Examining the Enrollment and Dropout Rates of URMs in STEM Courses at UC Berkeley

Jennifer Be

Hannah Broïdo

Pui Fung Lam

Jong Ha Lee

Research Question

Our research question centers around the topic of ‘weeder courses’ as a potential contributor to the lack of diversity in STEM fields at the undergraduate level at UC Berkeley. We divided our question into two parts. The first part centers around quantitatively analyzing the dropout and enrollment rates within several ‘weeder courses’ (as well as several control courses), specifically analyzing any disproportions that may exist between underrepresented minorities (URMs) and other demographic groups. The second part focuses on qualitatively analyzing potential factors that may contribute to the disproportion of dropout rates in introductory ‘weeder’ STEM courses, both through literature reviews and through interviews with students and professors of ‘weeder’ courses.

Part 1

Weeder Courses

‘Weeder’ courses is a term commonly used by many UC Berkeley students to describe introductory STEM courses in the College of Letters & Sciences. For the purpose of our research, we have defined a ‘weeder course’ as a College of Letters & Sciences lower division major prerequisites possessing the following characteristics:

1. Possesses a large class size which includes many students interested, but not declared, in pursuing a major that specifically requires completing the weeder course successfully
2. Are adequately difficult to determine whether one can successfully continue the major
3. And overall, results in many student that not only drop out from the prerequisite course, but more importantly, “drops out” from declaring a certain major itself

Based on this definition and student interviews, we identified the following ‘weeder’ courses, along with the course progression, to analyze:

1. Biology 1A
2. Chemistry 1A - Chemistry 3A - Chemistry 3B
3. Computer Science 61A - Computer Science 61B - Computer Science 61C
4. Physics 8A - Physics 8B

(See Data Appendix at end of paper for more information on each course)

The control ‘non-weeder courses’ that we identified are:

1. Engineering 7
2. Engineering 25
3. International & Area Studies 45

(See Data Appendix at end of paper for more information on each course)

We purposefully chose to exclude Engineering courses from ‘weeder courses’ (and include it as a control course) as we did not believe that it fit with our ‘weeder courses’ definition. Students at UC Berkeley are accepted into a specific college (e.g. College of Engineering or College of Letters and Sciences) and it is very hard to switch between colleges. We made the assumption that the College of Engineering was much more likely to have already ‘weeded’ out many high
school seniors from underrepresented minorities. Furthermore, the College of Engineering does not need to ‘weed’ students out - it accepts only the number of that it has the resources.

**Method**

We obtained data from the Berkeley Institute for Data Science (BIDS) for enrollment rates of various demographic groups in the courses listed above from Week 0 - Week 17. The demographic groups listed in our data were: African American, Asian, Chicano / Latino, Decline to State, International, Native American / Alaska Native, Pacific Islander and White. Furthermore, the data was disaggregated between Female, Male and Decline to State. We combined the enrollment numbers into five categories (selected out based on literature reviews and feedback from graduate student mentors):

1. Male non-URMs
2. URM
3. Female
4. Overall
5. Female URM

URMs were defined as belonging to the following demographic groups: African American, Chicano / Latino, Native American / Alaska Native and Pacific Islander. In order to analyze and compare the dropout rates within these different demographic groups, we normalized the enrollment numbers in Week 0 to 1, and then divided the enrollment numbers in each group in Weeks 1-17 by the enrollment number in Week 0. This enabled us to clearly see the dropout rates in each demographic group, and to compare these dropout rates.
Results

**Chemistry 1A Course Enrollment Progression**

![Chemistry 1A Course Enrollment Progression](image)

Discussion

In our definition of a “weeder course”, we managed to find consistent trends in our data. In our selected weeder courses, the high dropout rates for underrepresented minorities and female underrepresented minorities are consistent throughout our graphs (see data appendix). This common theme in our data further proves that weeder courses results in the lack of diversity in STEM fields. In addition to being in a competitive and difficult course, URMs could face societal and psychological factors that other students that might not apply to them. Some of these factors are further discussed in part 2, the qualitative part of our research.

Results
From our graphs (see data appendix), we found a correlation between higher dropout rates in weeder courses and underrepresented minorities. The gradients in dropout rate for weeder courses are much steeper than in our control courses. In contrast to our weeder courses, in which male non-URMs consistently rank high on the normalized scale, they drop the most in E 7 and IAS 45. From the data given, we made analysis on dropout rates and now have substantial evidence to support our thesis.

Part 2

The second part of our research project was primarily focused on finding qualitative reasoning for the trends that we observed through our data analyses. As mentioned in Part 1’s discussion, our results highlight a big disproportionately in dropout rates for URMs, specifically for female URMs. We therefore wanted to understand some of the potential factors that may have been contributing to this.

Method

We decided to use the snowball interviewing methodology, whereby we started out interviewing primarily URM but also non-URM students who had enrolled in identified weeder courses, and then asked them for referrals to other students they may know. A total of 6 students and a professor teaching a ‘weeder course’ were interviewed. The students identified themselves in the following ways:

1. African-American Male, enrolled and completed Chem 1A and Physics 8A
2. Chicano Female, dropped out of Chem 1A
3. African-American Male, dropped out of Physics 8A
4. African-American Female, dropped out of Bio 1A
5. Non-URM Male, enrolled and completed Chem 1A
6. Non-URM Female, dropped out of CS 61A

The interviews were all carried out in person. There were guideline questions for interviewers to follow, but all interviews were done in a fluid format based on the interviewee’s answers.

