FOUR STEPS TO FIX MATH EDUCATION

ROBERT KAPLINSKY

robert@robertkaplinsky.com

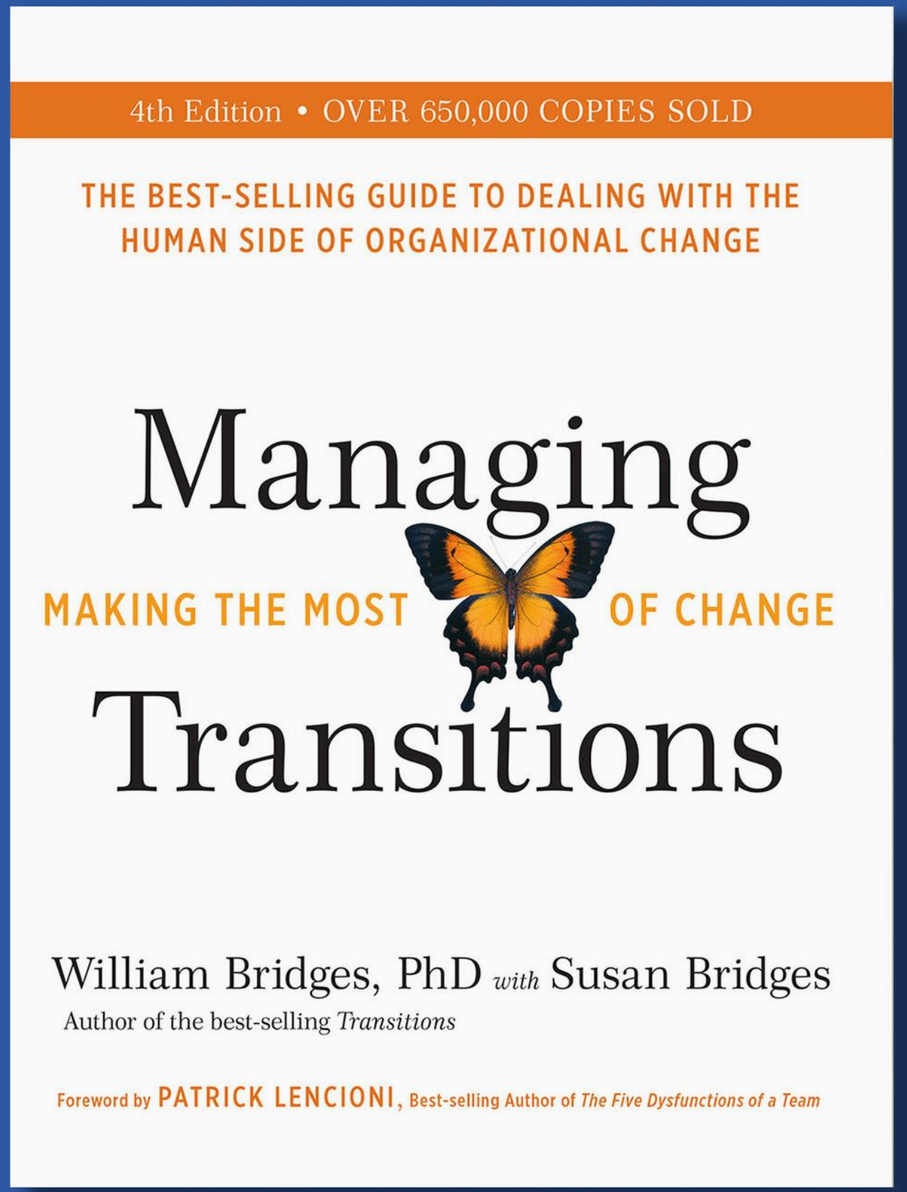
robertkaplinsky.com/fixmath

@robertkaplinsky

Source: World War Z

GOALS

- ❑ WHAT IS THE PROBLEM?
- ❑ WHAT SHOULD THE GOAL BE?
- ❑ HOW DO WE ACHIEVE IT?
- ❑ HOW DO WE GET SUPPORT?


4th Edition • OVER 650,000 COPIES SOLD
THE BEST-SELLING GUIDE TO DEALING WITH THE HUMAN SIDE OF ORGANIZATIONAL CHANGE
Managing
MAKING THE MOST
OF CHANGE
Transitions
William Bridges, PhD with Susan Bridges
Author of the best-selling Transitions
Foreword by PATRICK LENCIONI, Best-selling Author of The Five Dysfunctions of a Team

DEFINING THE PROBLEM

1. What is the problem?
2. Who says so, and on what evidence?
3. What would occur if no one acted to solve this problem?
4. And what would happen to us if that occurred?

US math education is broken.


Adapted from Dan Meyer

US math education is broken.

DEFINING THE PROBLEM

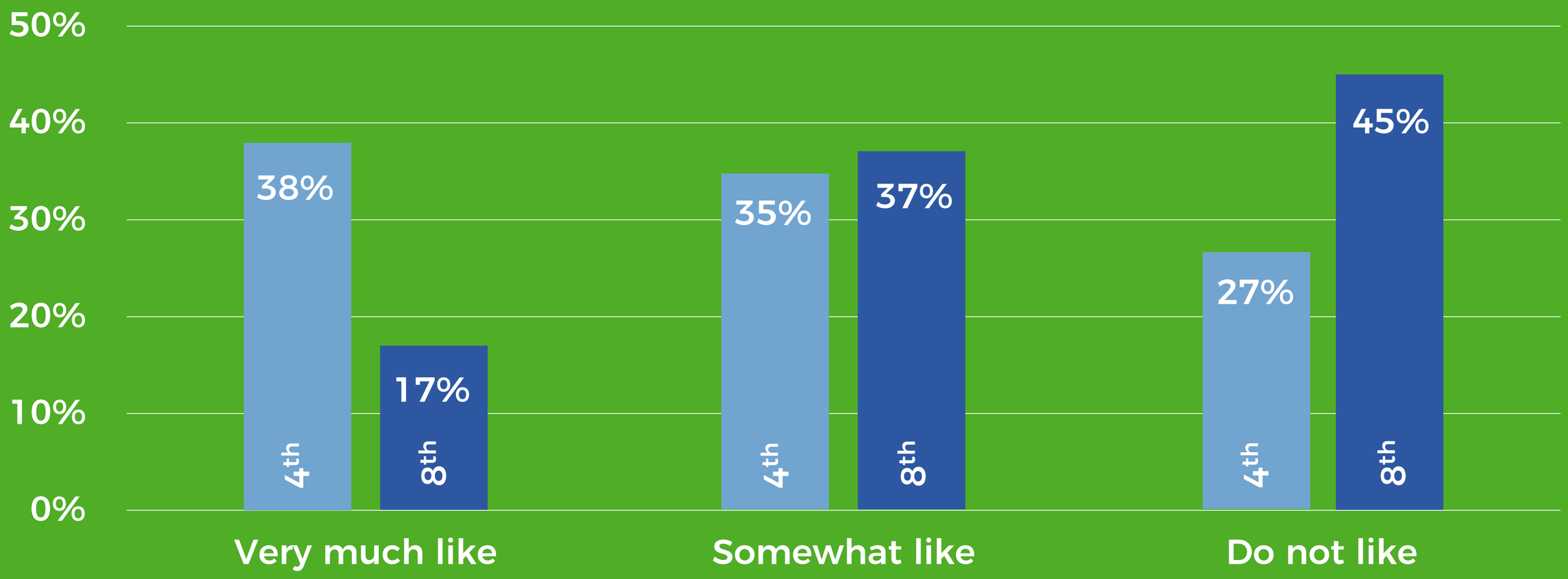
1. What is the problem?
2. Who says so, and on what evidence?

- Community

Google Search I'm Feeling Lucky

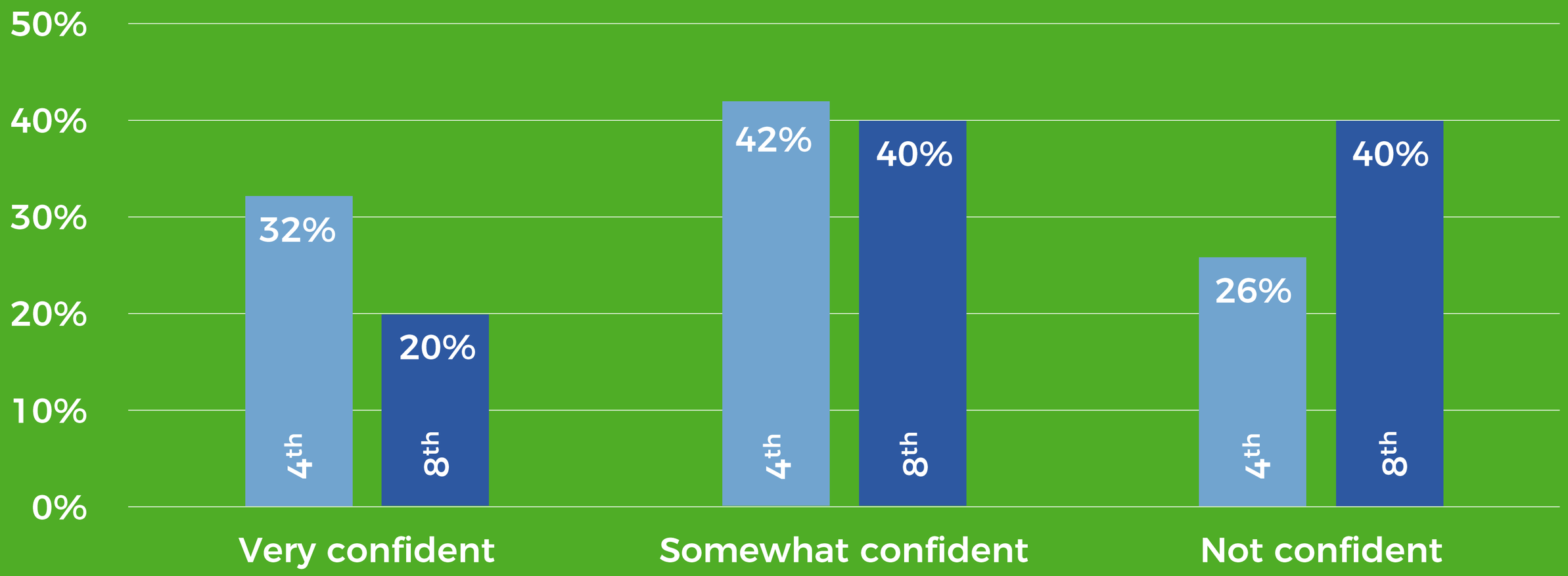
- Community
- Students

DO U.S. STUDENTS LIKE LEARNING MATH?



