



# HIGH SCHOOL MATH AND COLLEGE OUTCOMES: EXPLORING NEW RESEARCH

*Architects of Math Opportunity Webinar Series*

April 27, 2023

# JUST EQUATIONS

Re-conceptualizing the role of math in ensuring  
educational equity



# GOALS FOR TODAY

- Shed light on the relationship between students' high school math course taking and their postsecondary outcomes.
- Examine quantitative and qualitative research on advanced innovative math courses such as data science and discrete math.
- Consider the equity implications of the research for policy and practice.



# PANELISTS

Elisha Smith Arrillaga, UT-Austin, Just Equations

Erica Heinzman, UC-San Diego

Michal Kurlaender, UC-Davis

Meredith Phillips, UCLA

Sherrie Reed, UC-Davis

# 12<sup>th</sup> Grade Math

## A look at high school math course-taking in California

Sherrie Reed, Cassandra Merritt, & Michal Kurlaender

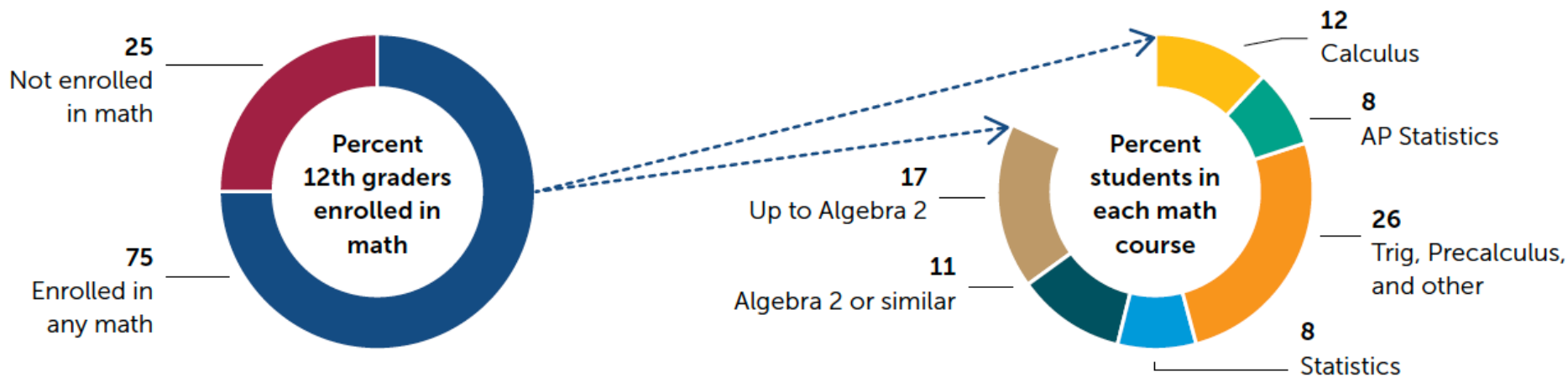
Research supported by the College Futures Foundation, through grants to the Education Insights Center at Sacramento State University and the California Education Lab at the University of California Davis, and by the Institute of Education Sciences, U.S. Department of Education, through Grant R305E150006 to the Regents of the University of California. Research leverages data available to the research team through a data sharing agreement with the California Department of Education (Michal Kurlaender, PI). The findings and conclusions here are those of the authors and do not necessarily reflect the positions or policies of the California Department of Education, the Institute of Education Sciences or the funders of the California Education Lab.



