

# ALEKS Preparatory Chemistry and Mathematics

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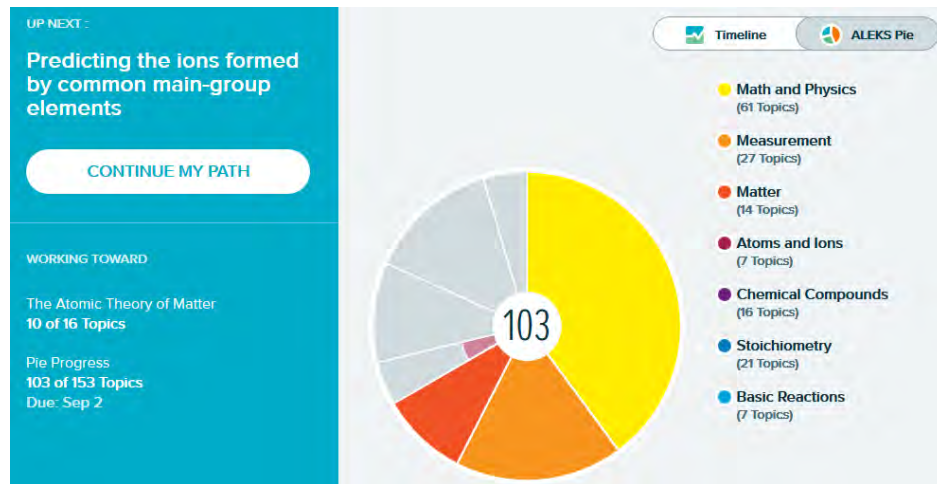
### What is ALEKS?

ALEKS is an addaptive-learning in knowledge spaces

Designed to test gaps in student's knowledge and give students a custom-tailored course

Goal: Fill Pie to 100%, Time not wasted going over things student already knows

Students can move forward, or backward, in their Pie



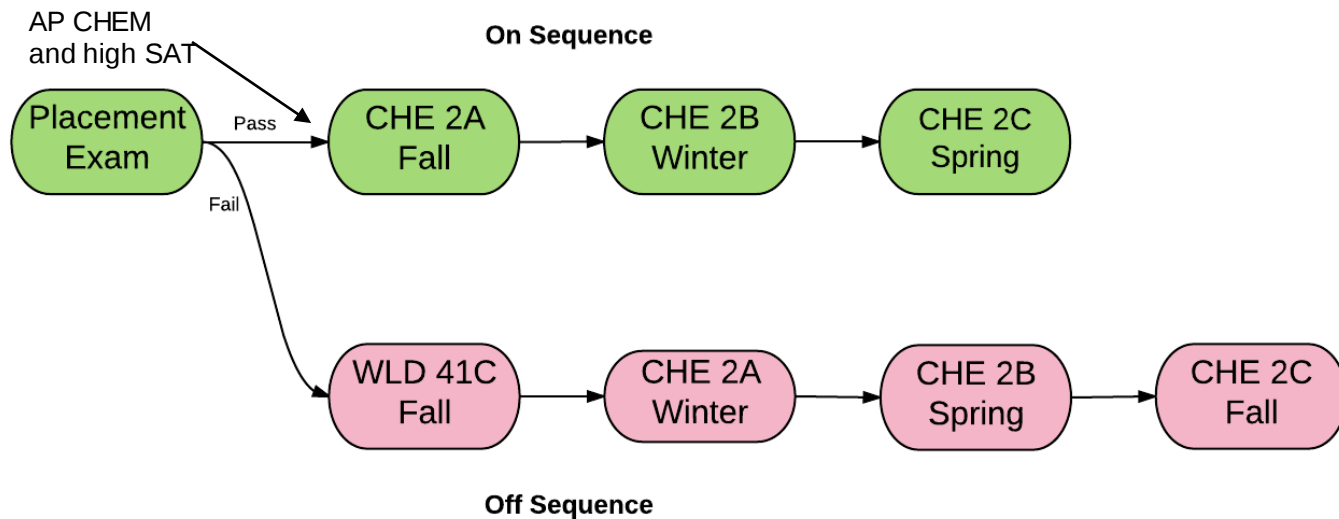
# Summer-Prep Chem – Adaptive learning for student preparation