Source: Trends in International Mathematics and Science Study (TIMMS) 2019

HOW CONFIDENT ARE U.S. MATH STUDENTS?



Source: Trends in International Mathematics and Science Study (TIMMS) 2019

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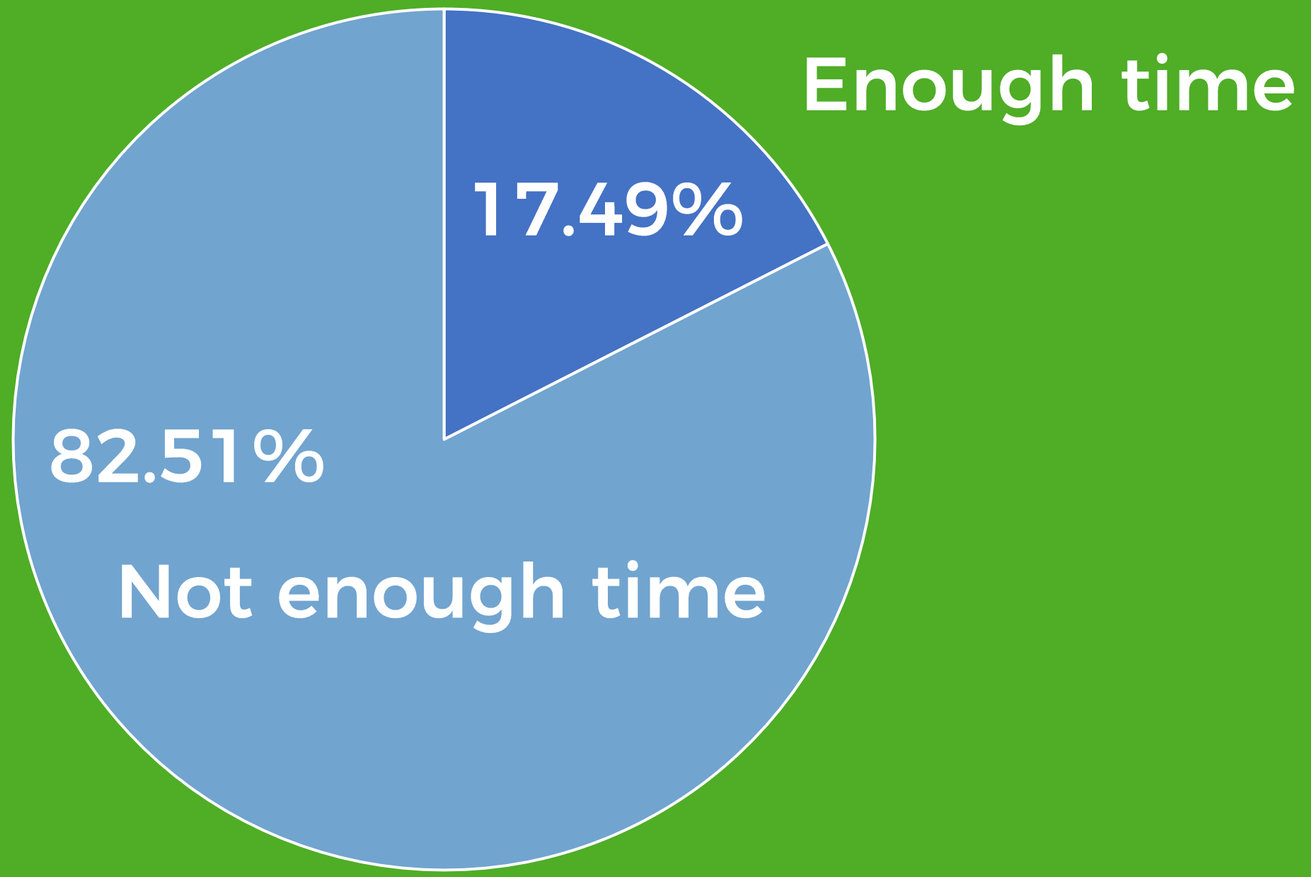
- Community
- Students
- Teachers

DO YOU HAVE ENOUGH TIME?



Source: Robert Kaplinsky online survey of 383 educators

Nick Corley
@MrCorleyMath

Replying to @robertkaplinsky

I used to have 42 min daily, now have 80 min daily. I can now cover all standards. #needmoretimeinmath

11:05 AM · Mar 24, 2017 · Twitter for iPhone

Josh Zagorski
@JZagorski1

Replying to @robertkaplinsky

yes 80 mins of math K-8 in our district

6:47 PM · Mar 25, 2017 · Twitter for Android

Zoe Rooney @positv_slope · Mar 27, 2017

@nc_teach I feel as though I have enough time over the year but not before the state test

1 1

Zoe Rooney
@positv_slope

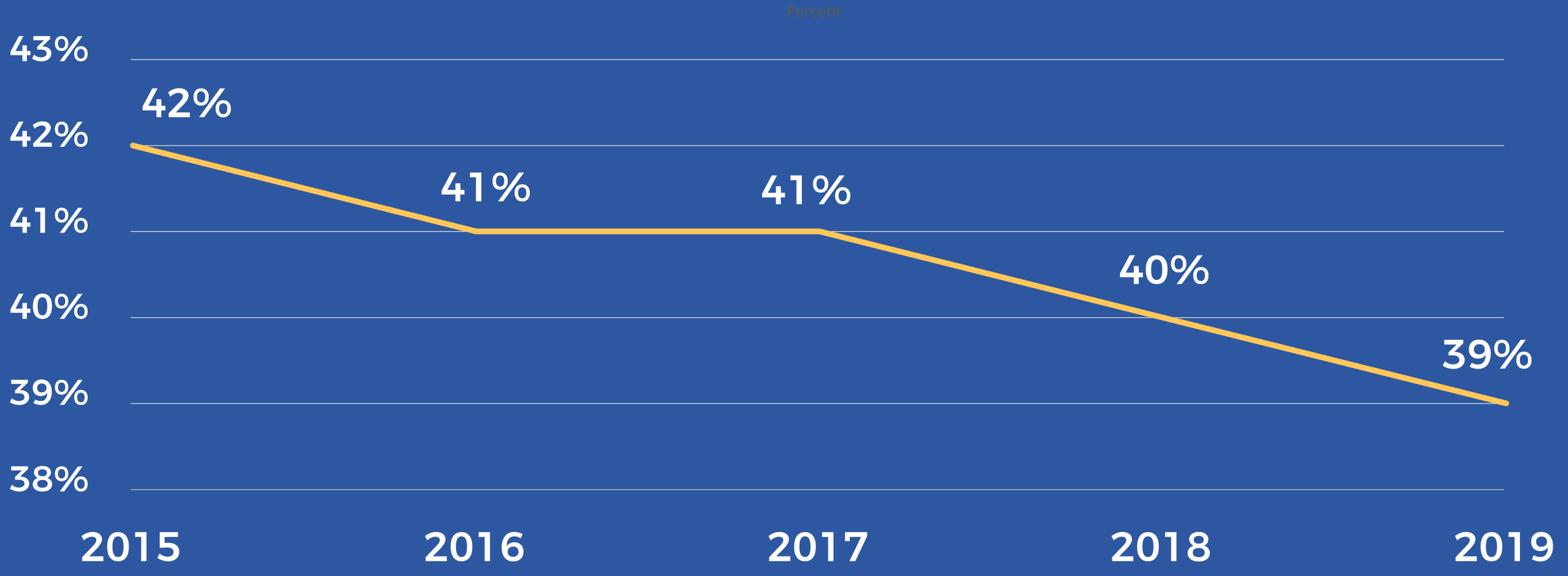
Replying to @positv_slope @robertkaplinsky and @nc_teach

(This is with 90 minutes per day)

3:24 AM · Mar 27, 2017 · Twitter for iPhone

- Community
- Students
- Teachers
- Universities

COLLEGE READINESS - MATHEMATICS



Source: ACT - *The Condition of College & Career Readiness* - 2019

HOW IS IT MEASURED?

"The ACT® College Readiness Benchmarks are [based upon] scores on the ACT subject area tests."