# High school math courses matter

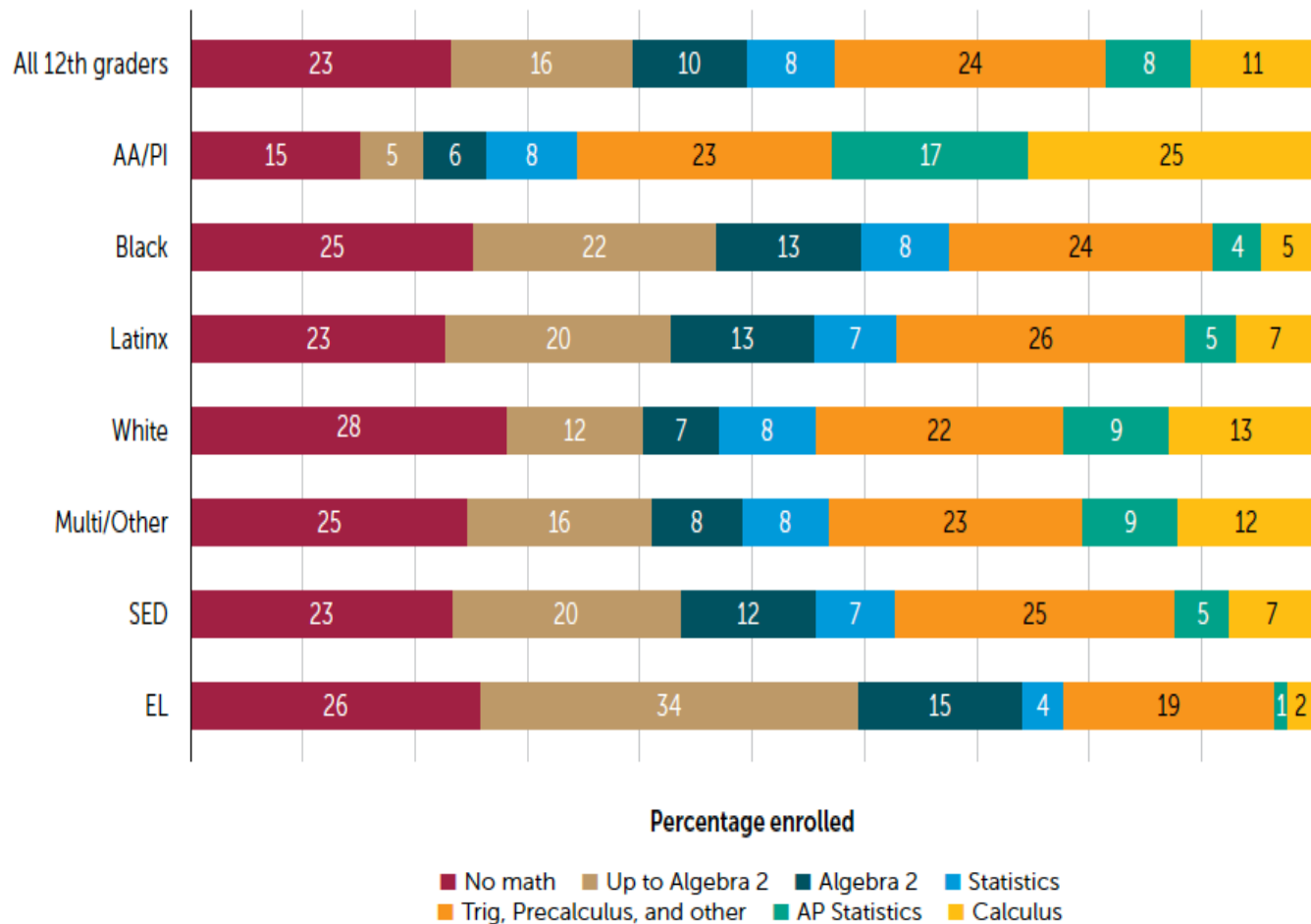
- Academic preparation in high school is a key predictor of college success
- Rigorous math courses are associated with postsecondary outcomes
  - College entry
  - Type of college entry (2-yr vs. 4-yr; selectivity)
  - College completion
  - Wages
- Persistent disparities exist in academic preparation by student and school characteristics
- Course “selection” is one of the most important student/school decisions in high school

# 25% of seniors do not take any math



**12th-Grade Math Course Enrollment, 2018–19**

# 12<sup>th</sup> grade math course- taking varies by student race/ethnicity





# 12th grade math course enrollment follows a predictable trajectory based on prior course-taking

Prior-year math category	12th-grade math course (percentage of enrolled students)							
	All 12th Graders	Calculus	AP Statistics	Statistics	Trig, Precalculus, and other	Algebra 2	Up to Algebra 2	No math
Calculus	6	19	28	2	4	0	0	3
AP Statistics	1	4	0	1	0	0	0	1
Statistics	1	0	2	1	1	0	0	1
Trig, Precalculus, and other	21	57	37	26	19	5	9	16
Algebra 2	38	19	30	59	59	36	17	38
Up to Algebra 2	29	1	1	17	8	56	67	31
No math	4	1	2	2	2	2	7	10

# Twelfth-Grade Math and College Access

LAERI Research Report

Leonard Wainstein (Reed), Carrie Miller (UCLA), Meredith Phillips (UCLA), Kyo Yamashiro (LMU), Tatiana Melguizo (USC)

We thank Los Angeles Unified School District staff from the Division of Instruction and the Office of Data and Accountability for their collaboration on this project. We are particularly grateful to the past and present members of the math instructional and counseling teams, including Philip Ogbuehi, Firoza Kanji, Patricia Heideman, Amy Uyeshima, Jesus Angulo, Shelly Alavez, and Burgandie Montoya, for their insightful contributions during meetings and presentations. We thank College Futures Foundation for their generous financial support.