Derek Dockter, Catherine Uvarov, Alberto Guzman-Alvarez, Marco Molinaro

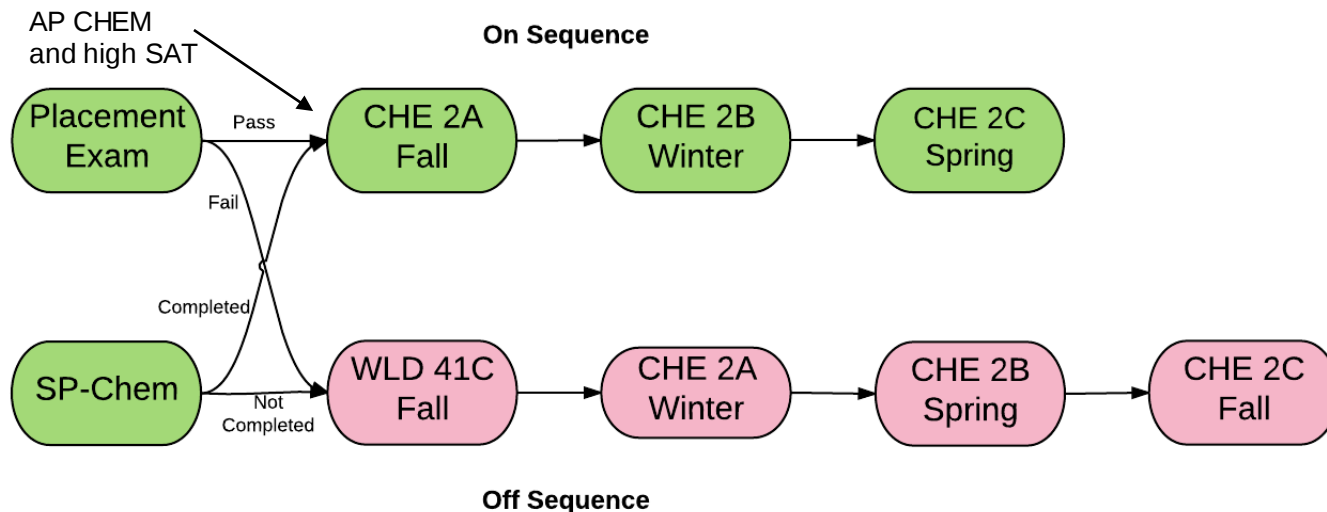


**Problem:** Upwards of 900 students yearly do not pass chemistry placement.

- Must take 3 unit, non-credit bearing course at local CC
- Changes course dynamics and impacts grading



**Proposal:** Give students the opportunity to prepare for on-sequence general chemistry over the summer by taking the SP-Chem ALEKS course.



“All in all, ALEKS worked for me simply because **it guided me rather than try to force me to understand or make me feel bad for not always getting the lesson at first try.** I enjoyed the fact that every new lesson was a build up from previous lessons, allowing me to understand review and learn new things at the same time. I am grateful to have experienced this program and even more grateful to the fact that it gave me a **newfound respect for the subject that once was my worst nightmare.**”

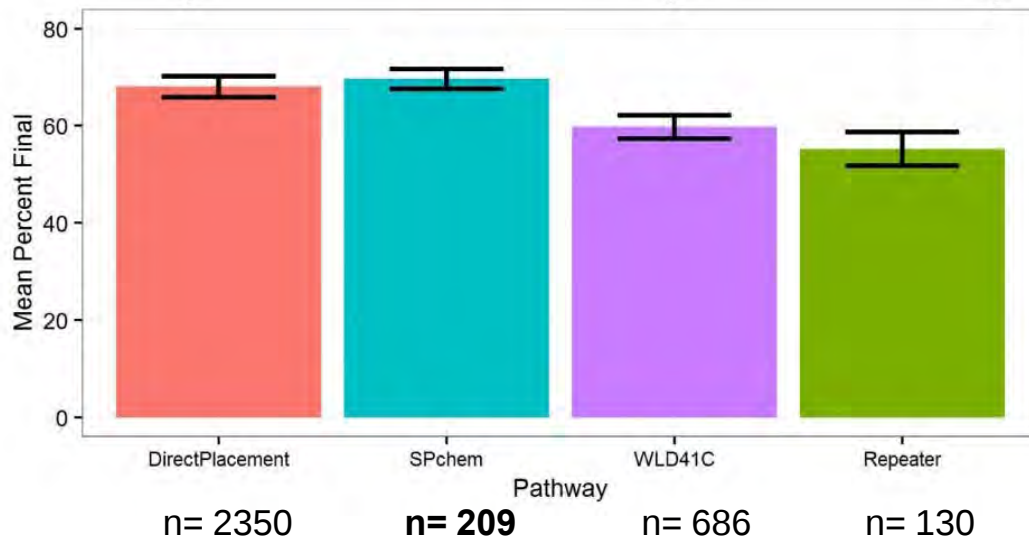
So how did it work...