Source: ACT The Condition of College & Career Readiness 2019

WHAT DOES IT MEAN?

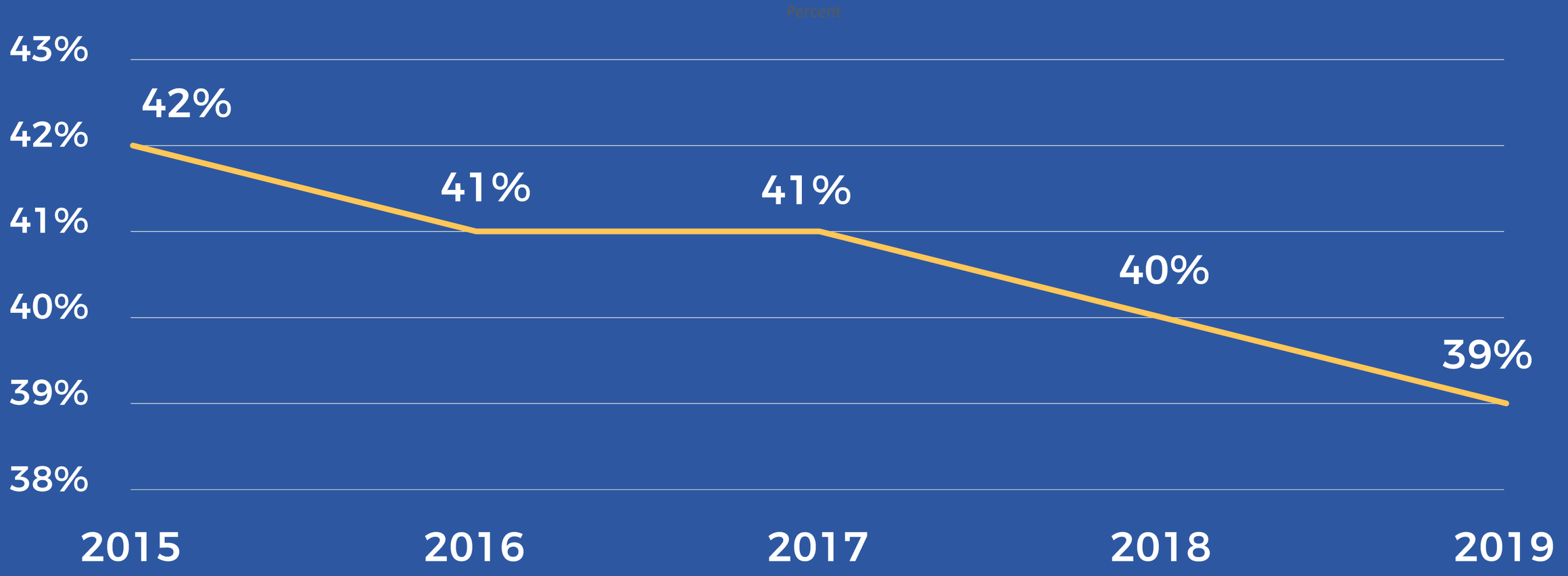
"[They] represent the level of achievement required for students to have a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in corresponding credit-bearing first-year college courses."

Source: ACT The Condition of College & Career Readiness 2019

WHAT COLLEGE COURSE?

- College Algebra
  - What's covered in "College Algebra" varies by institution.
  - Often considered to be the "greatest hits" of Algebra 1 and Algebra 2.

COLLEGE READINESS - MATHEMATICS



Source: ACT - *The Condition of College & Career Readiness* - 2019

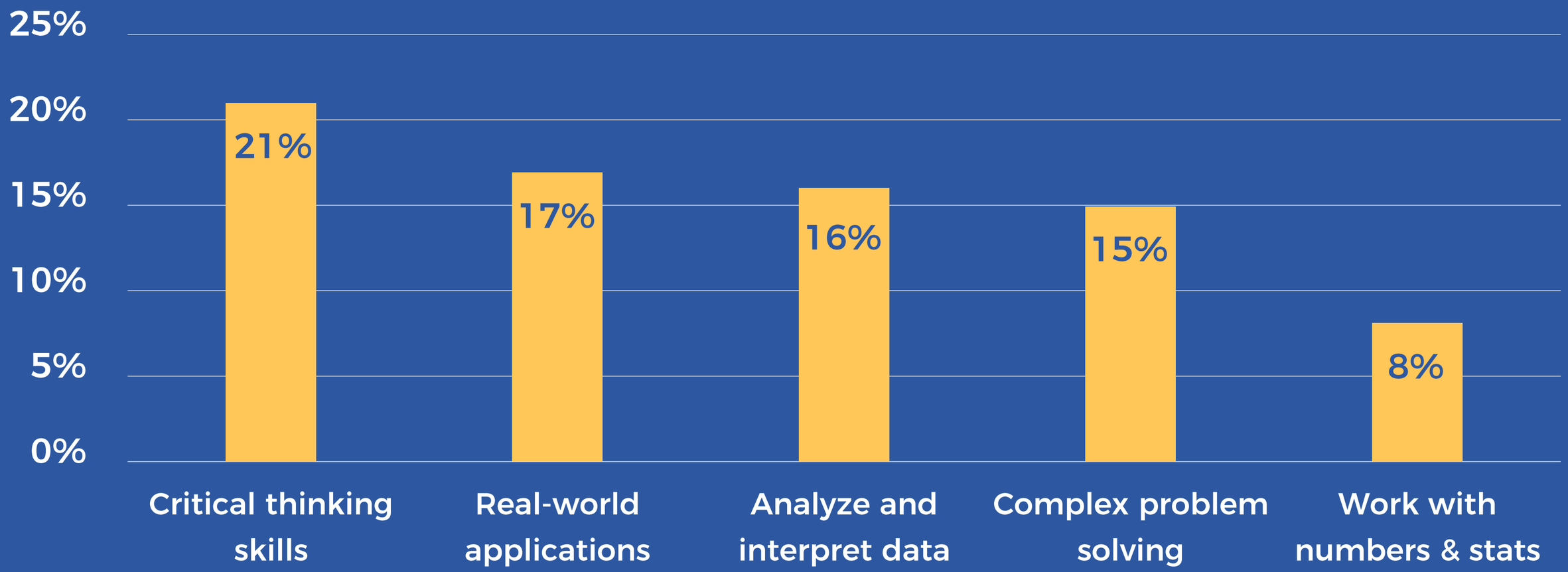
- Community
- Students
- Teachers
- Universities
- Employers

THE PREPAREDNESS GAP

- Surveyed 496 employers including private & public companies, and nonprofit organizations.
- They were asked:
  - whether a skill is “very important”
  - whether recent graduates were “very well prepared” on that skill.
- The difference between them is the preparedness gap.

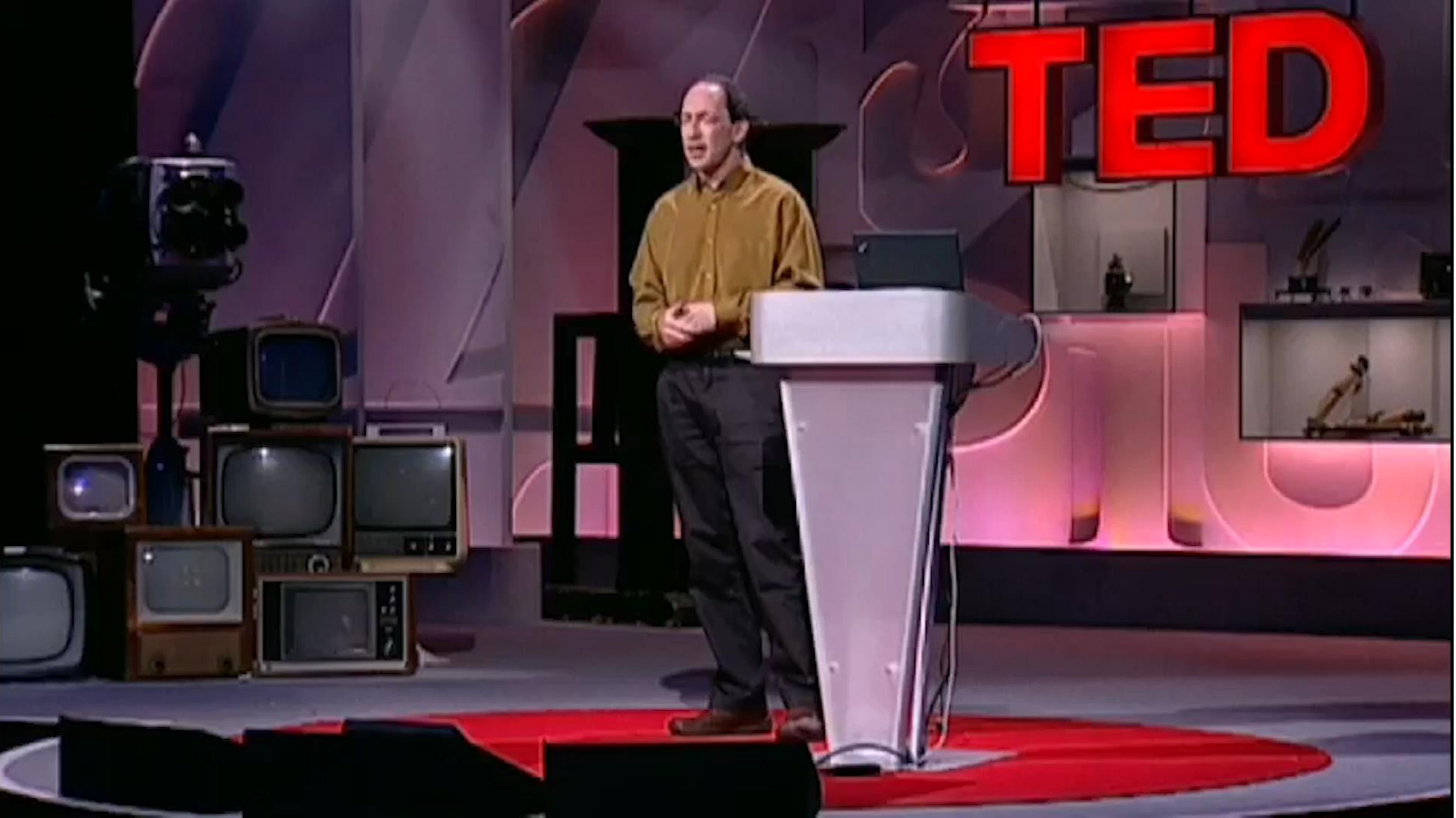
Source: Hanover Research - Employer Views on What Matters Most – 2021

