CALIFORNIA STATE UNIVERSITY EAST BAY

College of Science (CSCI)
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2015-2016 CSCI EETF Assessment Year End Report, June, 2016

Program Name(s)	EETF Faculty Rep	Department Chair
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A. Program Student Learning Outcomes

Students graduating with a B.S. or B.A. in Biological Sciences from Cal State East Bay will be able to

1. explain core biological concepts, including evolutionary processes, structure-function relationships across all levels of biological organization, homeostasis, information flow, matter and energy transformations, and the interactions and interconnectedness of living systems;
2. apply quantitative reasoning to explain biological phenomena and to address biological problems;
3. clearly communicate biological information in a variety of formats (written, oral, visual) using a style appropriate for the intended audience;
4. apply methods of scientific inquiry by formulating testable hypotheses, collecting and analyzing data, and reporting conclusions;
5. gather, interpret, and evaluate published scientific information.

B. Program Student Learning Outcome(s) Assessed

6. apply quantitative reasoning to explain biological phenomena and to address biological problems.

C. Summary of Assessment Process

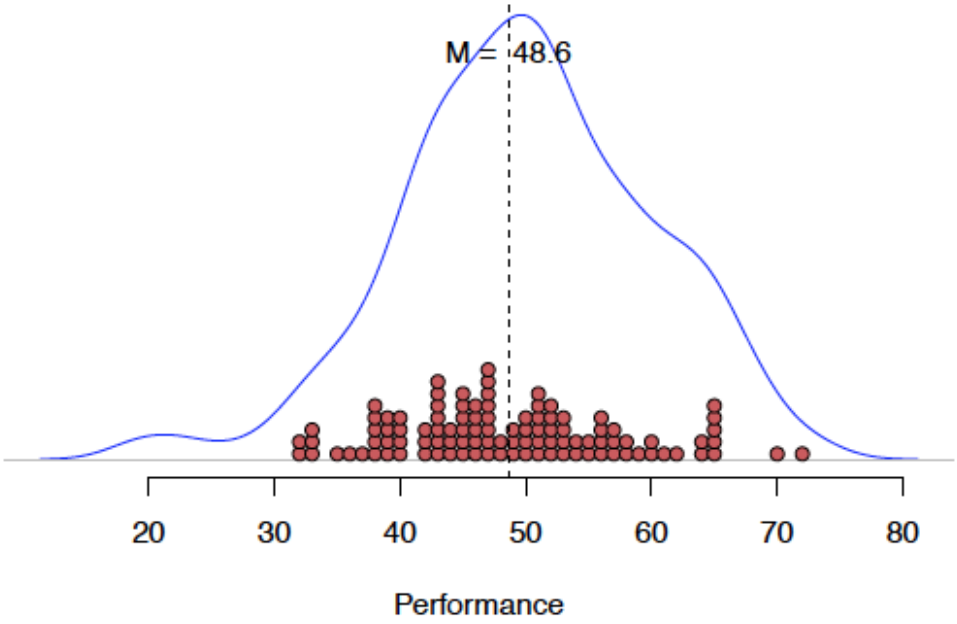
We identified an established, nationally validated, and fully online assessment instrument, the Biology Science Quantitative Reasoning Exam (BioSQuaRE), developed by a collaborative of six universities and sponsored by a grant from the Howard Hughes Medical Institute. Composed of 29 multiple choice questions, BioSQuaRE is designed for biology majors and assesses students' understanding of quantitative content in three main content areas: (1) algebra, functions, and modeling (9 questions); (2) probability and statistics (8 questions); and (3) data visualization (12 questions). We selected four courses, composed primarily of seniors, in which to administer the test during the last week of classes of Spring 2016. These courses were BIOL 4430 Immunology, BIOL 4455 Cell Molecular Biology, BIOL 4512 Applied Neurobiology, and BIOL 4518 Animal Behavior. The faculty members teaching these courses all agreed to offer extra credit points to students completing the exam. Although 114 students attempted the exam, a total of 104 students completed BioSQuaRE. Students in BIOL 4455 took the exam in person during class, while students in the other courses took the exam outside of class time. The exam had to be completed in one sitting. BioSQuaRE administrators at the University of Minnesota provided a comprehensive report of our students' performance. A synopsis of the results is provided in Section D

below.

D. Summary of Assessment Results

Overall Student Performance

BioSQuaRE scores are scaled so that the mean for all students completing BioSQuaRE is 50 and the standard deviation is 10. Of the 104 CSU East Bay biology majors completing BioSQuaRE, the mean score was 48.6 with a standard deviation of 8.8. The density plot below shows the distribution of scores for all students who have completed BioSQuaRE (blue curve) and for CSUEB biology majors (dot plot). Our students' scores were similar to the national average and range.



