

2010-11 Assessment Project – Final Report

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Project Title: Determination of Level of Preparedness of Juniors to Take Upper Division Courses in the Plant Science Major

Introduction

The goal of the Department of Plant Science is “to provide students with an education in modern, scientifically based, economically sound, and environmentally wise agriculture.” In order to meet this goal, our students first must have knowledge of the fundamental principles of plant biology. In our major, these principles are covered in general education area B2, and currently the department requires our majors to fulfill this area by taking Biol 11 (Plant Biology, 3 units).

Although almost all courses taught in our department rely on the knowledge gained in this foundational course, student success in Crop Growth and Development (Plant 100) and Crop Improvement (Plant 150) rely very heavily on this prerequisite knowledge. These courses cover applied aspects of plant growth, physiology and genetics. There is a perception by faculty teaching these courses (shared by faculty teaching other courses which require similar prerequisite knowledge) that students are not well prepared to take these upper division courses. Faculty often express that many students fail to understand basic concepts such as photosynthesis, cellular division or basic taxonomy. Valuable upper division course time is then devoted to review of these fundamental concepts rather than the more advanced topics which these courses are designed to deliver.

Although the perception by faculty that students are not well prepared for upper division coursework in plant science was common, the department had little or no data supporting this perception. . The faculty had discussed changing the prerequisite course from Biol 11 to Biol 1A (Introductory Biology, 4 units - a more in-depth course with an additional hour of lecture and lab per week), however, without these data, this curricular change seemed premature.

The objective of this study was to directly measure the level of prerequisite knowledge and preparedness of our students. To achieve this, an online test was developed and given to our students in three core required courses, at least one of which is typically taken in the junior year. The goal was to determine whether their level of preparation varied by the biology

course taken or by the institution where the course was taken. Tests were also structured with various sub-areas of biology to identify if there were particular knowledge areas where students were more or less prepared than others.

Methods

An online test was developed to measure prerequisite knowledge and preparedness of our students to take upper division courses in the plant sciences. Blackboard was chosen as a platform to deliver the test as it was already available, familiar to students and offered a level of security to handle confidential data.

A bank of test questions was developed by three faculty in the department (A. Lawson, J. Bushoven, and J. Farrar). The questions were designed to cover the following sub-areas of biology: cellular and molecular biology, plant anatomy/morphology, plant physiology, genetics, ecology and evolution, and taxonomy. A minimum of 30 multiple choice questions were developed for each of the six areas. Test questions for each sub-area were then uploaded to Blackboard and the exam was structured such that 10 random questions from the test bank were selected from each sub-area for a total of 60 questions. Test questions were randomly drawn for each individual taking the test. Students were given three days to complete the exam on their own. To discourage students from looking up answers while taking the test, once a student was logged on, the exam had a time constraint of one hour to complete, regulated by the Blackboard system. Students were given a one minute warning when they were running out of time and any test not completed within the time window received a zero on that sub-area of the exam.

In order to survey as many of our incoming majors as possible, the exam was implemented in three core courses required of all majors offered in the fall semester (Plant 100, Plth 103 and SW 100). In an attempt to ensure students put effort into taking this exam, faculty in each of the three courses allowed the exam to count for 2% of their final grade in each course (and the same score would be used in the grade for all three courses).

The following information was provided by the Office of Institutional Research and Planning (IRAP) for all students enrolled in the three courses in which the test was given: name, gender, ethnicity, level (sophomore, junior, senior), major, cumulative GPA, resident cumulative GPA, prerequisite course taken (Biol 1A, Biol 10, Biol 11, Biol 12, Plant 1 or applicable transfer course), transfer Institution where course taken (if applicable), prerequisite course grade, and year prerequisite course was completed.

