

Redesigning Assignments and Assessments in Calculus for Life Sciences Courses

Sophie Aiken
UC Santa Cruz

Jennifer Guerrero
UC Santa Cruz

Malachi Alexander
UC Santa Cruz

Deewang Bhamidipati
UC Santa Cruz

Nandini Bhattacharya
UC Santa Cruz

Pedro Morales-Almazan
UC Santa Cruz

Ryan Pugh
UC Santa Cruz

David Rubinstein
UC Santa Cruz

Keywords: Summative Assessments, Hispanic Serving Institutions, Scientific Identity, Calculus for Life Sciences, Applications

Math 11A/B is the Calculus for Life Sciences sequence at UC Santa Cruz which focuses on applications of Calculus most relevant to students who are proposing to major in Biology, Chemistry, Ecology & Evolutionary Biology, Psychology, Earth Science, Global & Community Health. In the Fall of 2019, there were approximately 4,500 Latinx students enrolled at UCSC with 28% of these students declaring or proposing a major requiring Math 11A or 11B. From Fall 2015 to Fall 2019, the DFW rate overall in Math 11A/B was 24%, with a DFW rate of 32% for Latinx students and 20% for White students. This data led to the acquisition of a Graduating and Advancing New American Scholars (GANAS) grant to fund the redesign of Math 11A/B.

Methods

Starting in the Summer of 2021, a team of faculty and graduate students worked together to redesign Math 11A/B at UCSC. The team was interested in decreasing the DFW rates and equity gaps and focused on: (a) Which content from the current curriculum for Math 11A/B was being used in the proposed majors of the students and in which contexts was the material being used? (b) How can we support students to succeed in alternative forms of assessment?

We completed interviews with faculty across STEM departments to determine which mathematical concepts were most relevant to their upper division courses, how these concepts are used in their STEM fields, and which mathematical concepts were the largest barriers to student success in their major-specific courses. Following the advice of (Hutchings et al., 2014, p. 10) that assignments should “be connected to one another and aligned and integrated with a broader curricular and co-curricular set of experiences”, we designed projects which closely align with the authentic use cases of mathematical concepts and could replace traditional exam(s). This involved reading current scientific papers to distill their necessary background and use of calculus in order to highlight the relevance of mathematics in science and build aspirational capital (Yosso, 2005). We also designed weekly worksheets to supplement students’ understanding and to offer low-stakes assignments to practice the broader scientific analysis which they are being asked to perform on the projects.

Results and Discussion

We have data showing a decline in the DFW rates for all students in both Math 11A and 11B since implementing the redesigned materials. We are in the process of reviewing the data to determine what is causing the decline in the DFW rate. We still see significant equity gaps and hope to gather more data to begin investigating the causes.

Acknowledgments

This work was funded by the Graduating Advancing New American Scholars (GANAS) grant, a Career Pathways HSI Title V project, grant number P031S200154.

References

- Arum, R., Roksa, J., & Cook, A. (Eds.). (2016). *Improving quality in American higher education : learning outcomes and assessments for the 21st century* (First edition.). Jossey-Bass, a Wiley brand.
- Hutchings, P., Jankowski, N. A., & Ewell, P. T. (2014). Catalyzing Assignment Design Activity on Your Campus: Lessons from NILOA's Assignment Library Initiative. In *National Institute for Learning Outcomes Assessment*. National Institute for Learning Outcomes Assessment.
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity and Education*, 8(1), 69–91.
<https://doi.org/10.1080/1361332052000341006>