU Required)
Earned Adaptive Follow-Up credit	74.8%	78.7%
Tested out of Adaptive Follow-Up by earning 95 percent or more on the MasteringBiology parent assignment	16.7%	36.6%
Chose to actively work on Adaptive Follow-Up sets after completing the parent assignment	58.1%	42.1%
Did not participate in Adaptive Follow-Up	25.2%	22.3%

Table 2. Participation in Knewton Adaptive Follow-Up, Summer 2013 and Spring 2014 (summer 2013, $n = 37$; spring 2014, $n = 36$)

encourages me to get a better grade on the [MasteringBiology parent] homework.”

Conclusion

Knewton Adaptive Follow-Up provides individualized recommendations to increase student proficiency in course content and delivers content based on demonstrated understanding of topics as well as the content graphed as a prerequisite for the success of future assignments.

Evaluation of AFU during summer 2013 and spring 2014 shows that AFU had a significant, positive effect on student exam performance. Students often complain about their perceived disconnect between the time and effort spent studying and their subsequent performance on exams. A resource that can identify individual gaps in knowledge facilitates the kind of focused effort and targeted remediation students need to succeed.

In fall 2014, Orr enabled the Knewton Adaptive Follow-Up sets beginning with Chapter 2. This was both in response to student requests that AFU be available earlier and a reflection of the results obtained to date. Orr will continue to evaluate the impact on student learning in future semesters.

In 2000, the Texas Higher Education Coordinating Board adopted *Closing the Gaps by 2015: The Texas Higher Education Plan*.⁴ The report focuses on key goals and outcome measures which include student participation (as measured by enrollment) and success (as measured by certificate and degree completion). Completion of a program starts with a student achieving success in core courses, such as General Biology I. By redesigning the course to enhance individual student learning, Orr is providing a learning opportunity to help more students accomplish their educational and career goals.

⁴2013 Texas Public Higher Education Almanac, *Texas Higher Education Coordinating Board*, p. 1.