HOW TO HELP STUDENTS BECOME PROBLEM SOLVERS, NOT MATH ROBOTS

ROBERT KAPLINSKY

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robertkaplinsky.com

@robertkaplinsky

WANT THE RESOURCES?

Text the message (one word):

NOROBOTS

To 44222

GOALS

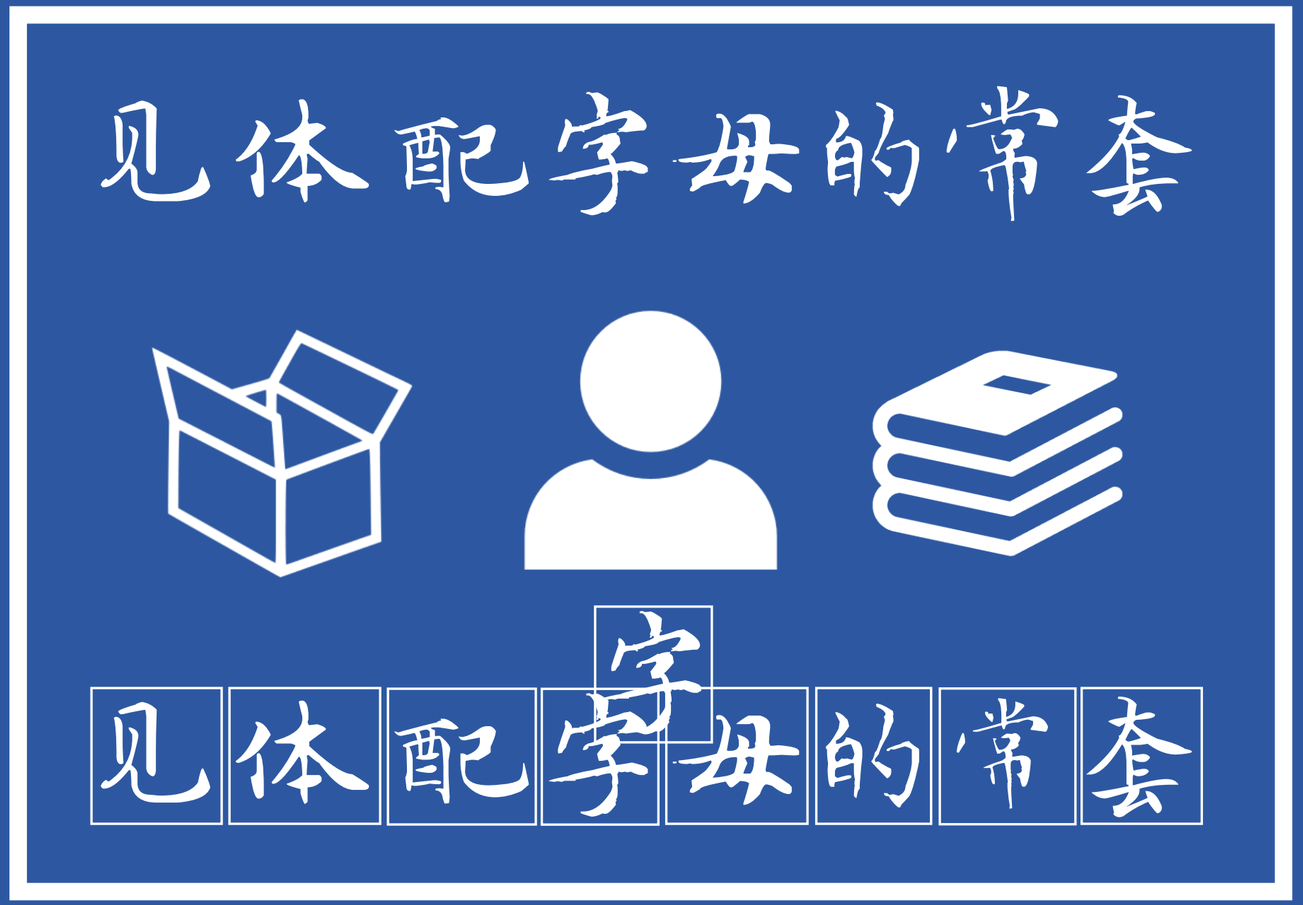
- ❑ HOW DO WE CHOOSE OUR PROBLEMS?
- ❑ HOW DO WE USE THEM WITH STUDENTS?
- ❑ WHERE CAN WE GET MORE PROBLEMS?

PROBLEM ONE

Solve for x.

$$4x + 3 = 2x + 7$$

CHINESE ROOM



PROBLEM TWO

Using the digits 1 to 9 at most one time each, place a digit in each box to create two equations: one where *x* has a positive value and one where *x* has a negative value. You may reuse all the digits for each equation.

$$\square x + \square = \square x + \square$$

DISCUSSION TIME

- For the next two minutes:
  - In the chat, please share correct and incorrect strategies students might use to solve this problem as well as where they might get stuck.
  - Use the format “CORRECT: _____”, “INCORRECT: _____”, or “STUCK: _____”.
  - Read what other educators are writing to find ideas that you like but hadn’t considered.