## Final Exam\*

No statistically significant difference between students who passed placement and ALEKS

Students who finished ALEKS:

- 9.9% higher than WLD 41C
- 14.4% higher than students repeating CHE 2A



\*SAT, URM and First Gen used as model covariates

Self-selection bias resulted in some demographic differences between samples of students who finished SP-Chem (controlled for in the analysis).

1099 students were randomly sampled and invited, 209 completed and enrolled in Che2A

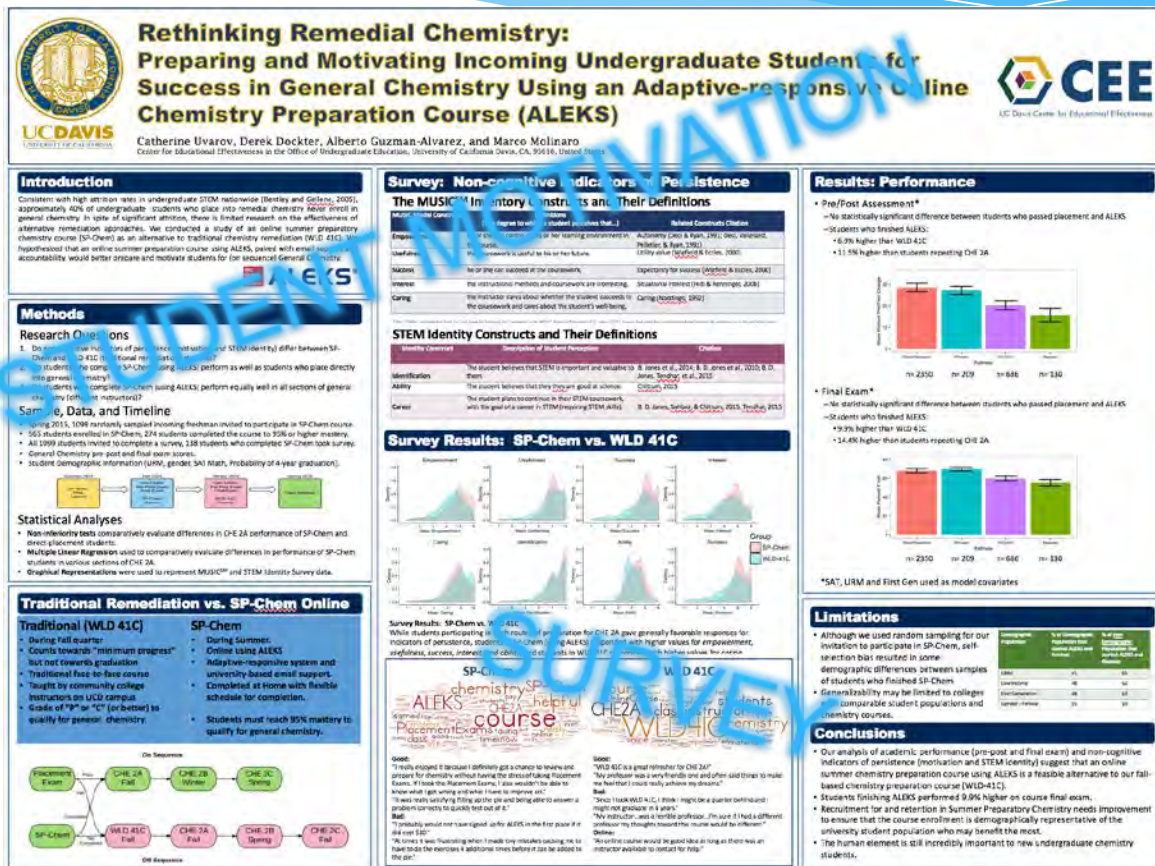
| Demographic Population | % of Demographic Population that started ALEKS who finished | % of <u>non-Demographic</u> Population that started ALEKS who finished |
|------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|
| URM                    | 41                                                          | 65                                                                     |
| Low Income             | 48                                                          | 62                                                                     |
| First Generation       | 48                                                          | 63                                                                     |
| Gender - Female        | 55                                                          | 59                                                                     |
|                        |                                                             |                                                                        |