THE PREPAREDNESS GAP



Source: Hanover Research - Employer Views on What Matters Most – 2021

- Community
- Students
- Teachers
- Universities
- Employers
- Experts

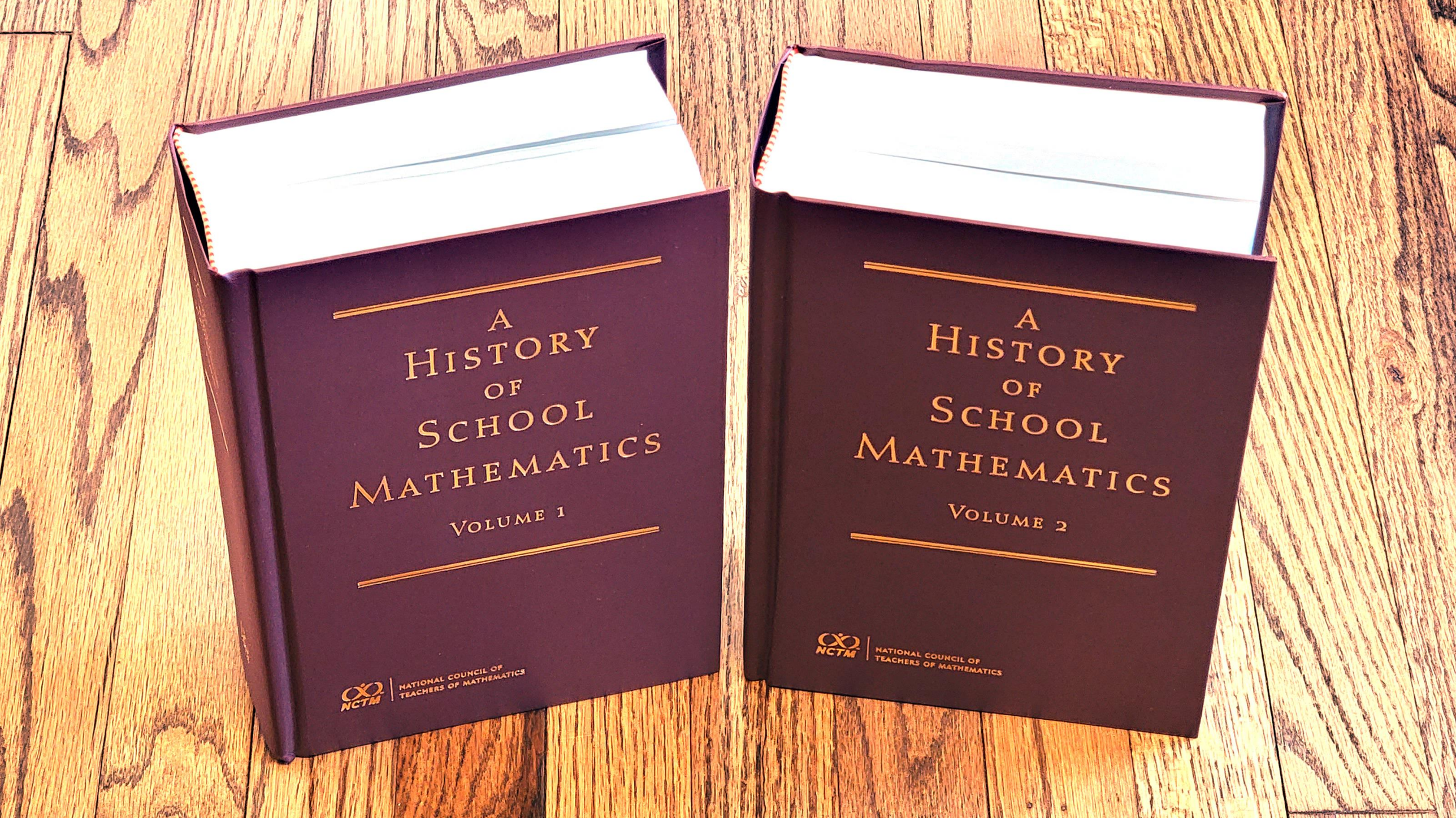

TED

- Community
- Students
- Teachers
- Universities
- Employers
- Experts

DEFINING THE PROBLEM

1. What is the problem?
2. Who says so, and on what evidence?
3. What would occur if no one acted to solve this problem?

Where did our math pathway come from?


A History of School Mathematics
Volume 1
NCTM
National Council of Teachers of Mathematics
A History of School Mathematics
Volume 2
NCTM
National Council of Teachers of Mathematics

WHERE DID IT COME FROM?

- In 1957, Sputnik launched.
- In 1959, the Commission on Mathematics of the College Entrance Examination Board (CEEB) made a recommendation for a new math pathway.

Source: A History of School Mathematics, Volume 1 - Fey, J. T., & Graeber, A. O. (2003).

WHAT DID THEY RECOMMEND?

- Logic
- Modern algebra
- Probability
- Statistics
- Geometry
- Advanced algebra and trigonometry

Source: A History of School Mathematics, Volume 1 - Fey, J. T., & Graeber, A. O. (2003).

WHAT WAS THEIR GOAL?

"students could proceed more quickly to the frontiers of mathematics and meet the national need for a sophisticated scientific workforce."

Source: A History of School Mathematics, Volume 1 - Fey, J. T., & Graeber, A. O. (2003).

WHAT DOES THIS MEAN FOR US?

- Societal needs changed in the 50s and 60s.
- Math education changed to meet them.
- Societal needs continued to change.
- The math students learn has not.

DEFINING THE PROBLEM

1. What is the problem?
2. Who says so, and on what evidence?
3. What would occur if no one acted to solve this problem?
4. And what would happen to us if that occurred?

Cryptocurrencies

Climate change

Artificial intelligence

Cyber security

Space exploration

Pandemics

Energy production

Resource collection

Medical research

Pollution reduction

Comet mining

3D manufacturing

We can’t solve 2060 problems with a 1960 education.

GOALS

- [x] WHAT IS THE PROBLEM?
- [ ] WHAT SHOULD THE GOAL BE?
- [ ] HOW DO WE ACHIEVE IT?
- [ ] HOW DO WE GET SUPPORT?

U.S. STATES ARE IN AGREEMENT

- Common Core State Standards: “to succeed in college, career, and life.”
- Alaska: “a foundation for college and career readiness.”
- Nebraska: “work towards college and career readiness.”
- Indiana: “prepared for both college and career opportunities.”
- Oklahoma: “college and the skills desired by many employers.”
- Florida: “success in career and college for students.”

U.S. STATES ARE IN AGREEMENT

- Texas: “guided by the college and career readiness standards”
- Minnesota: “keep learning and, beyond secondary school, to successfully navigate toward and adapt to an economically viable career.”
- Virginia: “success in entry-level, credit-bearing mathematics courses in college or career training.”
- South Carolina: The South Carolina College- and Career-Ready Standards for Mathematics

College and career readiness

THOUGHT EXPERIMENT

Imagine we asked teachers in every state to write down what “college and career readiness” means to them.

How likely is it that we share a common understanding?


Hilton Grand Vacations
VENETIAN
hollywood
Aria
MGM
JABB AWOC KEEZ
NEW YORK NEW YORK
EXCALIBUR
LUXOR

What about the beauty of math?!

GOALS

- [x] WHAT IS THE PROBLEM?
- [x] WHAT SHOULD THE GOAL BE?
- [ ] HOW DO WE ACHIEVE IT?
- [ ] HOW DO WE GET SUPPORT?

- ~~Students~~
- ~~Parents~~
- Teachers

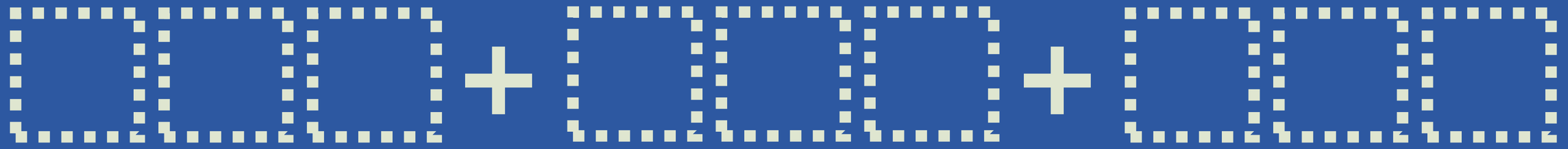
Column Addition (A)

Find each sum.