Guess and Checker

$$\boxed{1}x+\boxed{2}=\boxed{3}x+\boxed{4}$$

$$-4 \qquad\qquad -4$$

$$x-2=3x$$

$$-x \qquad\quad -x$$

$$-2=2x$$

$$-1=x$$

$$\boxed{8}x+\boxed{6}=\boxed{3}x+\boxed{2}$$

$$-6 \qquad\qquad -6$$

$$8x = 3x - 4$$

$$-3x \quad -3x$$

$$5x = -4$$

$$x = \frac{-4}{5}$$

Swapping Coefficients

$$\boxed{1}x+\boxed{2}=\boxed{3}x+\boxed{4}$$

$$-4 \qquad\qquad -4$$

$$3x-2=x$$

$$-3x \qquad -3x$$

$$-2=-2x$$

$$1=x$$

Swapping Constants

$$\boxed{1}x+\boxed{2}=\boxed{3}x+\boxed{4}$$

$$-4 \qquad\qquad -4$$

$$x = 3x - 2$$

$$-3x \quad -3x$$

$$-2x = -2$$

$$1 = x$$

Robert Kaplinsky
February 10 at 7:53 AM ·

Math 8 and Algebra 1 teachers, I could really use your help. Would you please try out these two problems with your students by 2/22/19 and let me know how many got each problem right? Problems are in the images. Form and answers here: https://goo.gl/forms/xr3fQIBUsPE7vvUQ2

PROBLEM ONE

Solve for x.

$$4x + 3 = 2x + 7$$

PROBLEM TWO

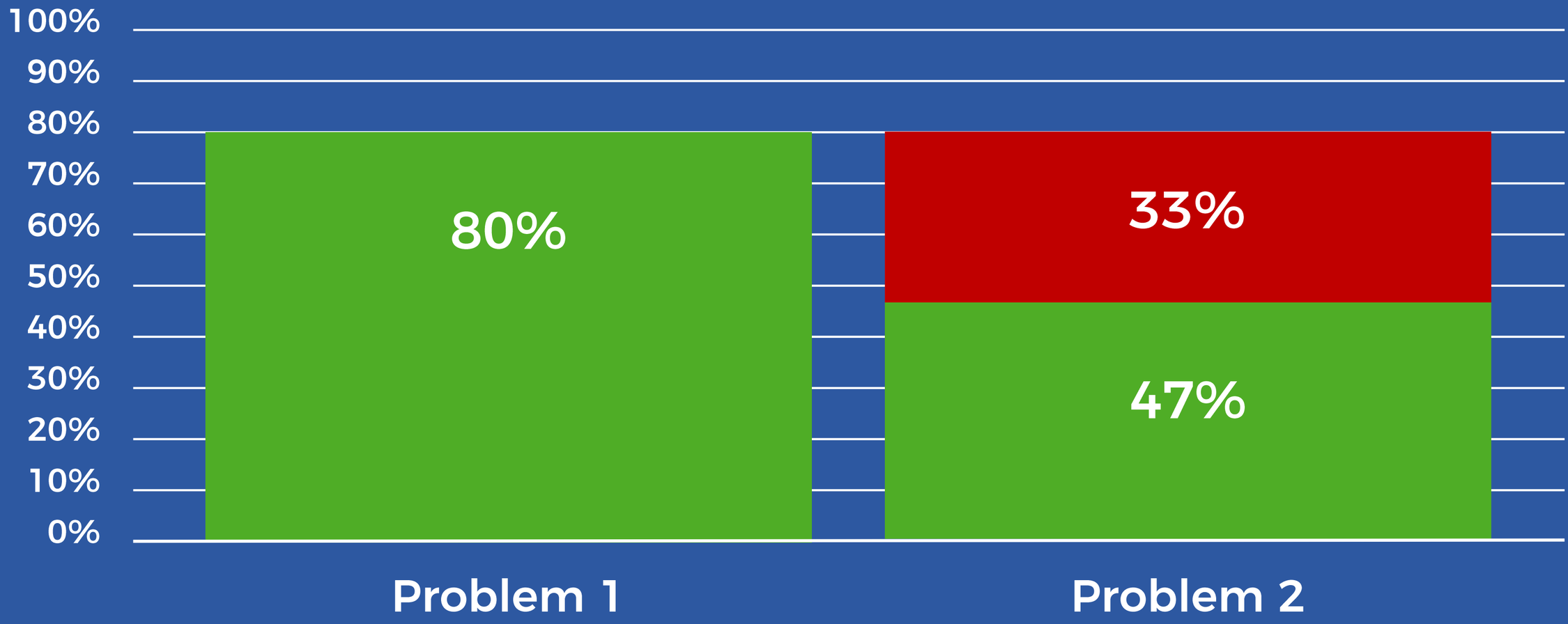
Using the digits 1 to 9, at most one time each, place a digit in each box to create two equations: one where x has a positive value and one where x has a negative value.

$$\square x + \square = \square x + \square$$

73

40 Comments 69 Shares

PROBLEM RESULTS



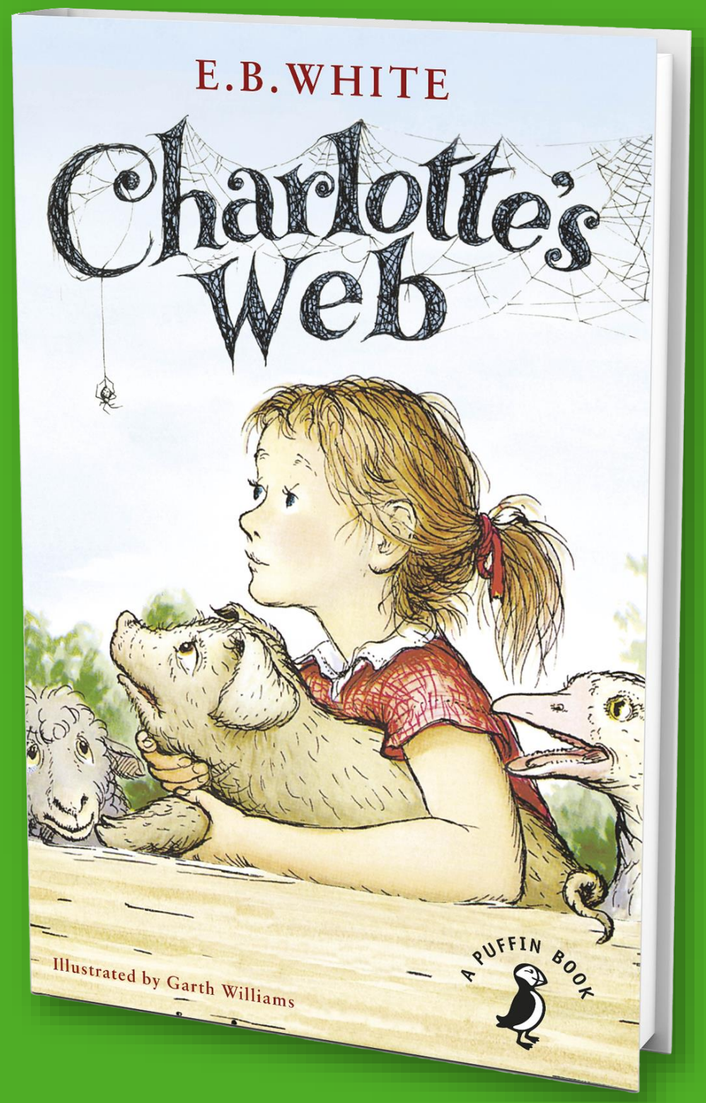
When you ask superficial questions, you get superficial info about what students know.