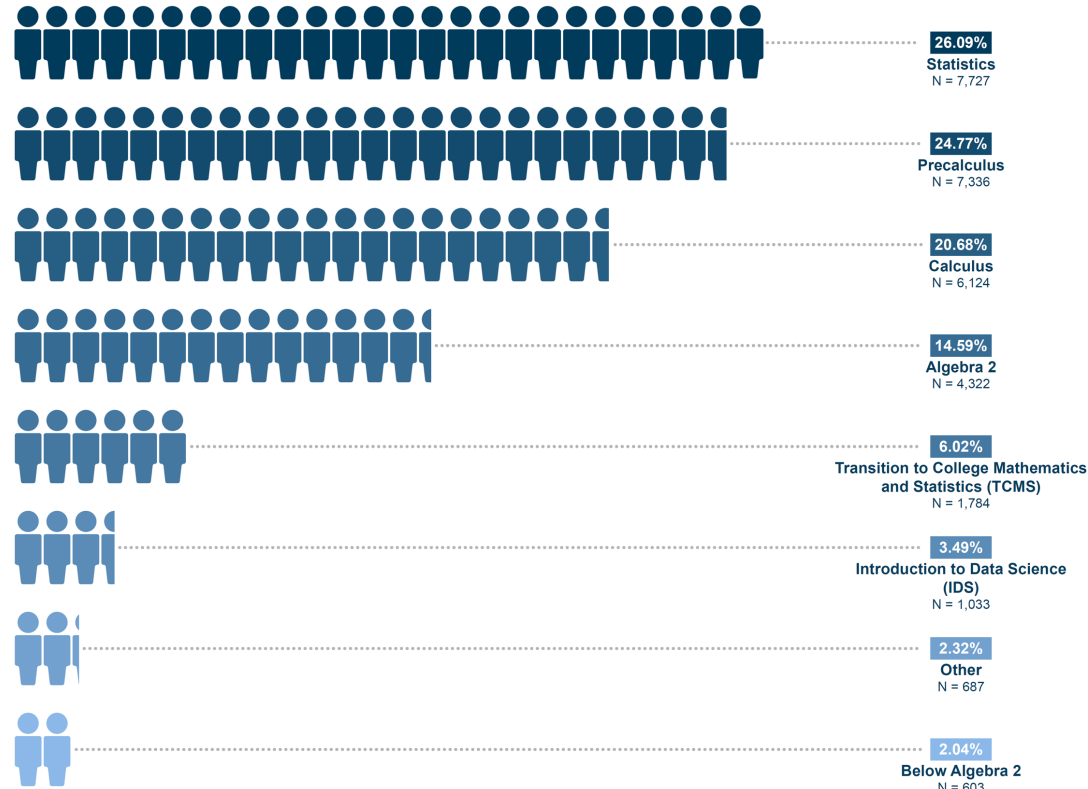
# Overview

- Purpose
  - Understand whether taking math in 12<sup>th</sup> grade improves students' high school and college outcomes, and whether some math courses are more beneficial than others
- Data
  - Longitudinal data from the Los Angeles Unified School District. 12<sup>th</sup> graders in 2016-17 and 2017-18.
- Methods
  - Compare end-of-high school and college enrollment outcomes of students who were similar prior to 12<sup>th</sup> grade (e.g., similar test scores, grades, prior course-taking, attendance, educational expectations, self-perceptions) yet who differed in whether they took math in 12<sup>th</sup> grade, or in the type of math course they took.