2520 students were sent invitations  
955 students accepted invitations to the course  
927 took the initial knowledge check (97.1 %)  
616 completed to 100% mastery (64.5%)

| Demographic Population | % of Demographic Population that started ALEKS who finished | % of <u>non-Demographic</u> Population that started ALEKS who finished |
|------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|
| URM                    | 58 (257/443)                                                | 70 (359/512)                                                           |
| Low Income+            | 58 (242/420)                                                | 70 (339/486)                                                           |
| First Generation*      | 60 (332/549)                                                | 71(271/384)                                                            |
| Gender - Female        | 63 (457/725)                                                | 69(156/225)                                                            |
|                        |                                                             |                                                                        |

\* Unknown for 13 participants

+ Unknown for 35 participants



# ALEKS PPL at UCSC

Debra Lewis, Julian Fernald, Jaye Padgett  
UC Conference on Undergraduate Education  
January 2017

# Background

Starting in Summer 2015, we have used ALEKS PPL as a math placement exam

After placing, students are invited to work within ALEKS PPL and place *again*

# Goals

Help incoming students place into more advanced courses in math

Without jeopardizing their performance

# Why?

Improve time to degree

Possibly improve retention and graduation rates,  
including in STEM fields

# Is ALEKS worth the expense?

As of 10/2016, **6085** students have assessed in ALEKS PPL

**1844** students (30%) have reassessed and **1628** (27%) improved by at least one placement tier

Roughly half of students who initially placed below calculus reassessed

# Overall improvements: placement tiers

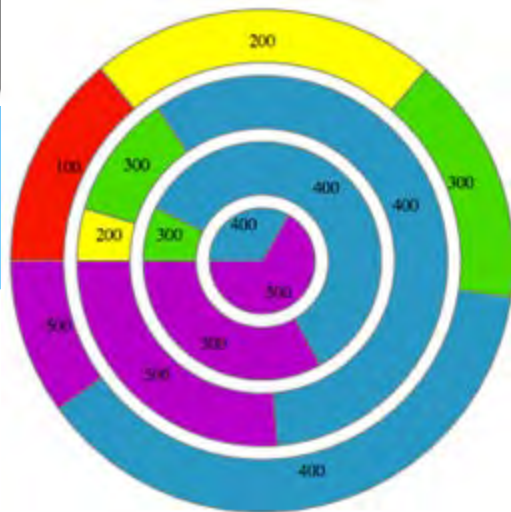
|     | first | best | shift |
|-----|-------|------|-------|
| 100 | 1994  | 1002 | -50%  |
| 200 | 1083  | 884  | -18%  |
| 300 | 565   | 665  | 18%   |
| 400 | 1554  | 2313 | 49%   |
| 500 | 889   | 1221 | 37%   |



**100:** College Algebra; **200:** Precalculus; **300:** Calculus with Applications (Biology);  
**400:** Calculus for Math, Physical Sciences & Engineering; **500:** Honors Calculus

# Improvements by initial tier

|     | 100      | 200       | 300       | 400       | 500      |
|-----|----------|-----------|-----------|-----------|----------|
| 100 | 160 (9%) | 258 (14%) | 185 (10%) | 434 (24%) | 115 (6%) |
| 200 |          | 22 (1%)   | 52 (3%)   | 279 (15%) | 126 (7%) |
| 300 |          |           | 11 (1%)   | 88 (5%)   | 49 (3%)  |
| 400 |          |           |           | 21 (1%)   | 42 (2%)  |