DISCUSSION TIME

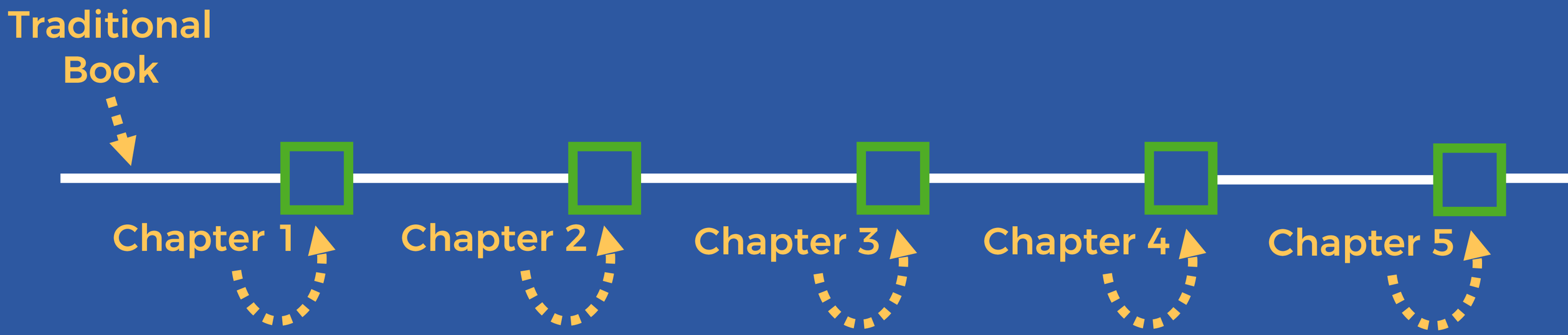
- How do the problems we pick affect our ability to determine which of our students are in the Chinese Room?