Results

These common themes came out from our student interviews:

1. The innate difference in background and resources
   a. Well-off background of majority groups vs. underprivileged background of minority groups, and the lack of support for the latter especially in STEM courses

2. Lack of representation for minorities
   a. Includes both being unaware of the other fellow minority groups present in the class, and simply not having enough minorities in STEM courses
   b. According to a recent Daily Californian article, “UC Berkeley’s faculty diversity falls well behind the relative diversity of California’s population, and recent campus reports show that it also lags behind diversity in the academic job market.”

3. Sheer difficulty of the course
   a. Dropouts not only due to midterm scores, but also the speed and quantity of content covered in introductory STEM courses
   b. Traditional lecture courses are typically packed in content and are not intended to actively engage students

From the results, it appears that the adverse effects of chemistry courses experienced by many of
the URM students leads directly to these students questioning their own ability to continue to pursue a medical career, and as a consequence dropping medicine as a possible career trajectory (The Turning Point).

We also noticed that male URM s versus female URM s opinions differed greatly. Female URM s were more likely to talk about lack of “empowerment” and “representation” in the weeder courses they took, while male URM s and non-URM s focused primarily on time management and exploring different options, not necessarily experiencing difficulty in terms of support groups or representation.

The professor teaching a “weeder course” made the following observations:

1. Weeder courses must have the intent of weeding out students, otherwise they should just be considered hard classes with challenging course material.

2. URM students do not utilize resources such as office hours and student learning center
   a. The professor hypothesized that this may primarily be due to high school experiences - URM s may have attended high schools with little resources and may therefore not have the experience and confidence to utilize resources available to them in college.

3. Students are used to getting As in high school and may therefore be dropping out as they consider Bs and Cs to be bad grades, when in fact they should be considered very respectable grades at Berkeley.

4. Although the gender of course GSIs is representative of students, they are very rarely URM GSIs.

Discussion
Several possible band-aid solutions emerged from our interviews:

1. Mini-introductory STEM courses
   a. Especially for those coming from an under-educated background who have had little or no exposure to the difficulty of introductory STEM courses at Berkeley
   b. Example: Chemistry P offered by the Student Learning Center (SLC)
2. A well-developed resource on finding fellow URMs in STEM courses
   a. Mentors who have already took the course, fellow students in the course, etc
3. Ability test in weeder courses to assign discussion sections
4. Increased diversity amongst GSIs / course TAs

The combination of these solutions led us to ask ourselves the following questions:

- Are these resources / solutions already available? Are they publicized and made aware of to URMs? Why do we constantly see this problem of “lack of resources”?
- Are the problems minorities face with STEM courses attributed to their predisposed backgrounds, lack of support from the University, or both?
- There are a few programs targeted toward minority students, but to what extent are they effective? How can we scale them?

**Conclusion**

In conclusion, our data analysis demonstrated the disproportion of retention rates in individual STEM courses and STEM major course progressions. Female URMs suffered the greatest dropout rates, while Male non-URMs had the lowest dropout rates. This trend was consistent throughout the biggest “weeder courses” at UC Berkeley - Biology 1A, Chemistry 1A, Computer Science 61A and Physics 8A. We led in-person snowball interviews with students from a variety
of demographic groups and a professor of a “weeder course” in order to gain a qualitative understanding of the reasons or factors behind this trend. Next steps may entail experimenting potential solutions provided in this paper and delving further into where exactly lies the problem: awareness, support or initiative?
Data Appendix

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<th>‘Weeder’ Courses</th>
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<td>Biology Series</td>
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<td>Chemistry Series</td>
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<td>Physics Series</td>
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 physical science majors.

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<th>‘Non-Weeder’ Courses</th>
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<td><strong>Engineering Classes</strong></td>
<td><strong>Engineering 7 (E)</strong></td>
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<td>Except for EECS majors, E7 is required for all College of Engineering majors. It can be taken instead of CS 61A for Cognitive Science and some CoE majors. It covers the elements of programming using MATLAB, a programming language intended for numerical computing.</td>
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<tr>
<td><strong>Engineering 25 (E)</strong></td>
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<td>Engineering 25, or Visualization for Design, is part one of a three-part series required for Mechanical Engineering majors. This three-part series is fairly new (Fall 2014) and is intended to replace the two-part series consisting of E10 and E28.</td>
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<tr>
<td><strong>Other Control Classes</strong></td>
<td><strong>International &amp; Area Studies 45 (IAS)</strong></td>
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<td>IAS 45, or Survey of World History, is reading-intensive class that fulfills the L&amp;S International and Area Studies requirement; however, it is typically taken by prospective Political Economy and Development Studies majors. For the Political Economy major, must be completed with a B- or higher on the 1st attempt.</td>
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Chemistry Series
Computer Science Series
Physics Series
Bio 1A

Control: Non Weeder Courses Engineering 7 & IAS 45
IAS 45 Course Enrollment Progression
Citations

Barr, Don, and John Matsui. "The" Turning Point" for Minority Pre-Meds: The Effect of Early Undergraduate Experience in the Sciences on Aspirations to Enter Medical School of Minority Students at UC Berkeley and Stanford University." (2008).