100: College Algebra

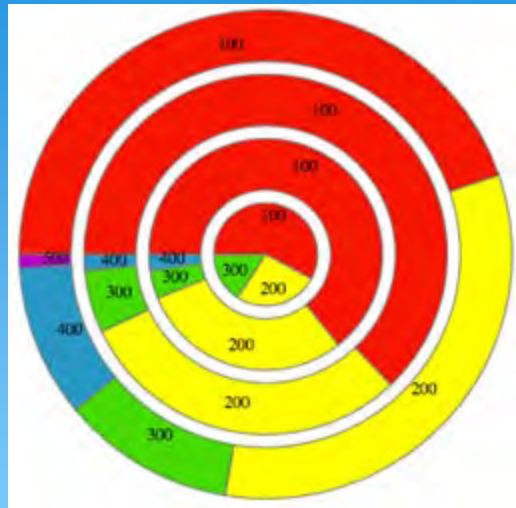
200: Precalculus

300: Calculus with Applications (Biology)

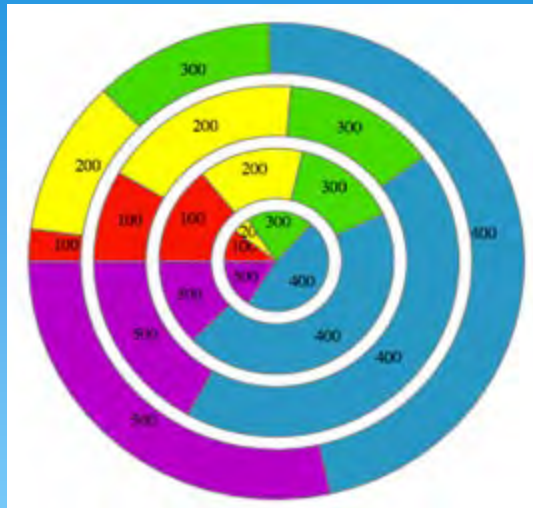
400: Calculus for Math, Phys Sci & Eng

500: Honors Calculus

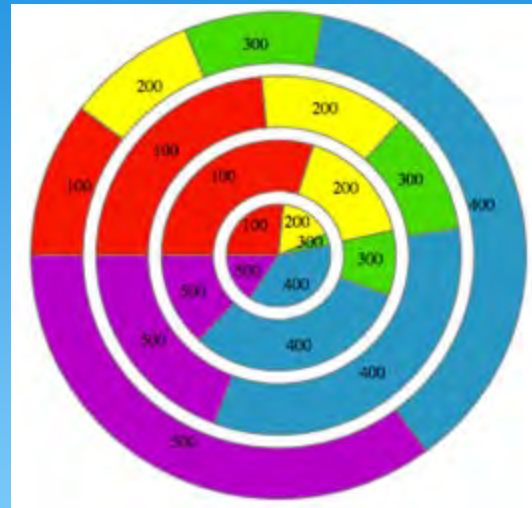
# Assessment by ethnicity



Multiple: initial placement



Multiple: best placement



Single assessment

Outer ring: Asian  
Second ring: White/Caucasian  
Third ring: Hispanic/Latino  
Inner pie: All others

100: College Algebra

200: Precalculus

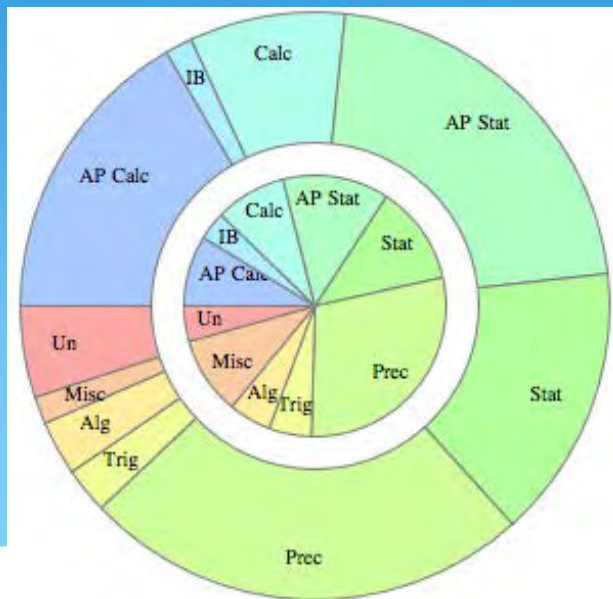
300: Calculus with Applications (Biology)