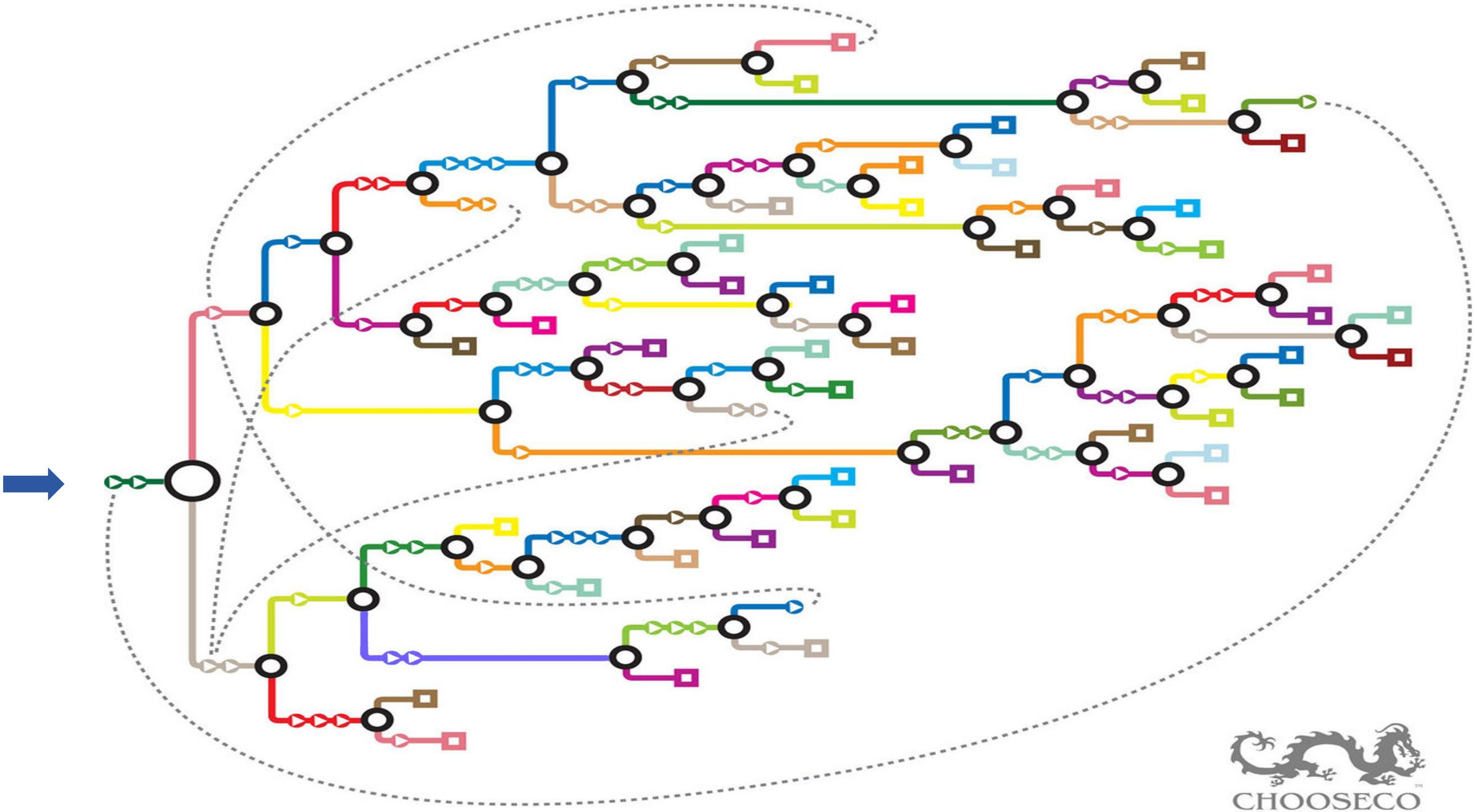
GOALS

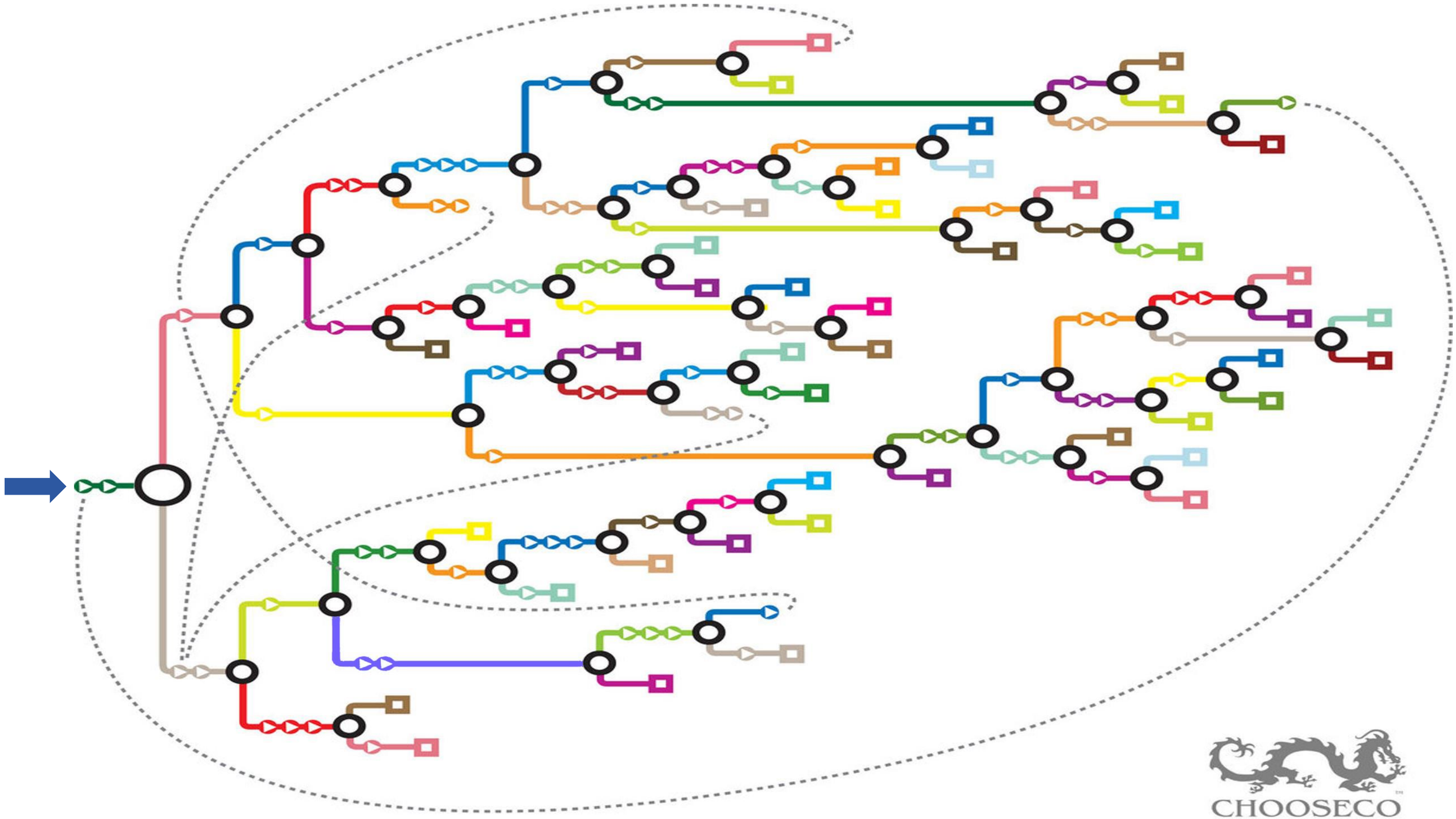
- [x] HOW DO WE CHOOSE OUR PROBLEMS?
- [ ] HOW DO WE USE THEM WITH STUDENTS?
- [ ] WHERE CAN WE GET MORE PROBLEMS?