Results from students who took the exam, but for whom no data was provided by IRAP from Peoplesoft were not included in the analysis (10 students). Subtest scores where the student ran out of time were manually graded for the portions completed such that student performance would not be artificially lowered with the exception of two students who ran out of time on three and five of the six subtests; results from these students were excluded from the analysis. Overall scores were analyzed using a separate analysis of variance for each of the factors to determine influence of each factor. A stepwise regression model was also conducted which combined all factors with the level of significance to exclude from the model set to $P \geq 0.1$. Effect of cumulative GPA, resident cumulative GPA and years since taking the prerequisite course on total score were analyzed using a linear regression model. Effect of prerequisite score on final grade in the course (either Plant 100, PltH 103 or SW 100) was also analyzed using a linear regression model. Sub-scores were analyzed using a repeated measures analysis with sub-score as *within* subject factor and gender, ethnicity, previous course, previous course location and previous course grade as *between* subject factors.

Results

A total of 106 students completed the exam; 78% male, 22% female. Of the 12 ethnicity categories reported, the most commonly reported were: white (50.9%), Hispanic (17%), Mexican American (11.3%), and decline to state (5.7%). 63% of the students were seniors, 30% juniors and 5.7% were sophomores. The most commonly declared majors were: plant science (60.4%), enology (22.6%), and viticulture (4.7%). Of the prerequisite courses taken, the most common were: Biol 11 (50.9%), Biol 10 (18.9%), Biol 1A (2.8%) and Plant 1 (2.8%). 55% of students had completed their prerequisite course at Fresno State, while the remainder completed it at a transfer institution.

Overall student scores were low (52.4%, 9.03 SD) which supports the faculty perception that many of our students are not well prepared for upper division coursework in plant sciences. The Department initially undertook this assessment effort because we had considered changing our prerequisite to Biology 1A, however, the analyses showed that the course taken to satisfy the prerequisite did not significantly affect the test score ($F=22.1$, d.f.=4, 89, $P=0.901$) (Fig 1). The perception that students transferring from other institutions were less prepared was not valid as institution did not significantly affect test score (Table 1). Similarly, gender, ethnicity, academic level, major, and if the prerequisite course was taken locally vs. transferred did not significantly affect overall test score (Table 1). The only variables that significantly affected the test score were those related to academic performance. Grade received in the prerequisite course significantly affected test score ($F=6.29$, d.f.=4, 88, $P=0.000$) (Fig 2) as did cumulative GPA ($F=11.45$, d.f.=1, 92, $P=0.001$, adj. $r^2 = 0.101$) and resident GPA ($F=8.806$, d.f.=1, 77, $P=0.004$, adj. $r^2 = 0.091$), however both GPA variables were poor predictors of test score performance as

indicated by the low adjusted r^2 values. Total score received on the prerequisite test significantly affected final grade received in the course ($F=25.57$, $d.f.=1, 87$, $P\leq 0.000$, $adj. r^2 = 0.22$).

Stepwise regression analysis on total scores found the only variable which significantly affected total score was grade received in the prerequisite course.