400: Calculus for Math, Phys Sci & Eng

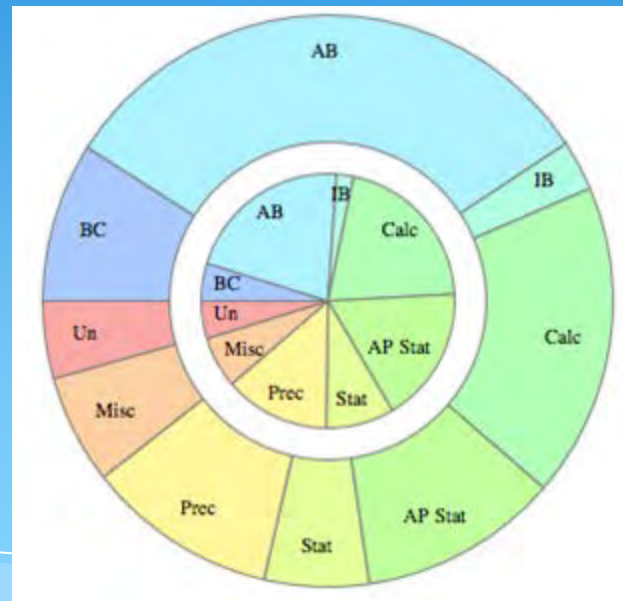
500: Honors Calculus

# Last pre-UCSC math or statistics course

From an informal survey of students enrolled in a “first year” math course in Fall 2016



Inner: enrolled in College Algebra  
Outer: enrolled in Precalculus



Inner: Calculus with Applications (bio)  
Outer: Calculus for Math, Phys Sci & Eng

# ALEKS builds skills & confidence

Students can dive into an ALEKS session at any time, do a few problems, and resurface

Control over timing of practice and assessment reduces stress

Common format for practice, progress checks, and assessment helps desensitize anxiety-prone students

# Academic outcomes

How do students who *re-place* into a course do compared to those who placed there to begin with?

- No difference in course grade or pass rate, once demographic and academic prep were taken into account
- Likewise no difference in outcomes in subsequent math course

*Comparison of Enrollment, Mean Grade Points, Pass Rates, and % B or Above Rates in Math Courses Fall 2014 vs. Fall 2015*

|           | N         |           | Mean Grade Point* |           | Pass Rate** |           | % B or above |           |
|-----------|-----------|-----------|-------------------|-----------|-------------|-----------|--------------|-----------|
|           | Fall 2014 | Fall 2015 | Fall 2014         | Fall 2015 | Fall 2014   | Fall 2015 | Fall 2014    | Fall 2015 |
| Math 2    | 537       | 262       | 2.17              | 2.47      | 75.0        | 78.2      | 39.1         | 50.0      |
| Math 3    | 1063      | 695       | 2.42              | 2.59      | 79.7        | 73.2      | 47.2         | 43.9      |
| Math 11A  | 380       | 442       | 2.15              | 2.65      | 73.2        | 79.9      | 28.4         | 55.4      |
| Math 19A  | 471       | 805       | 2.81              | 2.73      | 87.3        | 83.4      | 54.8         | 46.3      |
| Math 20 A | 36        | 43        | 2.51              | 2.73      | 75.0        | 86.0      | 52.8         | 39.5      |

# Reassessment activity

Reduce the redness!