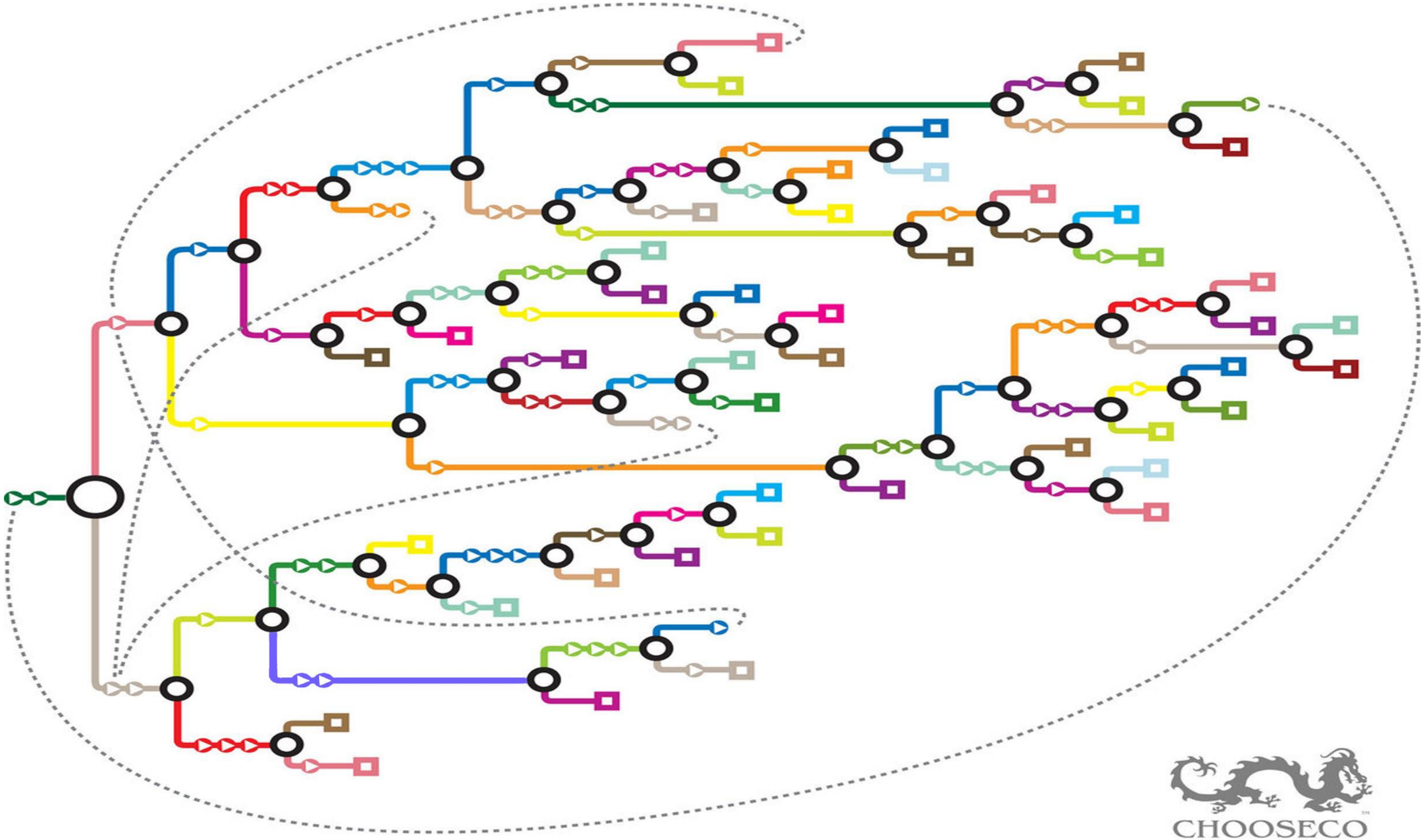

E.B. WHITE
Charlotte's Web
Illustrated by Garth Williams
A PUFFIN BOOK

TRADITIONAL BOOK PATH









NAME: _____ DATE: _____ PERIOD: _____

Lesson 5-6 Solving Linear Equations Practice

Objective: Solve linear equations in one variable

Solve for x.