461	470	745	702	527
732	102	443	520	361
+ 769	+ 776	+ 861	+ 994	+ 747

553	694	187	245	749
502	591	537	415	794
+ 783	+ 669	+ 399	+ 441	+ 166

Using the digits 1 to 9 exactly one time each, place a digit in each box to make the sum as close to 1000 as possible.



Source: John Ulbright and Robert Kaplinsky on openmiddle.com

20. Shopping

There are eight hot dogs and twelve hot dog buns in each package. How many packages of hot dogs and hot dog buns should you buy so that there are no extra hot dogs or hot dog buns?

CONRAD WOLFRAM'S POINTS

1. Posing the right questions
2. Real world → math formulation
3. Computation
4. Math formulation → real world, verification

CONRAD WOLFRAM'S POINTS

1. Posing the right questions
2. Real world → math formulation
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4. Math formulation → real world, verification


MIF 0 - 0 SF
Zebra 2
21
3
11
41
9
HANSEN
KIRKENS BYMISJON
27
HANSEN

Teachers decide how math is taught

- ~~Students~~
- ~~Parents~~
- Teachers
- Administrators

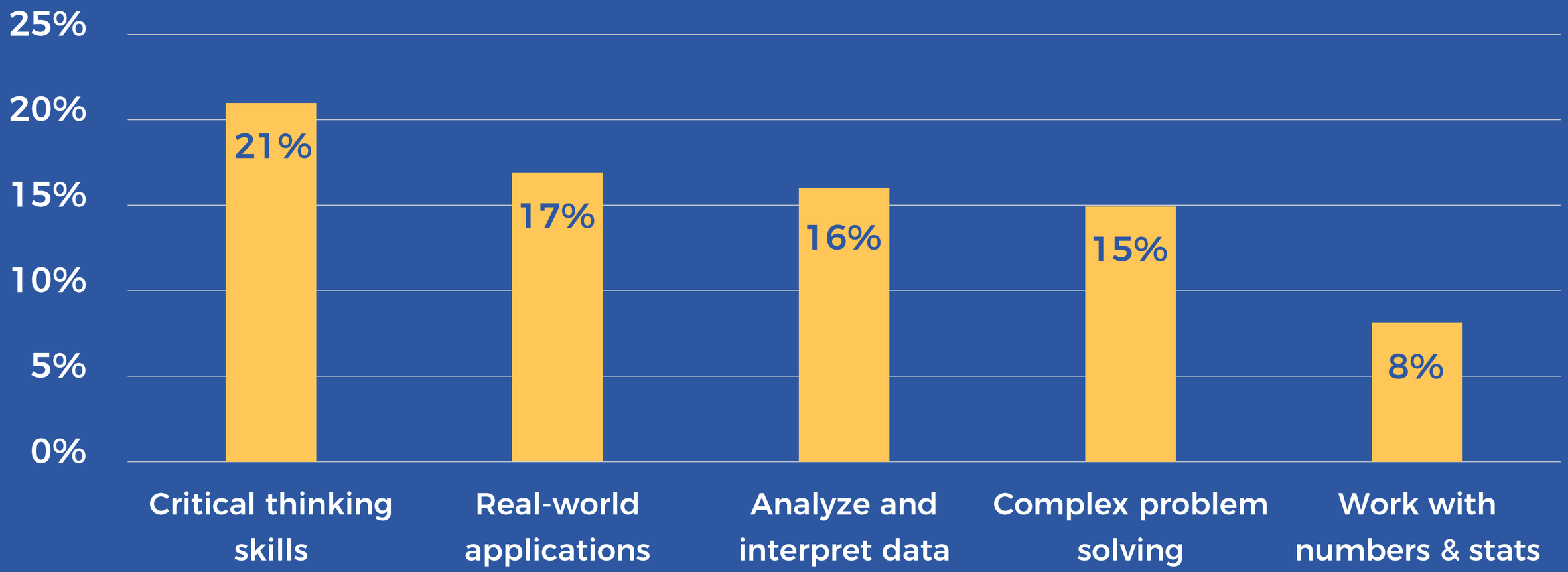
INTRODUCTION TO DATA SCIENCE

- Marriage of statistics and computer science
- Helps kids learn how to use data and technology to answer questions.
- Prepares them for careers in statistics, medicine, public policy, social sciences, law, etc.

INTRODUCTION TO DATA SCIENCE

- Alternative high school mathematics pathway
- May be taken in lieu of Algebra 2 for Universities of California.
- Los Angeles USD began offering this in 2013.
- Fourteen other districts have joined them.

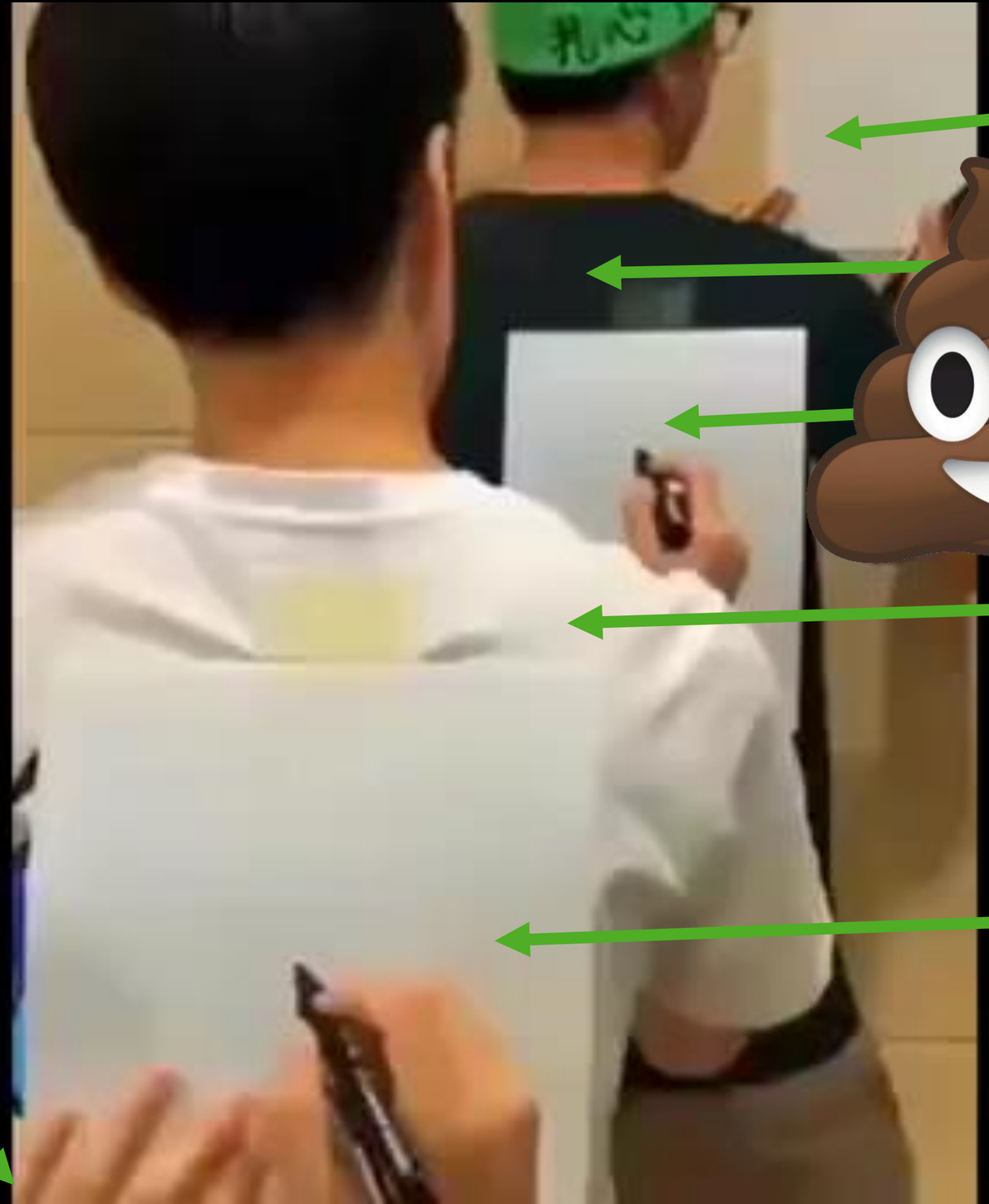
THE PREPAREDNESS GAP



Source: Hanover Research - Employer Views on What Matters Most – 2021

Administrators should advocate for better pathways.

- ~~Students~~
- ~~Parents~~
- Teachers
- Administrators
- State standards and assessment writers



What students learn

Teacher

rriculum

Curriculum writer

Standards

Skills needed to be truly college and career ready.

THOUGHT EXPERIMENT

- Imagine that math standards have never been created.
- Tomorrow they will be written down for the first time.
- What standards would go away?
- What new standards would we have?

Standards writers need to prioritize.

- ~~Students~~
- ~~Parents~~
- Teachers
- Administrators
- State standards and assessment writers
- Curriculum writers

Curriculum writers should emphasize best practices over familiarity.