Hispanic, EOP

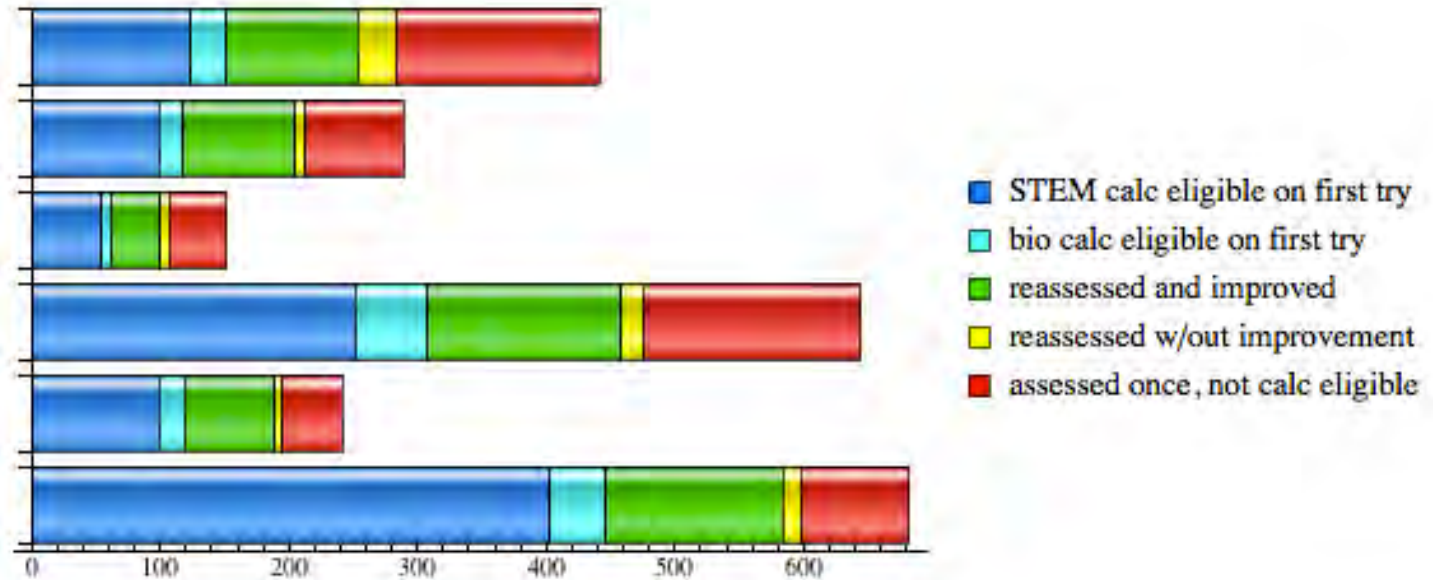
Hispanic, non-EOP

White, EOP

White, non-EOP

Asian, EOP

Asian, non-EOP



# Goal: increase reassessment

Efforts to improve outreach, advising, etc so that more students who could benefit actually reassess

# ALEKS at UCSB

Darby Feldwinn, Carl Gutierrez-Jones, Linda Adler-Kassner,  
Steven Velasco, and Margarita Safronova  
UC Conference on Undergraduate Education  
January 2017

# Background

UCSB has two first year chemistry classes:  
general chemistry (~2000 students) and  
honors general chemistry (~60 students).

Students background chemistry knowledge varies greatly  
for the non honors general chemistry class.

# Background

UCSB started using ALEKS in fall 2010 in all general chemistry classes (Chem 1A, 1B, and 1C)

Students are given a pre quarter assignment that is ~3% of their overall grade in the course.

The pre quarter assignment has 130 topics: math (~77%) basic chemistry (~33%).

# Research Questions

Does performance on the ALEKS initial assessment knowledge check administered in the ALEKS “summer course” serve as a predictive tool for success in Chemistry 1A?

Are there any differences in final grades among students who do and do not complete the pre-quarter assignment?

For students in the lowest quartile of the ALEKS summer course initial assessment, what correlation, if any exists between students' ALEKS use and students' final grades?

# Study Group

The study group consisted of students enrolled in 2 sections of Chem 1A in the fall quarter of 2015.

|                  | All students | Section 1 | Section 2 |
|------------------|--------------|-----------|-----------|
| Female           | 46%          | 46%       | 47%       |
| African American | 4%           | 4%        | 4%        |
| Hispanic         | 26%          | 21%       | 32%       |
| Native American  | <1%          | <1%       | <1%       |
| Asian            | 30%          | 36%       | 23%       |
| International    | 7%           | 5%        | 8%        |
| Observations     | 598          | 313       | 285       |