1. $4x + 3 = 2x + 7$

2. $-2x + 6 = 4x - 3$

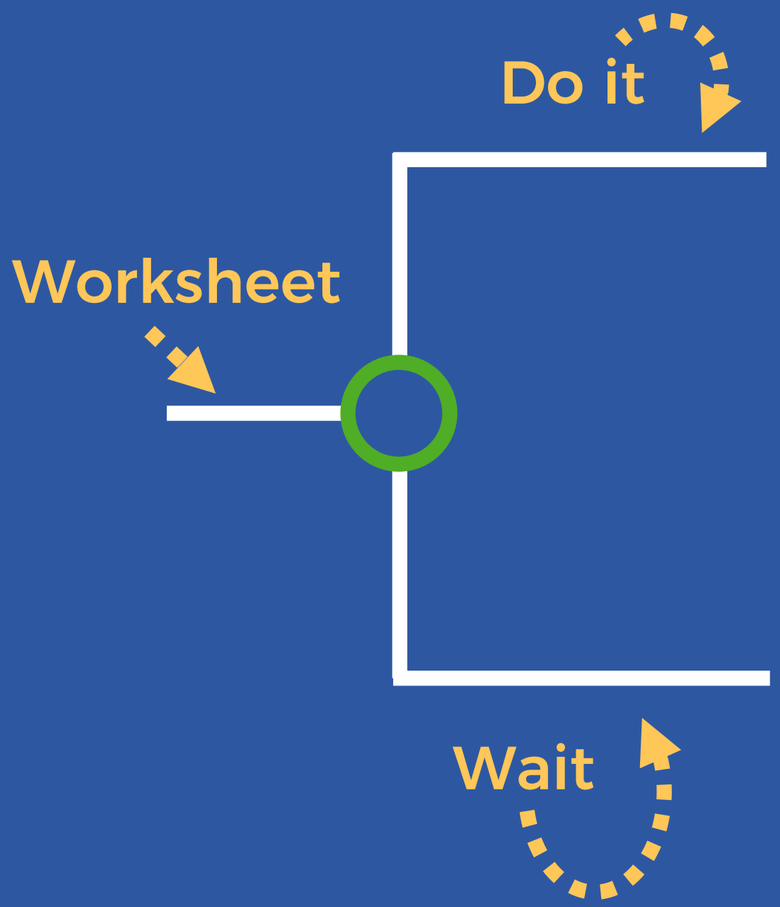
3. $4x + (-9) = x + 12$

7. $-7x - (-10) = 6x - (-10)$

8. $6x - (-5) = 10x + (-11)$

9. $-2x + (-2) = 4x + (-5)$

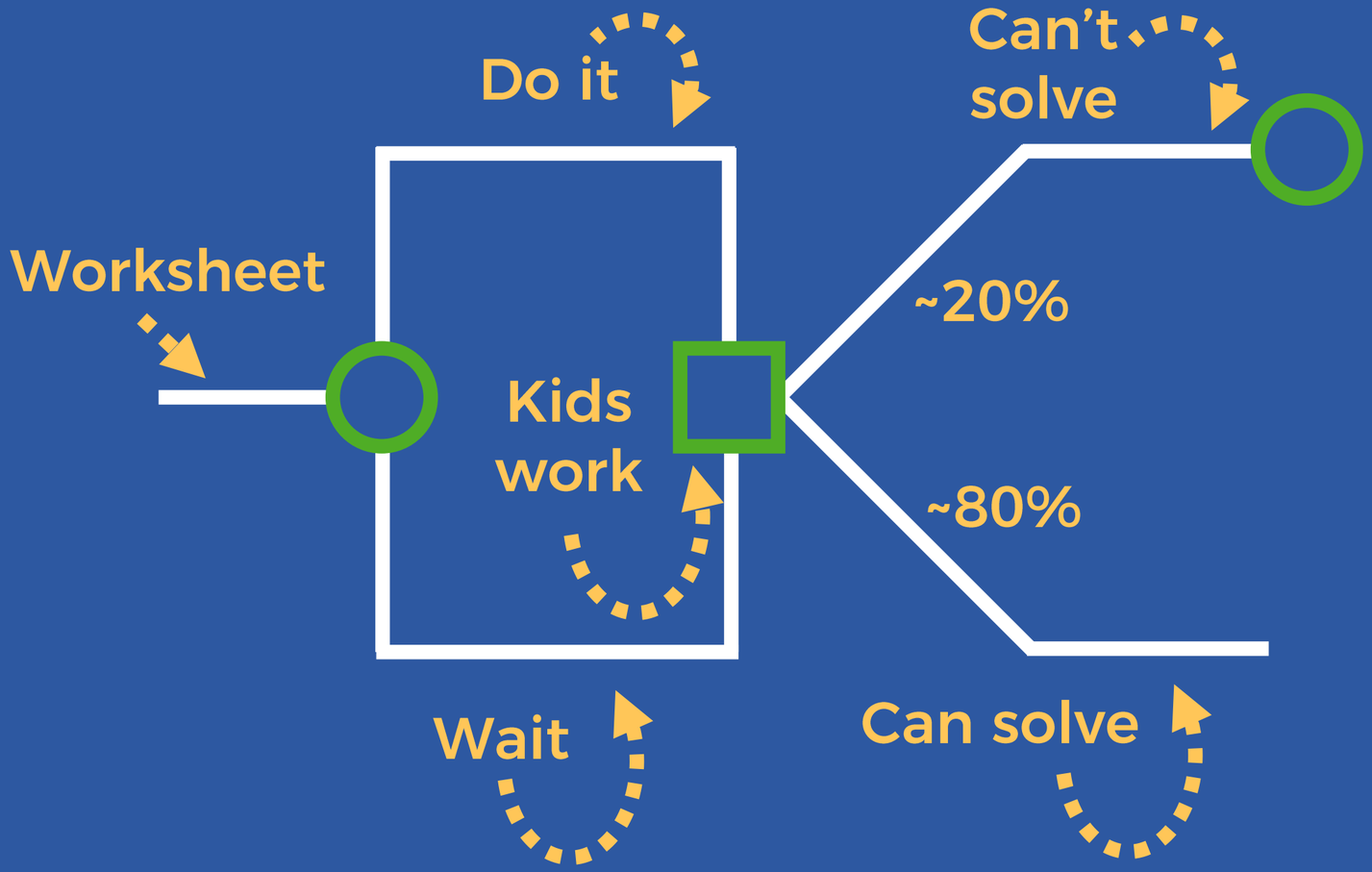
TRADITIONAL WORKSHEET PATH



DISCUSSION TIME

- How will your choice about doing the worksheet ahead of time impact the rest of the lesson?