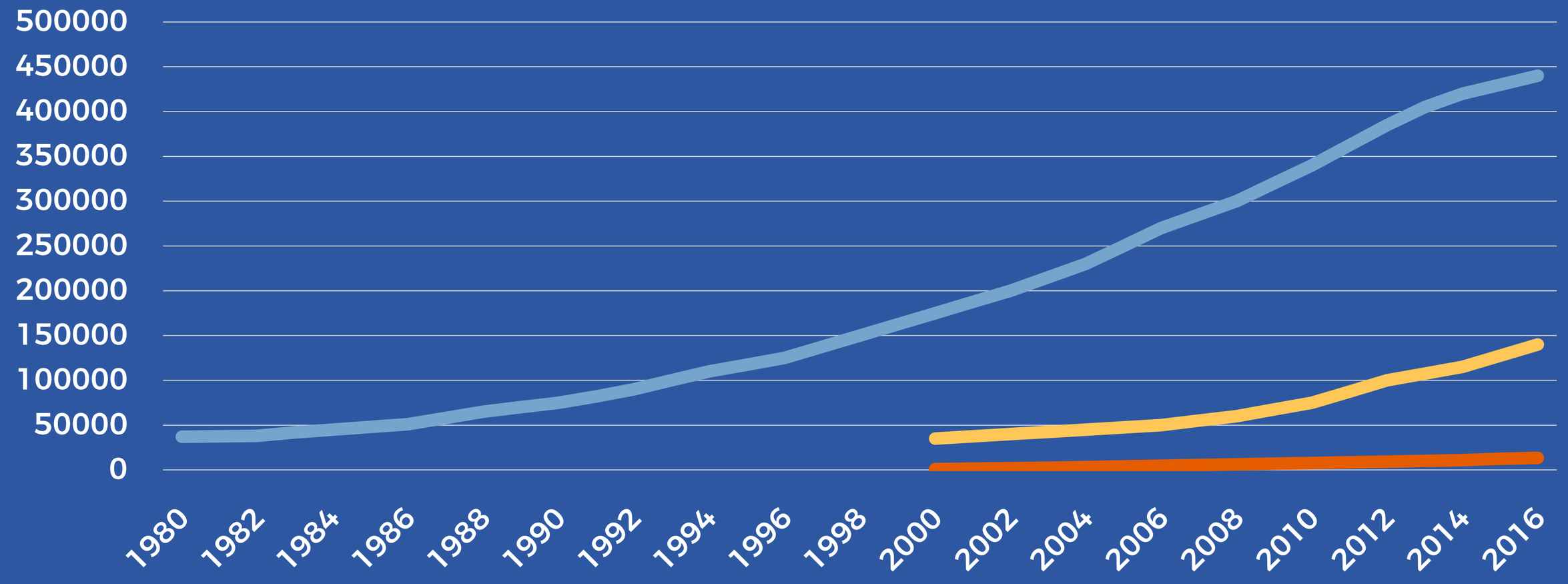
- ~~Students~~
- ~~Parents~~
- Teachers
- Administrators
- State standards and assessment writers
- Curriculum writers
- Colleges and universities

THOUGHT EXPERIMENT

"While students can still take AP Calculus in high school, it will no longer count as part of the admissions process."

What would change about the way we teach math in K-12?

HOW MANY ARE TAKING AP CALC?



Source: National Center for Education Statistics (NCES) longitudinal study

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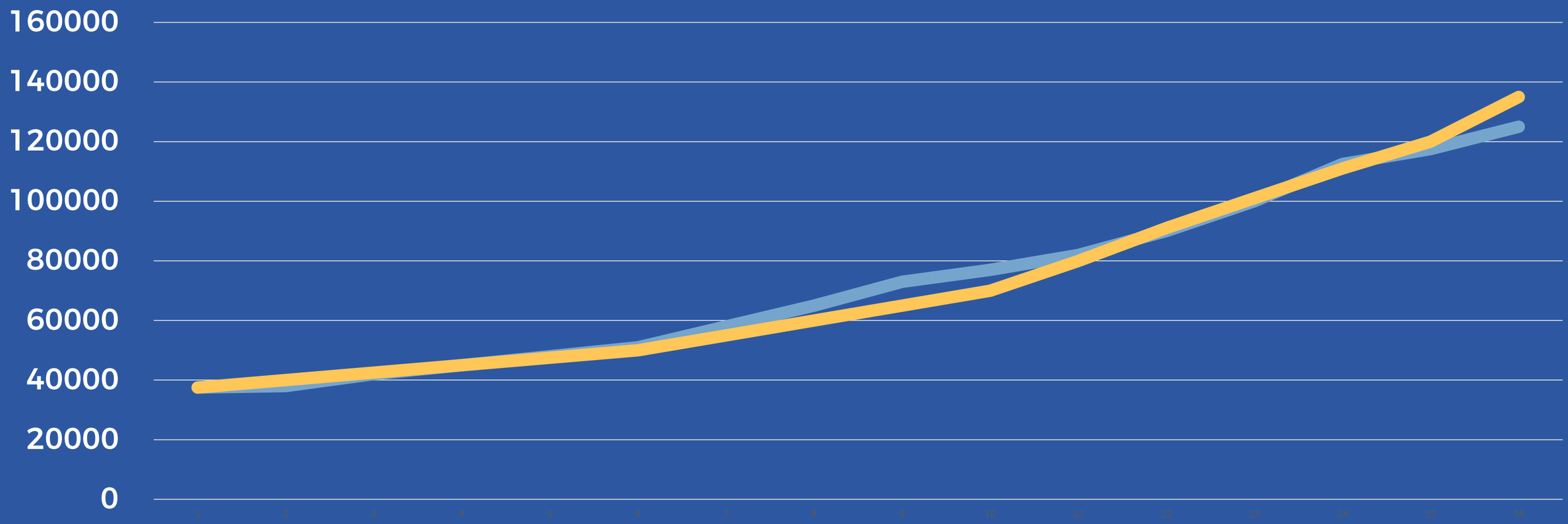
AP CALCULUS GROWTH OVER TIME



Source: National Center for Education Statistics (NCES) longitudinal study

RobertKaplinsky.com

WHY DO KIDS TAKE CALCULUS?

- 332 Rutgers students who had taken an AP Calculus exam were surveyed to determine why they chose to take calculus while in high school.
- Across all scores, about 80% said they took the course because it “looks good on college applications.”

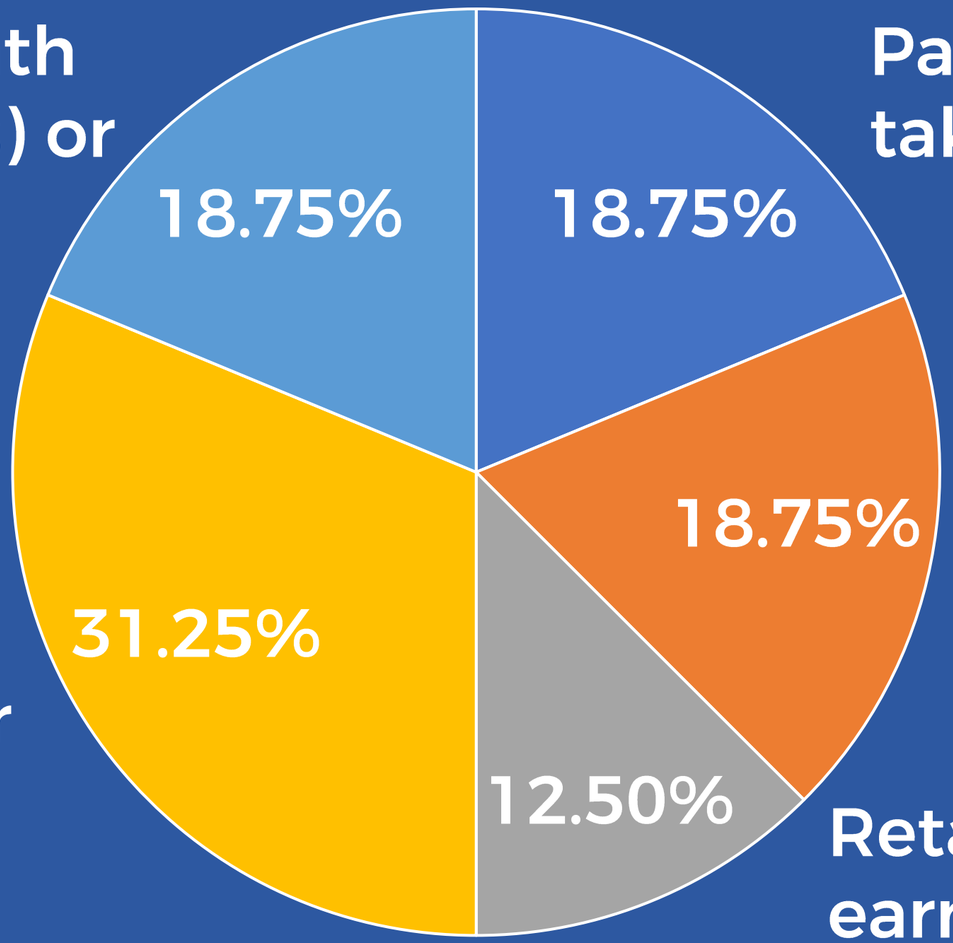
Source: Rosenstein, J. and Ahluwalia, A.(n.d.), *Putting brakes on the rush to AP Calculus.*

HOW DO THEY GET TO CALCULUS?