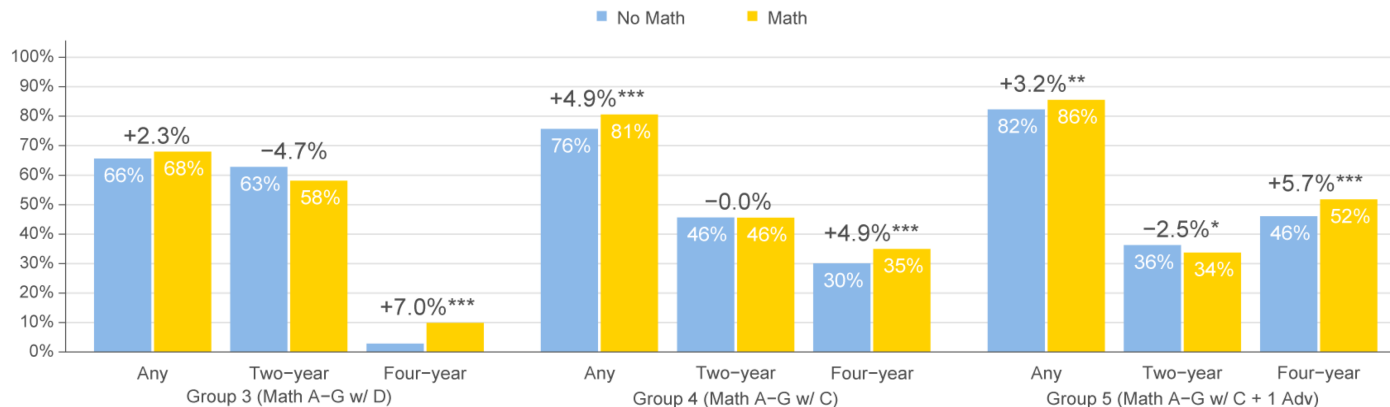
# Students differ in what math they need to take or are ready to take in 12<sup>th</sup> grade

- **Groups 1 & 2:** Still need to take math to graduate from high school (12% of our sample; nearly all took math in 12<sup>th</sup> grade)
- **Group 3:** Need to take math and get at least a C to meet the A-G math requirements for UC/CSU eligibility (8% of our sample; about half of them didn't take math in 12<sup>th</sup> grade)
- **Group 4:** Already A-G complete in math but haven't taken a course beyond Alg 2 (31% of our sample; about a third of those didn't take math in 12<sup>th</sup> grade)
- **Group 5:** Already took an additional math course beyond the A-G requirements (36% of our sample; about a quarter of those didn't take math in 12<sup>th</sup> grade)

# Of all the students in our sample who took math in 12<sup>th</sup> grade, most took Statistics, Precalculus, or Calculus



# Taking 12<sup>th</sup> grade math increases students' likelihood of enrolling in college



- Positive and statistically significant effect on 4-year college enrollment across the groups
- Positive and statistically significant effect on any college enrollment for Groups 4 & 5
- For Groups 3 and 5, suggestive evidence that taking 12<sup>th</sup> grade math shifts enrollment from two-year to four-year colleges
- Results for college persistence largely mirror these results

# Inconclusive Results about Whether Type of Math Course Matters

- Slight differences among a few courses in their effects on high school GPA:
  - Group 5: Statistics vs. Calculus: Statistics  $\rightarrow$  +.04 weighted GPA points
  - Group 4: IDS vs. Precalculus: IDS  $\rightarrow$  +.05 weighted GPA points
- Inconsistent and statistically insignificant differences among the courses in their effects on A-G completion or college enrollment/persistence, except:
  - Group 4: Statistics vs. Precalculus. Statistics-takers were more likely to enroll and persist in a four-year college but that effect is probably due to unmeasured differences between the two groups, so it's probably not causal.
- Imprecise estimates for TCMS and IDS--not that many students took TCMS and IDS in the cohorts we study. Important topic for future research...

# Discussion





# Innovating High School Math Through K12 and Higher Education Partnerships

Sherrie Reed, Kathy Bracco, Michal Kurlaender,  
& Cassandra Merritt

Research supported by the College Futures Foundation, through grants to the Education Insights Center at Sacramento State University and the California Education Lab at the University of California Davis, and by the Institute of Education Sciences, U.S. Department of Education, through Grant R305E150006 to the Regents of the University of California. Research leverages data available to the research team through a data sharing agreement with the California Department of Education (Michal Kurlaender, PI). The findings and conclusions here are those of the authors and do not necessarily reflect the positions or policies of the California Department of Education, the Institute of Education Sciences or the funders of the California Education Lab.