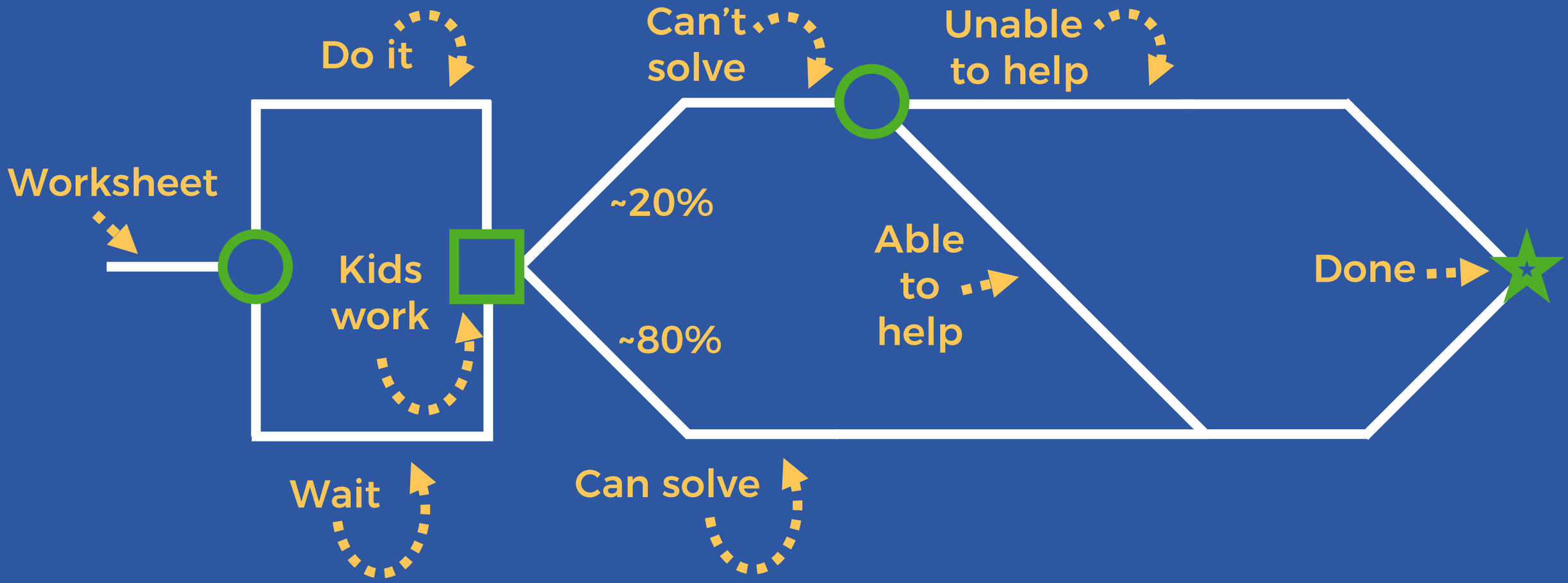
TRADITIONAL WORKSHEET PATH



DISCUSSION TIME

- How will your choice about doing the worksheet ahead of time affect your ability to help the ~7 struggling students?

TRADITIONAL WORKSHEET PATH

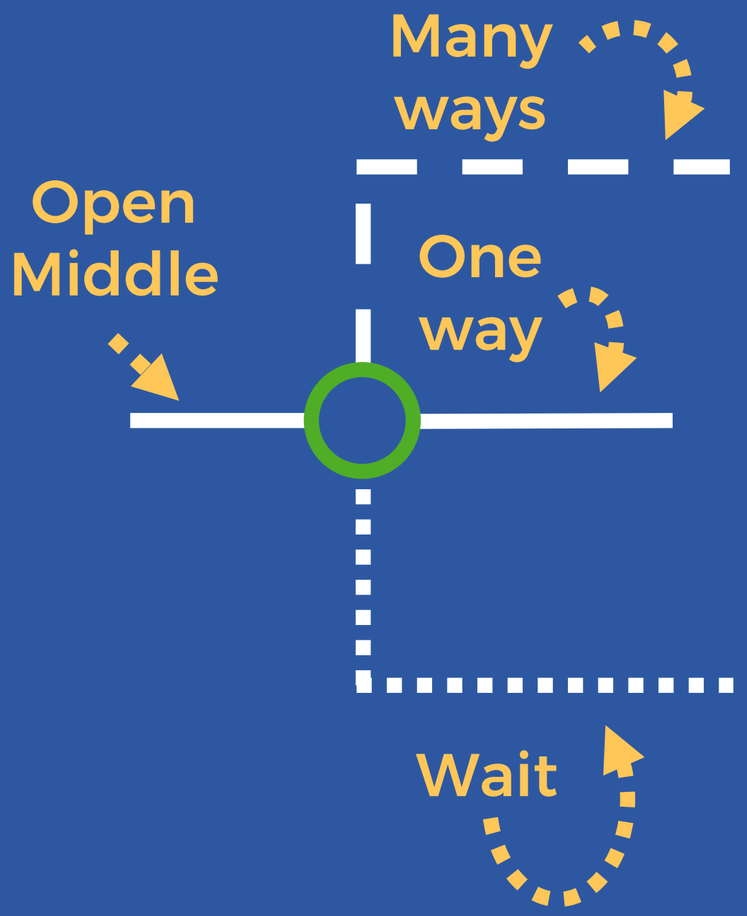


PROBLEM TWO

Using the digits 1 to 9, at most one time each, place a digit in each box to create two equations: one where *x* has a positive value and one where *x* has a negative value.

$$\square x + \square = \square x + \square$$

OPEN MIDDLE PROBLEM PATH



Robert Kaplinsky
@robertkaplinsky

Hey @OpenMiddle fans. I have a quick poll as I'm curious about how you prepare to use a problem. Traditionally, you can pull a problem from a textbook without solving it and you're ready to go. What do you do for OM problems? FYI, this poll is anonymous. #iteachmath #MTBoS

a) Have not solved it.

b) Have 1 correct way.