- Acceleration
- Skipping

	6th Grade	7th Grade	8th Grade	9th Grade	10th Grade		11th Grade		12th Grade
Traditional A-G Pathways	Math 6	Math 7	Math 8	Algebra 1	Geometry	Decision Point	Algebra 2	Decision Point	Adv Alg w/Financial Application, MRWC, AP Stats, IB Math SL
							Math 96		MRWC Adv Alg w/Financial Application

WHAT HAPPENS AFTER AP CALC?



Source: National Center for Education Statistics (NCES) longitudinal study

THOUGHT EXPERIMENT

"While students can still take AP Calculus in high school, it will no longer count as part of the admissions process."

What would change about the way we teach math in K-12?

- There would be significantly fewer kids in Calculus.
- Far less acceleration and pressure to rush through materials.
- More time to focus on core topics, especially in middle school.

Robert Kaplinsky
@robertkaplinsky

I just heard about a school that compacts 6th, 7th, & 8th grade math into one year. This is a travesty to students and their teachers. 1/2

4:08 PM · Feb 28, 2017 · TweetDeck

Colleges and universities should not count AP Calculus for admissions.

GOALS

- [x] WHAT IS THE PROBLEM?
- [x] WHAT SHOULD THE GOAL BE?
- [x] HOW DO WE ACHIEVE IT?
- [ ] HOW DO WE GET SUPPORT?

FOUR MAKE OR BREAK QUESTIONS

1. What is the problem?
2. Who says so, and on what evidence?
3. What would occur if no one acted to solve this problem?
4. And what would happen to us if that occurred?

THE FIVE WHYS - TOYOTA

- What's the problem?
  - Many vehicles are not starting.
- Why?
  - Their batteries are dead.
- Why?
  - Their alternator is not functioning.
- Why?
  - Their alternator belt has broken.
- Why?
  - The alternator belt was not replaced when it should have been.
- Why?
  - The vehicle was not maintained according to the recommended service schedule.

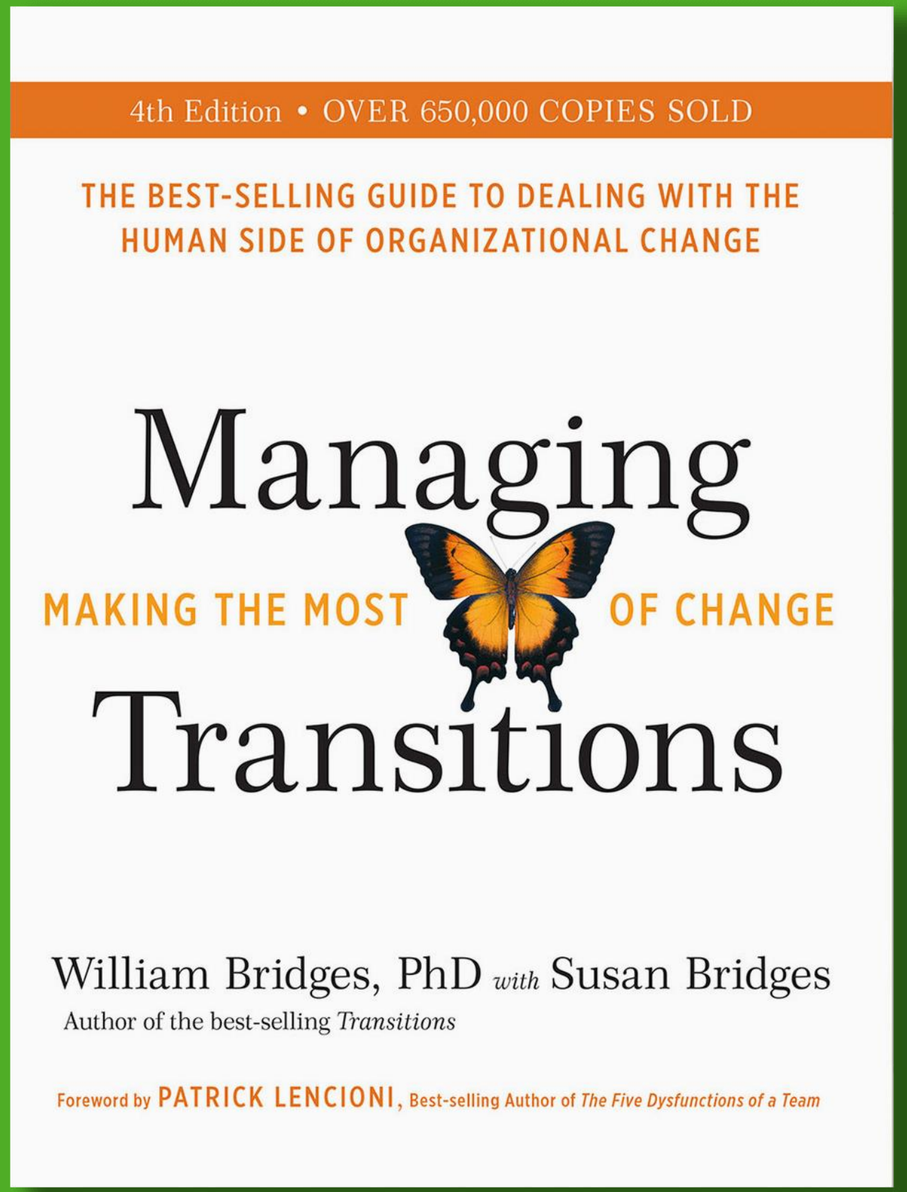
THE FIVE WHYS – MATH ED

- What's the problem?
  - The way we teach math is not meeting students' needs.

- Why?
  a) Not enough time to teach it all.
  b) Students aren't ready for university math.
  c) Students lack skills employers need.
  d) We focus too much on skills calculators can do.
  e) ???
  f) ???

THE FIVE WHYS – MATH ED

- What's the problem?
  - The way we teach math is not meeting students' needs.
- Why?
  - Students aren't ready for university math.
- Why?
  - They are not scoring well on placement exams.
- Why?
  - They're missing many foundational skills.
- Why?
  - They didn't deeply learn them in their secondary math classes.
- Why?
  - There wasn't enough time to go deeply into concepts because of acceleration.



WHAT THE PROCESS LOOKS LIKE

- Change
- Transition
  - Ending
  - Neutral Zone
  - New Beginning

MY EXAMPLE

- Change

MY EXAMPLE

- Change
- Transition
  - Ending
  - Neutral Zone
  - New Beginning

THE PROCESS IN MATH ED

- Change
  - Stop accelerating students as a rule.
- Transition
  - Ending

A. People may not stop doing anything. They may try to do all the old things and the new things. Soon they burn out with the overload.