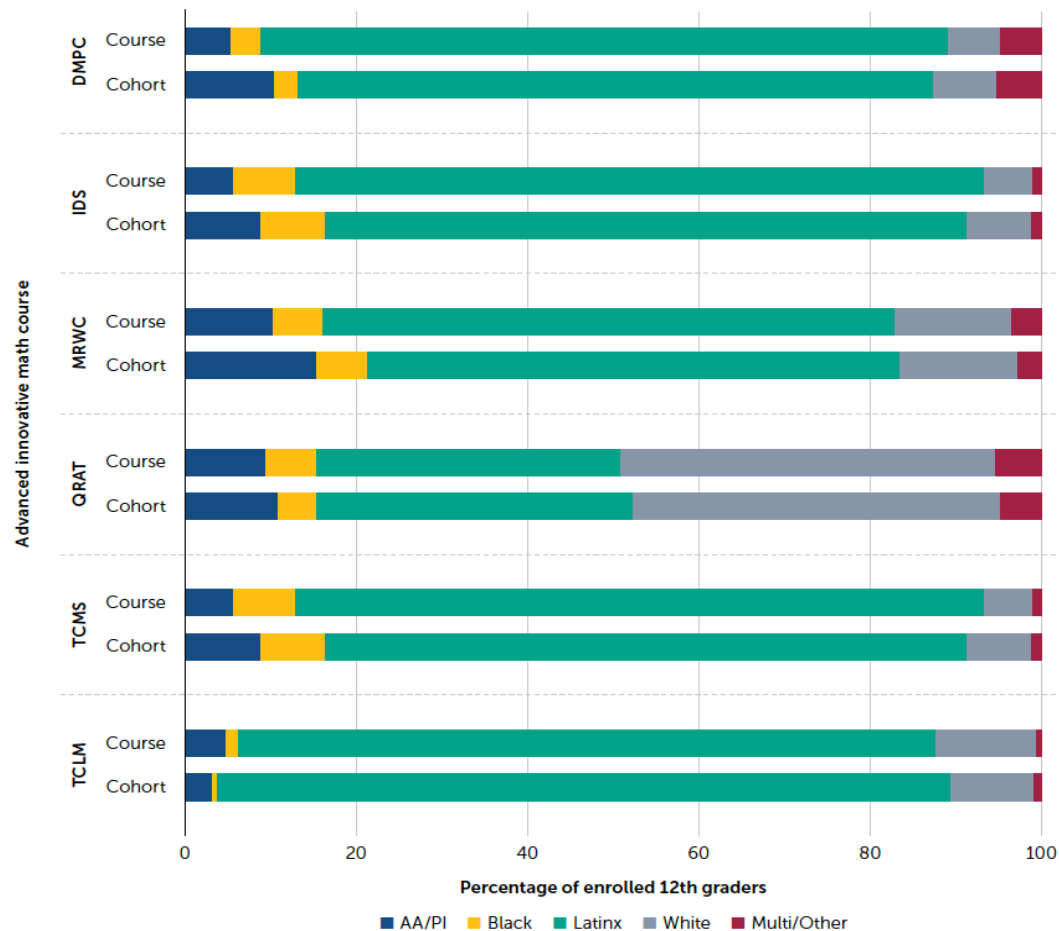
# Diversifying high school math courses

- **California Math Readiness Challenge Initiative (CMRCI)**
  - funding to create 12th grade math courses that would “prepare students for college-level mathematics, with expected collaboration between high schools and CSU campuses”
- **Reflected in the proposed revisions to CSU admission criteria, that were not ultimately adopted**
  - students complete an additional year-long course in quantitative reasoning (including math, science, or computer science) in high school in order to be eligible for admission
- **Reflected in the proposed *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve***

# Advanced Innovative Math (AIM) Courses

Advanced Innovative Math Course	University - Lead Partner	Number K-12 Districts	Number Students	Percent Cohort
Mathematical Reasoning with Connections (MRWC)	Cal Poly Pomona	17	2,756	16%
Transition to College Level Math (TCLM)	California State University, Monterey Bay	5	99	14%
Transition to College Math & Statistics (TCMS)	California State University, Northridge	1	2,437	19%
Quantitative Reasoning with Advanced Mathematical Topics (QRAT)	Sacramento State University	15	1,093	13%
Discrete Math for Pre-College Students (DMPC)	San Diego State University	3	1,066	12%
Introduction to Data Science (IDS)	University of California, Los Angeles	12	1,558	16%