# Previous Performance

|                                                                  | All students | Section 1 | Section 2 |
|------------------------------------------------------------------|--------------|-----------|-----------|
| ALEKS Summer Course<br>Initial Assessment<br>(% of Topics Known) | 59%          | 61%       | 58%       |
| High School GPA                                                  | 3.98         | 3.99      | 3.97      |
| Reading                                                          | 605          | 612       | 596       |
| Writing                                                          | 621          | 630       | 610       |
| Math                                                             | 646          | 659       | 633       |

# ALEKS Statistics

|                                                  | All students | Section 1 | Section 2 |
|--------------------------------------------------|--------------|-----------|-----------|
| % of Students<br>Completing Summer<br>Assignment | 90%          | 89%       | 91%       |
| ALEKS Topics Learned<br>Per Hour (Fall)          | 2.8          | 2.6       | 2.9       |
| ALEKS Total Hours<br>(Fall)                      | 48 hours     | 46 hours  | 51 hours  |

# Models

Model 1: Explores the relationship between ALEKS variables and students' academic performance **accounting for previous academic performance and demographic characteristics.**

Model 2: Explores the relationship between ALEKS variables and students' academic performance **absent controls for previous academic performance.**

# Findings

How do students' percentages on the initial assessment affect students' abilities to succeed (earn a grade of B- or better) in the class?

Model 1: 0.0047 (0.012)

Model 2: 0.0085 (0.0011)

Summary: For every 1% increase on mastered topics on initial assessment the probability of a student succeeding in Chemistry 1A increase by ~0.5%.

# Findings

How does the summer assignment affect students' abilities to succeed (earn a grade of B- or better) in the class?

Model 1: 0.30 (0.069)

Model 2: 0.39 (0.075)

Summary: Completing the summer assignment increases the probability of a student succeeding in Chemistry 1A by ~30%.

# Findings

|                                                     | Mean     | Median   |
|-----------------------------------------------------|----------|----------|
| All students in Sections 1 and 2                    | 2.46 (C) | 3.00 (B) |
| Students Completing the AELKS Summer Assignment     | 2.61 (C) | 3.00 (B) |
| Students Not Completing the ALEKS Summer Assignment | 1.21 (D) | 1.00 (D) |

# Study Group

Demographics of students in the lowest quartile.

|                  | All students | Lowest Quartile |
|------------------|--------------|-----------------|
| Female           | 46%          | 64%             |
| African American | 4%           | 8%              |
| Hispanic         | 26%          | 45%             |
| Native American  | <1%          | <1%             |
| Asian            | 30%          | 18%             |
| International    | 7%           | <1%             |
| Observations     | 598          | 137             |

# Previous Performance

|                                                                  | All students | Lowest Quartile |
|------------------------------------------------------------------|--------------|-----------------|
| ALEKS Summer Course<br>Initial Assessment<br>(% of Topics Known) | 59%          | 35%             |
| High School GPA                                                  | 3.98         | 3.94            |
| Reading                                                          | 605          | 565             |
| Writing                                                          | 621          | 582             |
| Math                                                             | 646          | 572             |

# ALEKS Statistics

|                                                  | All students | Lowest Quartile |
|--------------------------------------------------|--------------|-----------------|
| % of Students<br>Completing Summer<br>Assignment | 90           | 80              |
| ALEKS Topics Learned<br>Per Hour (Fall)          | 2.8          | 2.4             |
| ALEKS Total Hours<br>(Fall)                      | 48 hours     | 59 hours        |

# Findings

How does the summer assignment affect students' abilities to succeed (earn a grade of B- or better) for students that scored in the lowest quartile of the initial assessment in ALEKS?

Model 1: 0.45 (0.24)

Model 2: 0.48 (0.25)

Summary: Students that score in the lowest quartile who complete the summer assignment have an average grade 0.45 higher than those that do not.

|                            | Complete ALEKS<br>Summer Assignment | Did not Complete ALEKS<br>Summer Assignment |
|----------------------------|-------------------------------------|---------------------------------------------|
| Average Chemistry 1A Grade | 1.76                                | 0.80                                        |

# Recap

The higher students score on the initial assessment the more likely they are to succeed in Chemistry 1A.

Students that complete the summer assignment are 30% more likely to succeed in Chemistry 1A than those that do not.

The positive effects seen by completing the summer assignment are magnified for the students in the lowest quartile.