Content Profile of Students

Item analyses of student performance within the three content strands provided a finer grain look into the relative strengths and weaknesses in the quantitative skills of our students.

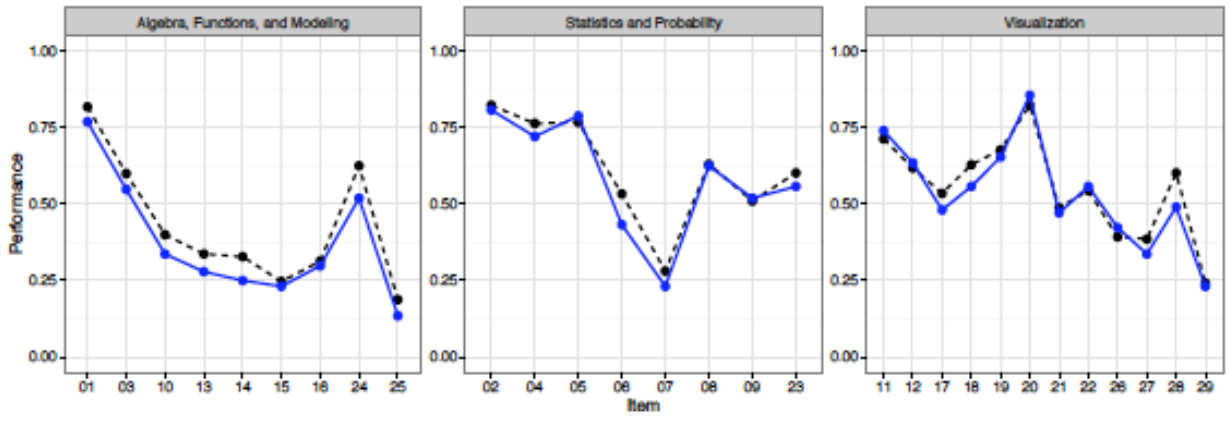
(1) Algebra, Functions, and Modeling. The mean proportion of students answering each of the nine questions in this content strand correctly was very low at 0.37 and ranged from 0.13 to 0.77. Fewer than 50% of the students completing the assessment answered six of the nine questions correctly. These areas of weakness included interpreting plots of logarithms, graphing a non-linear function, and predicting from a recursive model of population growth. Students showed adequate performance in three content areas, with more than half the students correctly predicting from a genetic model (0.52), understanding variation in log-transformed measurements (0.55), and computing probability from a

two-way table (0.77).

(2) Probability and Statistics. The mean proportion of students answering each of the eight questions in this area was adequate at 0.59 and ranged from 0.23 to 0.81. Students demonstrated competency (i.e., the proportion of students answering a content question correctly was greater than 0.50) on six of the eight questions, e.g., understanding variation in measurements (0.81), translating summary statistics to a distribution (0.79), and relating sample size to uncertainty (0.72). Students showed particular weakness in their understanding of p-value (0.23) and in translating content to a statistical hypothesis (0.43).

(3) Visualization. The mean proportion of students answering each of the twelve questions in this area was mediocre at 0.54 and ranged from 0.23 to 0.86. Students demonstrated competency on six of the twelve questions, e.g., interpreting relationships between variables from a lineplot (0.86), interpreting variation on a heatmap (0.74), and interpreting interaction effects from a plot (0.56). Students showed particular weakness in the ability to understand the relationship between data, relative quantification, and the plot (0.23 to 0.42).

The three plots below (one for each content strand) show the proportion of CSUEB biology students answering each question correctly (blue, solid line) relative to the population of students from all schools who took BioSQuaRE (black, dashed line). Again, these results suggest that our students perform similarly to all other students across the U.S. who have completed BioSQuaRE.



E. Suggestions and Recommendations for the CSCI EETF in the Future

The BioSQuaRE assessment tool has allowed the department to recognize areas of strengths and weaknesses in the quantitative reasoning skills of our biology majors. The overarching goal of the

department is to help students develop and master their ability to apply quantitative reasoning to explain biological phenomena and to address biological problems. The assessment results informs biology faculty discussions of how to effectively integrate more deliberate/explicit teaching of and activities that support specific aspects of quantitative reasoning in our courses. In the future, we plan to administer this assessment to incoming freshmen to establish a baseline performance index, so that we can distinguish any significant shifts/improvements in QR skills in students upon completing the biology major.