

# Online Learning Objects with Embedded Self-Assessments as a Model for a Blended Student Centered Approach in Introductory Biology

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Blended learning classroom formats are becoming increasingly prevalent in large lecture undergraduate science courses. Integration of blended learning practices with online embedded student self-assessments provide flexibility during in-class time to extend conceptual understanding with student-centered approaches. We have developed web-based quiz questions with feedback that can be used in concert with online materials outside of class for introductory biology courses. The questions are in html5/Javascript format and can be accessed by most internet browsers and mobile devices. We specifically focused on difficult concepts in molecular biology such as DNA replication, transcription, and translation. Several question formats were used in concert with online materials to provide students with background material and opportunities for self-assessment. We compared in-class assessment results using a comparison group study approach that analyzed overall conceptual understanding in various classroom formats: a traditional large lecture with no student-centered learning, a large lecture with active learning and flipped components, a completely flipped student-centered format (Student-Centered Active Learning Environments with Upside-down Pedagogies – SCALE-UP), and a distance education section of the class.

**Keywords:** online learning, student self-assessment, student centered learning

## Link to Supplemental Materials

<http://www.ableweb.org/volumes/vol-36/poster?art=74>

## Extended Abstract

Integration of blended learning practices with online embedded student self-assessments provide flexibility during in-class time to extend conceptual understanding using student-centered approaches. We have developed web-based quiz questions with feedback that can be used in concert with online materials outside of class for introductory biology courses. The questions are in html5/Javascript format and can be accessed by most Internet browsers and mobile devices. We specifically focused on difficult concepts in molecular biology such as DNA replication, transcription, and translation. Several question formats were used in conjunction with online materials to provide students with background material and opportunities for self-assessment. We compared in-class assessment results using a comparison group study approach that analyzed overall conceptual understanding in various classroom formats: a traditional large lecture with no student-centered learning; a large lecture with active learning and flipped components; and a completely flipped student-centered format (Student-Centered Active Learning Environments with Upside-down Pedagogies – SCALE-UP).

A webquest (an online interactive guide to a topic) was developed to introduce introductory concepts of DNA replication, transcription, and translation and was made available to three sections of Introductory Molecular Biology (BIO 183) comprised of one distance education section, a modified lecture section, and a SCALE-UP section. Included in the webquest were five online self-assessment exercises related to the webquest content that students were asked to complete following completion of the online learning module. The students in the traditional lecture were asked to read sections of their textbook covering the same material as the webquest prior to coming to class. To assess the effectiveness of the webquest in conjunction with the various pedagogical methodologies being examined, a free-response assessment written at higher levels of Bloom's Taxonomy was given to students once all material had been covered in class. Along with this self-assessment, students in the modified

lecture and SCALE-UP sections were asked to report whether they had completed the online self-assessments. Although the reporting was not anonymous, students were told that self-reporting would not affect their grades in the course. Samples for assessments were simple random and independent. Sample size was based on 35% of total class size for overall averages and 50% of total class size for averages of students who self-reported on their completion of the online self-assessments. All  $p$ -values were calculated using either a one-way ANOVA or a student  $t$ -test and evaluated at  $\alpha = .05$ . Data was assessed assuming independent variables with unequal variances.

Class averages for traditional students on the replication/translation/transcription assessment were significantly lower ( $p = .000001$ ) than both averages for SCALE-UP and the modified lecture. There were no significant differences found between SCALE-UP and the modified lecture settings. The averages for students who self-reported as having completed all five online self-assessments was significantly different ( $p = .017$  for SCALE-UP and  $.002$  for modified lecture) from those who self-reported as having not completed the self-assessments.

Student centered learning strategies, in conjunction with a blended learning classroom format, can improve student comprehension of course material even within classrooms that already employ student centered learning strategies.

Similar performance between modified lecture and SCALE-UP students suggests that incorporating at least some student centered learning strategies within large lecture hall settings can increase student performance to levels comparable to students in the preferred SCALE-UP format. Interestingly, all participating students in the study scored relatively low on the free-response assessment. This may be attributed to student difficulty answering questions targeting higher levels of Bloom's Taxonomy. However, it should be noted that even though all scores were low both SCALE-UP and modified lecture students performed better than their traditional lecture peers indicating that these instruction models do provide students with at least some opportunities to develop skills necessary for handling higher order questions.

After the completion of this study several questions still remain. Future studies should be aimed at further determining how to optimize the modified lecture environment in conjunction with a blended learning approach to continue increasing student performance in large introductory biology courses where large numbers of students and limited resources constrain the numbers of SCALE-UP sections offered each semester. Focus should be placed on further quantifying the effects of both online learning elements and student centered pedagogical methods on student performance.

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