# Enrollment in AIM courses is representative



# AIM courses developed through intersegmental partnerships

- **Math course developed by higher education faculty & high school math specialists**
- **Shared purpose**
  - Target college-bound students not interested/ready for calculus
  - Improve quantitative reasoning and student confidence in math
  - Commitment to equity
- **Extensive & ongoing professional development**
  - Build community & develop capacity
- **Curricular content varies, but all student-centered – emphasizing problem solving and collaboration**

## Innovative pedagogy

“I can create opportunities for students to learn  
and discover things on their own,  
and that is a much more powerful way of  
learning for students when they come  
to a discovery on their own and they make  
sense of it in their own way.”

– High school math teacher

## Develop capacity of teachers

“I was already wanting to move in that direction, but actually being trained in teaching this course has kind of given me the **tools to be more confident** in allowing that to happen in my other classes... **I've grown in the ability to choose student work, and to ask students to present and to lead whole class discussions about that work**, and so all of those things .”

– High school math teacher

## Changing student mindsets

“I’m finally not dumb in math. I finally understand what’s going on.”

- High school math teacher quoting a former student

“We do get a lot of **student** comments about **how successful they feel for the first time**. For the first time they can come to **believe that they can do mathematics** and that mathematics is not ... about being a human computer .”

- High school math teacher



**Positive impact  
on student  
outcomes**

Enrollment in an AIM course:



Increases the likelihood of completing the courses requirements for UC/CSU eligibility by 3 to 10 percentage points



Improves high school math GPA



Increase the likelihood of postsecondary enrollment

# STUDENT EXPERIENCES IN DISCRETE MATH AND INTRO TO DATA SCIENCE

A Case Study



## TWO HIGH SCHOOLS

Discrete Math	Intro to Data Science
2,400 students	2,000 Students
27% Socioeconomically disadvantaged	80.1% Socioeconomically disadvantaged
6.5% English Learners	20% English Learners
Latinx (55%), Filipino (20%)	Asian (59.5%), Latinx (33.9%)

# FINDINGS

- Experience Curiosity and Creative Freedom
- Feel Connected to a Community of Learners
- Use “Easy” and “Fun” in complex ways

# EXPERIENCE CURIOSITY AND CREATIVE FREEDOM

*"With regular math, it's the set equation and then you find your numbers. But with discrete, you have your numbers and then you find the equation....And that's why I like discrete a lot more than I like regular math"*

Nia, Black DMPC Senior

*"I like that.... I don't have to follow one simple rule, one way, I don't have to follow one way to get this answer, I like how I can just change it up a bit. I like it how I can use a histogram or maybe a bar graph or like tally or a XY plot [for] my answer"*

Nolan, Latinx IDS Junior

# FEEL CONNECTED TO A COMMUNITY OF LEARNERS

*"Because other years, I've just been, okay, I got the answer.... I want to put it on a projector and be like, this is my work. I did it like this. Is there anybody else that relates to me?... I genuinely get happy... I have an urge to push myself and show it to other people. Whereas, I didn't like math before"*

Jayden, Black DMPC Senior

*"It's good because everyone in that class could help you because we're all at the same level. We're all beginners into IDS, so we're at the same level and we could really help each other."*

Catherine, Latinx IDS Junior

## USE "EASY" IN COMPLEX WAYS

*"Oh, some of my friends are in AP stats.... in AP calc. And then I'm like, 'Yeah, I'm in Discrete.' And they're like, 'Oh, why are you in that class? It's so easy. You guys don't do anything.' But it's not that **easy**. You actually have to think more."*

Ava, Latinx DMPC Senior

*"So my past math experiences were kind of bad. I hated math. You know, I was the type of person who would slack off on homework, fail my test. And but I feel like IDS for me, I started using coding and that was a lot **easier** for me to understand."*

Will, Asian IDS Senior

## USE “FUN” IN COMPLEX WAYS

*“Math is **funner** than it was before. And I like to just be able to do my own thing and figure it out myself without having a set equation.”*

Savannah, White DMPC Senior

*“I like puzzles. I like putting things together and coming up with something. So like, coding has been really **fun** for me.”*

Caleb, Latinx IDS Junior



# Discussion





**THANK YOU**

JustEquations.org