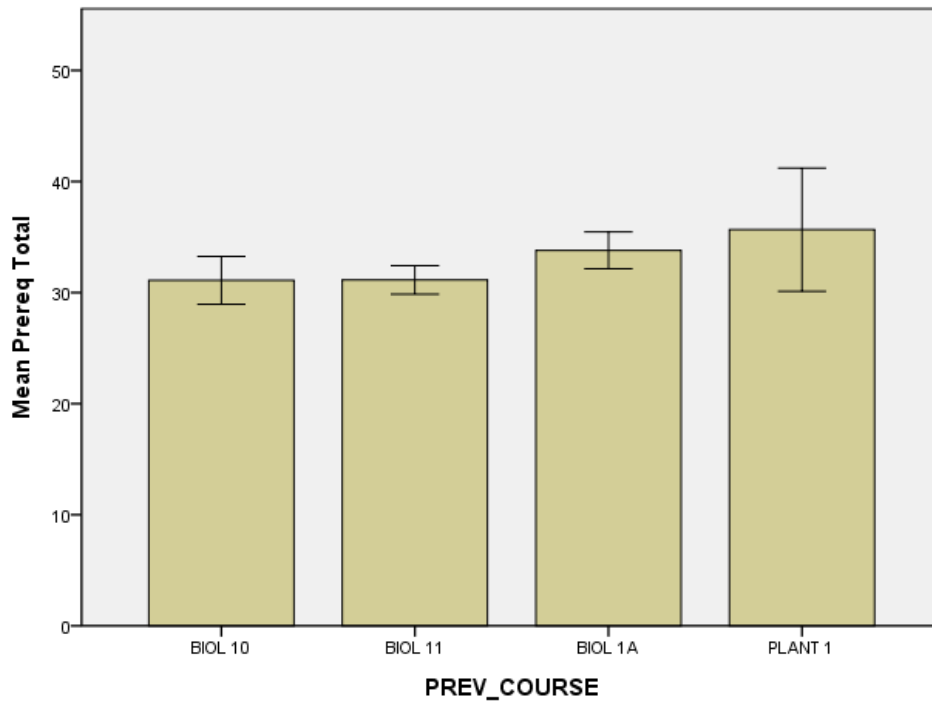


Figure 1. Total score on prerequisite test out of 60 points separated by prerequisite course taken. Test scores did not differ significantly depending on the previous course taken. Error bars are +/- 1 SE.

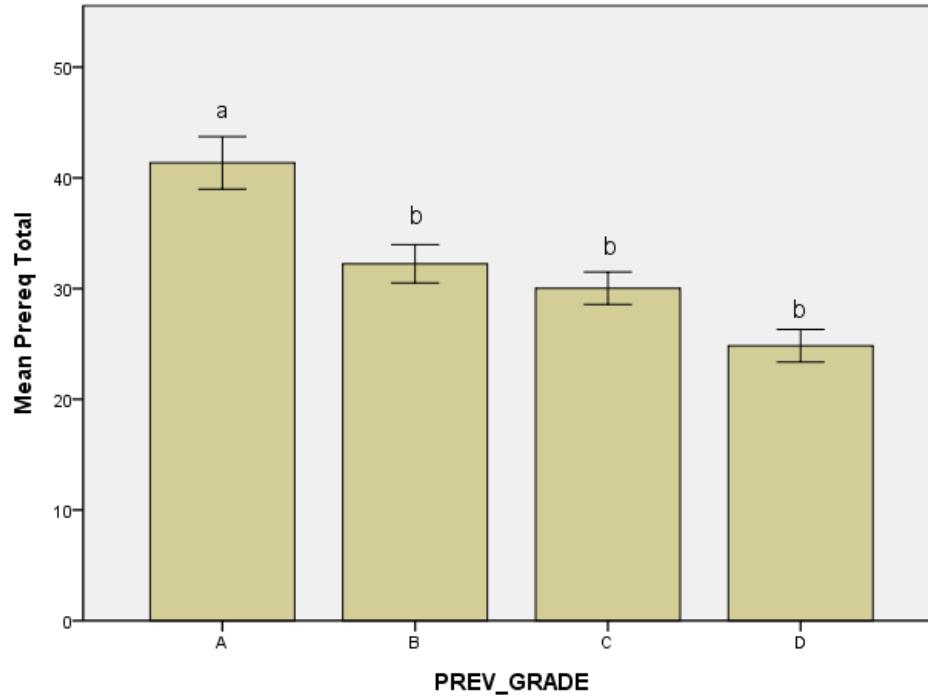


Figure 2. Total score on prerequisite test out of 60 points separated by grade earned in the prerequisite course. Previous grades labeled with different letters are significantly different (Tukey's HSD $P \leq 0.05$). Error bars are ± 1 SE.