B. People make their own decisions about what to discard and what to keep, and the result is inconsistency and chaos.

C. People toss out everything that was done in the past.

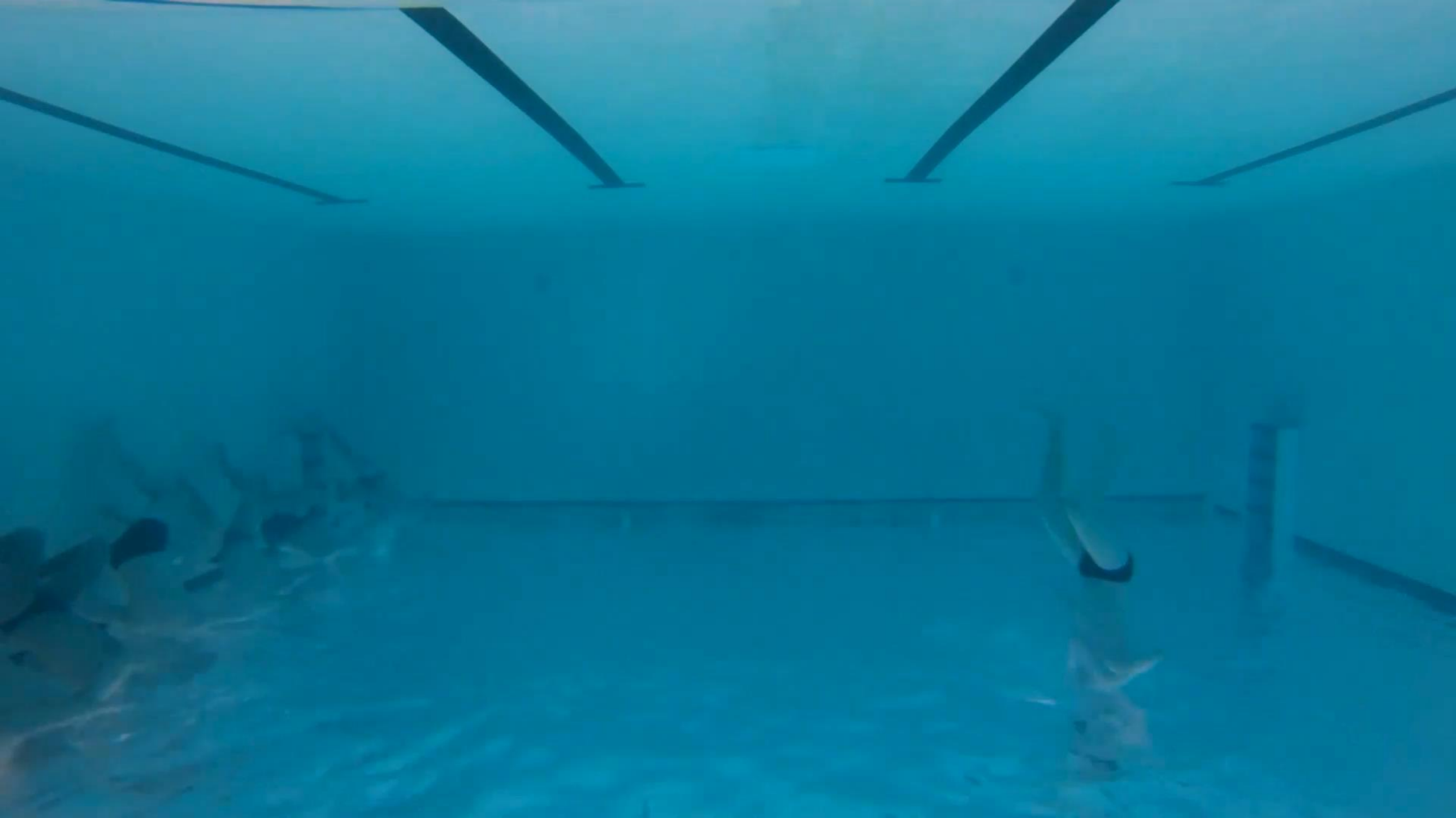
THE PROCESS IN MATH ED

- Change
  - Stop accelerating students as a rule.
- Transition
  - Ending
  - Neutral Zone
  - New Beginning

BE STRATEGIC WHEN YOU BEGIN

- Some groups wield more influence:
  - Teachers
  - Standards writers
  - Universities
- Talk to them!

Who do you begin with?



GOALS

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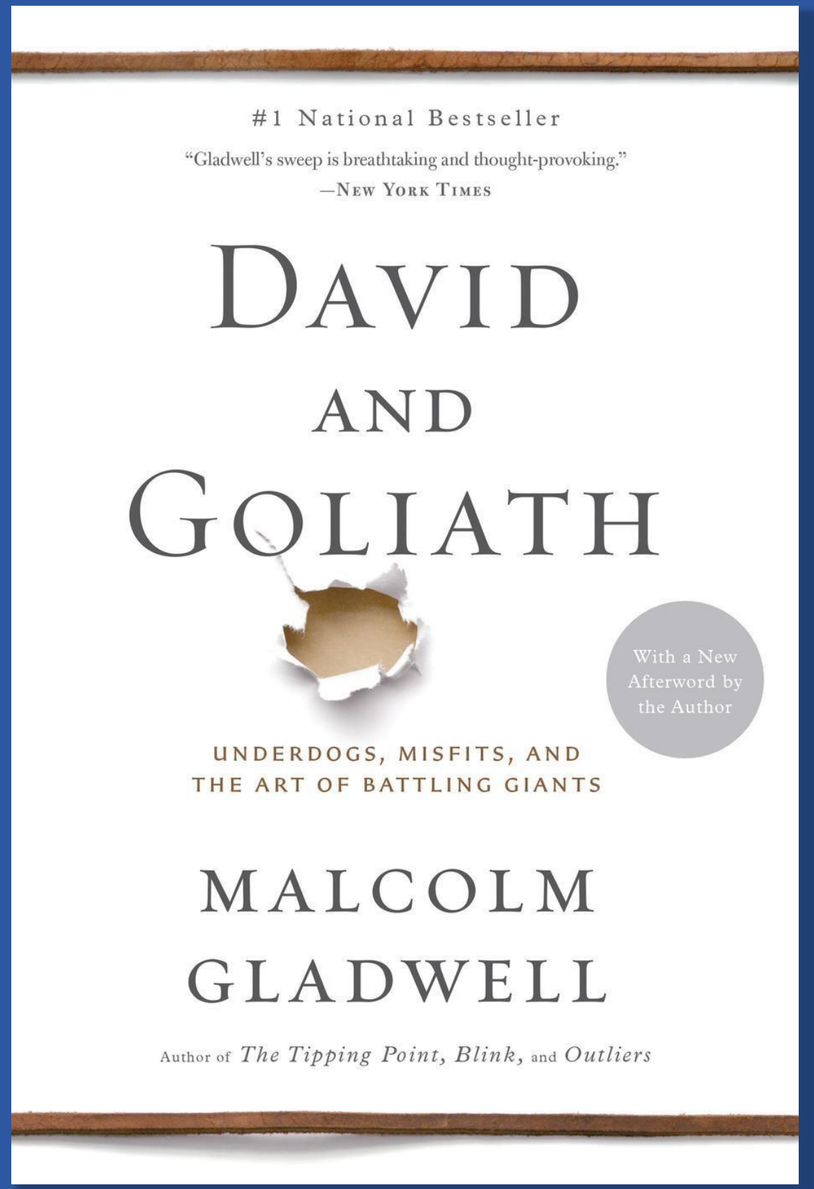
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—New York Times
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AND
GOLIATH
With a New Afterword by the Author
UNDERDOGS, MISFITS, AND
THE ART OF BATTLING GIANTS
MALCOLM
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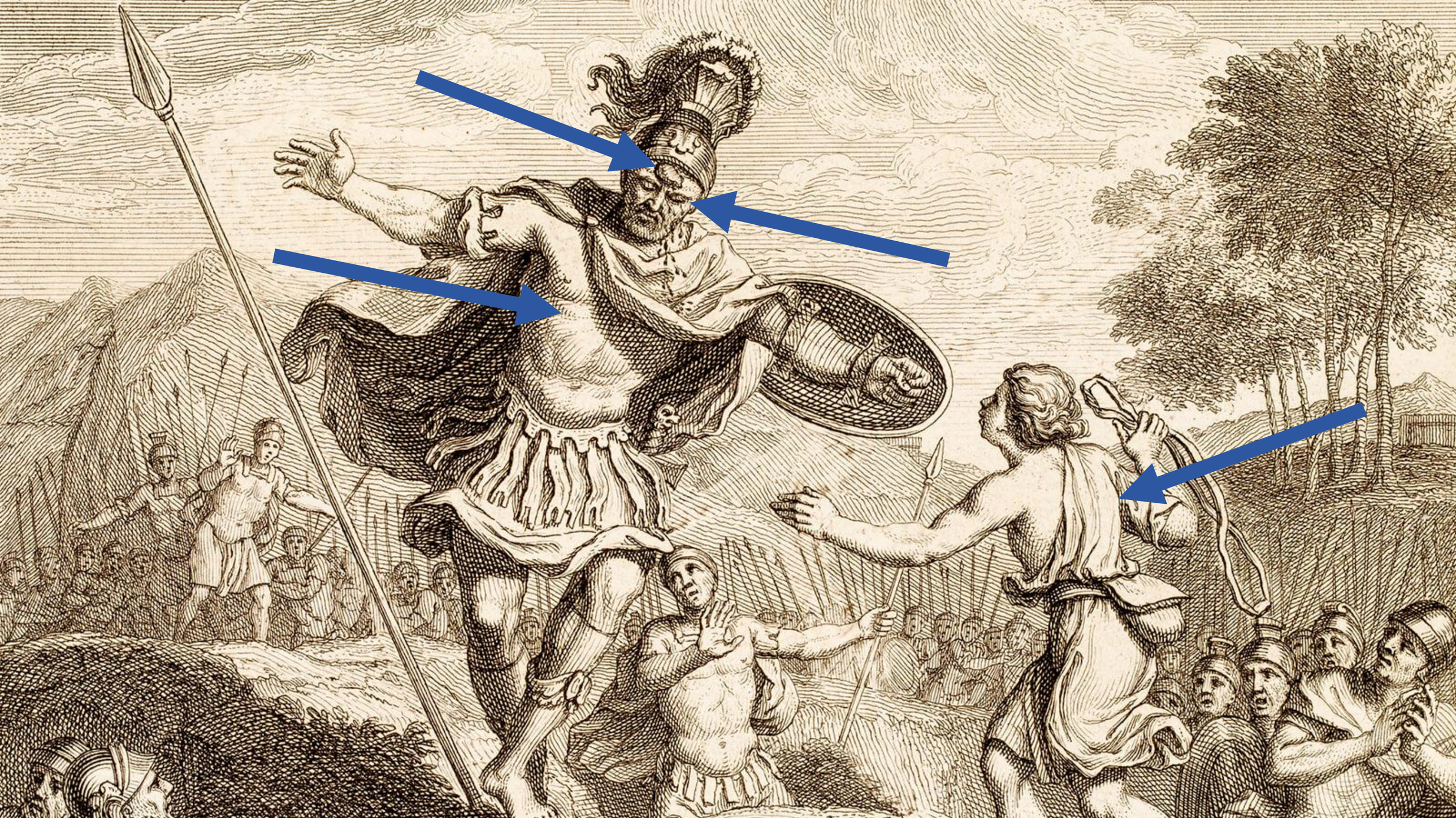
Author of The Tipping Point, Blink, and Outliers



Source: Practical Paracord on YouTube

Sometimes perceived weaknesses are actually strengths

WE CAN DO WHAT THEY CAN'T

- We can help students and parents see the unintended consequences.
- We can influence district acceleration policies.
- We can influence state standard revisions.
- We can demand the curriculum writers aim higher.
- We can advocate to our local colleges and universities.

Change must begin with us.

FOUR STEPS TO FIX MATH EDUCATION

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