Table 1. Summary of analysis for each factor and its effect on total test score.

| Factor | F | d.f. | P |
|--|-------|-------|-------|
| gender | 0.752 | 1,92 | 0.388 |
| ethnicity | 0.95 | 12,81 | 0.503 |
| academic level (sophomore, junior, senior) | 2.203 | 2,91 | 0.116 |
| major* | 0.308 | 3,69 | 0.820 |
| transfer institution | 0.517 | 11,82 | 0.886 |
| prerequisite taken locally vs transferred | 0.098 | 2,91 | 0.907 |

* majors with fewer than 5 students were excluded from analysis

Sub-test scores differed significantly, with scores on the genetics sub-test being higher than on the plant physiology, plant taxonomy, ecology/evolution and plant anatomy/morphology sections ($F=8.606$, $d.f.=5, 385$, $P=0.000$) (Fig 3). Sub-test scores did not vary by prerequisite course taken, location where the prerequisite course was taken, or grade received in

the prerequisite course (Table 2). Similarly, sub-test scores did not vary by demographic variable or whether the prerequisite course was taken locally or transferred from another institution.

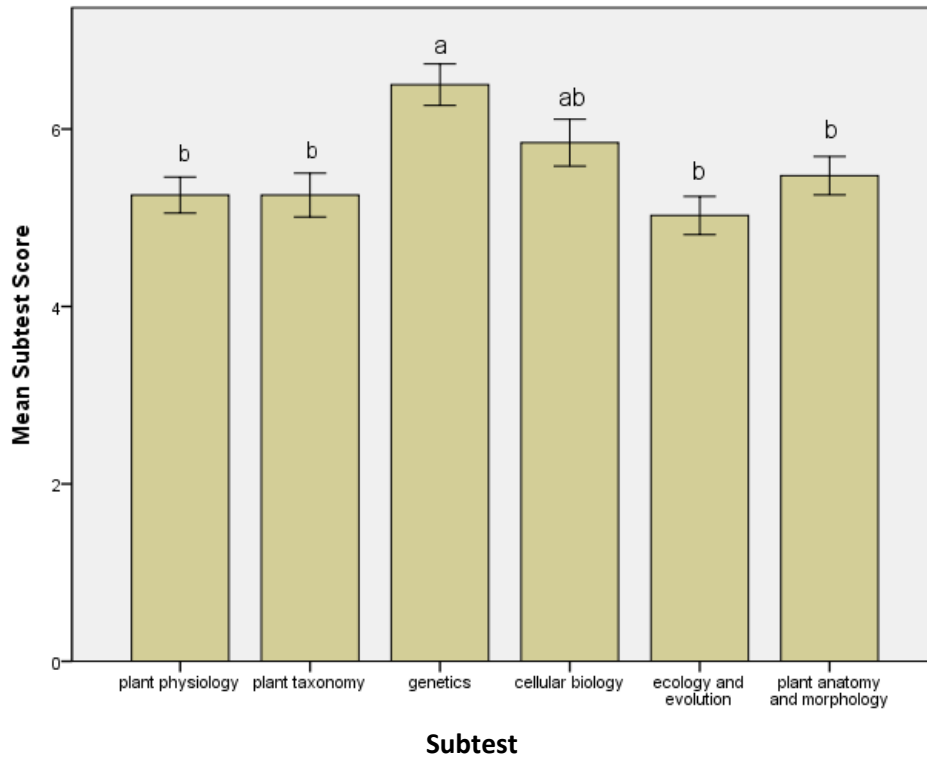


Figure 3. Mean subtest scores out of 10 possible points. Subtest scores labeled with different letters are significantly different (Bonferroni pairwise comparison, $P \leq 0.05$). Error bars are ± 1 SE.

Table 2. Summary of analysis for each factor and its effect on sub- test score.

| Factor | F | d.f. | P |
|--|----------|-------------|----------|
| prerequisite course taken | 1.348 | 15,270 | 0.173 |
| location where the prerequisite course was taken | 1.445 | 35,270 | 0.057 |
| grade received in the prerequisite course | 1.531 | 15,270 | 0.094 |
| gender | 1.410 | 5,380 | 0.220 |
| ethnicity | 0.859 | 55,330 | 0.750 |
| academic level (sophomore, junior, senior) | 1.123 | 10,375 | 0.343 |
| prerequisite taken locally vs transferred | 0.794 | 10,375 | 0.635 |

Discussion

Total scores and sub-test scores were low (mean of 52.4% for total score and mean subtest scores ranging from 50.3% to 66.2%). Poor student performance supports the faculty perceptions that our students are not well prepared for work at the upper division level. What we did not expect; however, was that the course taken to satisfy the prerequisite did not affect test scores. The original objective for this study was to provide evidence to support changing the prerequisite course to Biol 1A; however, the data indicate that this course (designed for biology majors) does not significantly improve performance of our students. It is possible that the low number of students in this sample who took Biol 1A (only 5 out of the 106 students) prevented us from detecting significant differences in performance. As we continue to administer this test each year, we can perform a pooled analysis with data from multiple years, increasing our sample size and we may eventually see differences in performance. Alternatively, there may truly be no difference between the classes and no change in prerequisites courses may be warranted.

Not surprisingly, students who received a high grade in their prerequisite course performed better on the prerequisite test. What is more concerning is that seniors did not perform better than sophomores. Seniors should have completed multiple courses within the department and theoretically, received reinforcement of the prerequisite knowledge, and therefore would be expected to perform better on this exam.

Although subtest score did not vary by the location where the prerequisite course was taken, this factor would be significant at $\alpha = 0.1$. With additional data in the future to increase

our sample size, trends may become apparent where different institutions do better or worse in certain subject areas, but before approaching our transfer institutions, the authors would like to be more certain that these trends are real.

The level of preparedness as measured by the prerequisite exam did significantly affect the final grade received in the three classes in which the test was administered, with 22% of the variability in final grade predicted by the score on the prerequisite test. This level of predictability appears low, but is considerable given the many assignments and types of work which constitute the final course grade.

Given such low performance on the prerequisite test, we must also question whether our test questions were written at the appropriate level. For two of the areas (ecology / evolution and plant taxonomy), many of the questions were taken directly from the practice questions provided in the required textbook for Biol 11. These questions should have been appropriate for students completing this course and yet scores on these sub-sections were no higher than for any other sub-section. It is also possible that students did not take the exam very seriously and put forth little effort in completing this exam. It was made clear to the students that the exam would be worth 2% of their final grade in three courses, which the faculty thought would be sufficient motivation. We will discuss increasing this percentage slightly next year.

The authors identified several issues with deploying online exams through Blackboard. First, although Blackboard allows the use of test bank questions, it will not report the scores on sub-sections of the test separately. Therefore, in order for us to collect scores for the six sub-sections for our test, six separate tests had to be created and deployed. In addition, the test could not be created and then deployed easily in each of the three courses. The test bank questions could easily be imported into each of the three courses, but the various test parameters had to be set up individually within each course (thus requiring 3x6 or 18 separate tests to be deployed). In the future, we will create a prerequisite test "shell" in Blackboard and then add the students from each of the courses as users, thereby only requiring us to create and deploy the six sub-tests once.

Another issue we found with the Blackboard platform was when students had problems with their Internet connection to while taking the exam. The exam was set to only allow students 10 minutes per sub-section and to not allow them to retake a section once complete. We found a number of students who said they were dropped from their connection partway through answering a section and then not allowed to get back into the test to retake it. There does not appear to be a remedy for this problem in the system settings which will still alleviate our concerns of students looking up answers.

Conclusion

Data from the first year of the study do not support making any changes in the prerequisite biology course required in the Department of Plant Science. The test will be given each year and, as sample size increases, we may be able to detect differences between groups at a later date. Several changes will be made in the way the test is deployed on Blackboard this year in an effort to reduce the administrative time and effort needed to deploy the test.