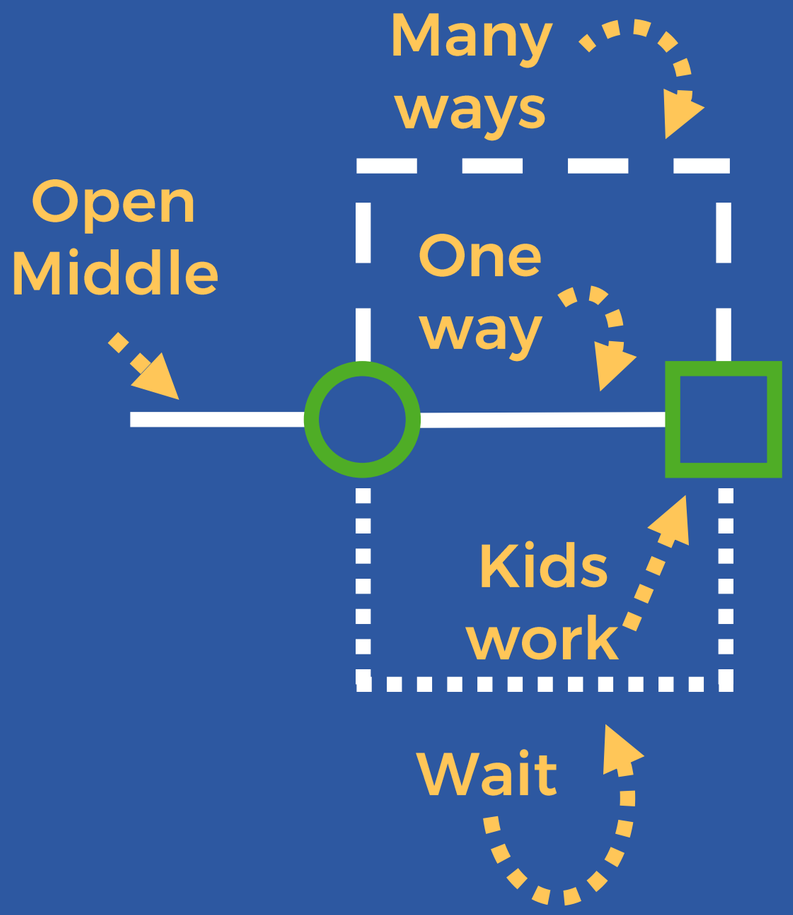
c) Many (in)correct ways.

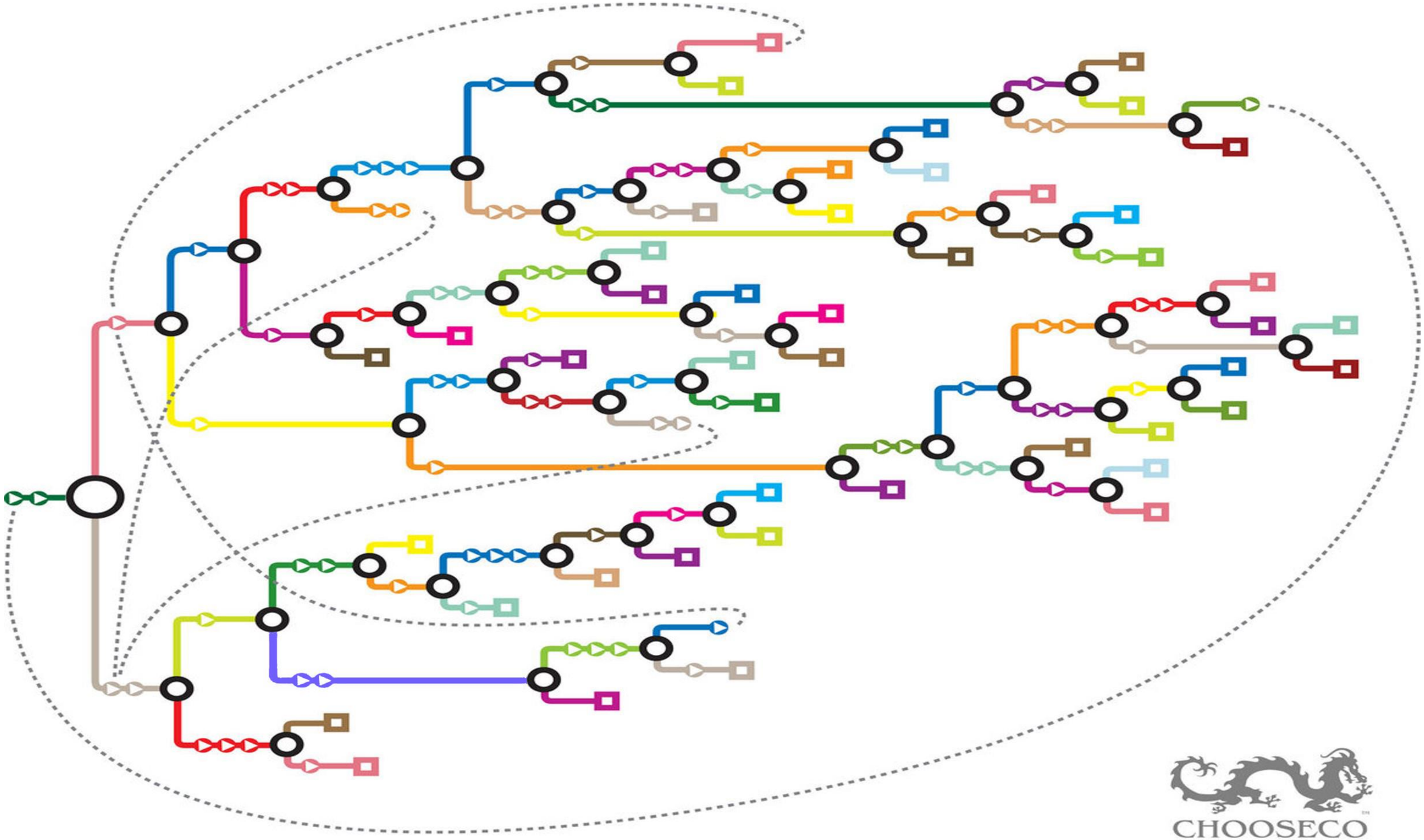
70 votes • Final results

DISCUSSION TIME

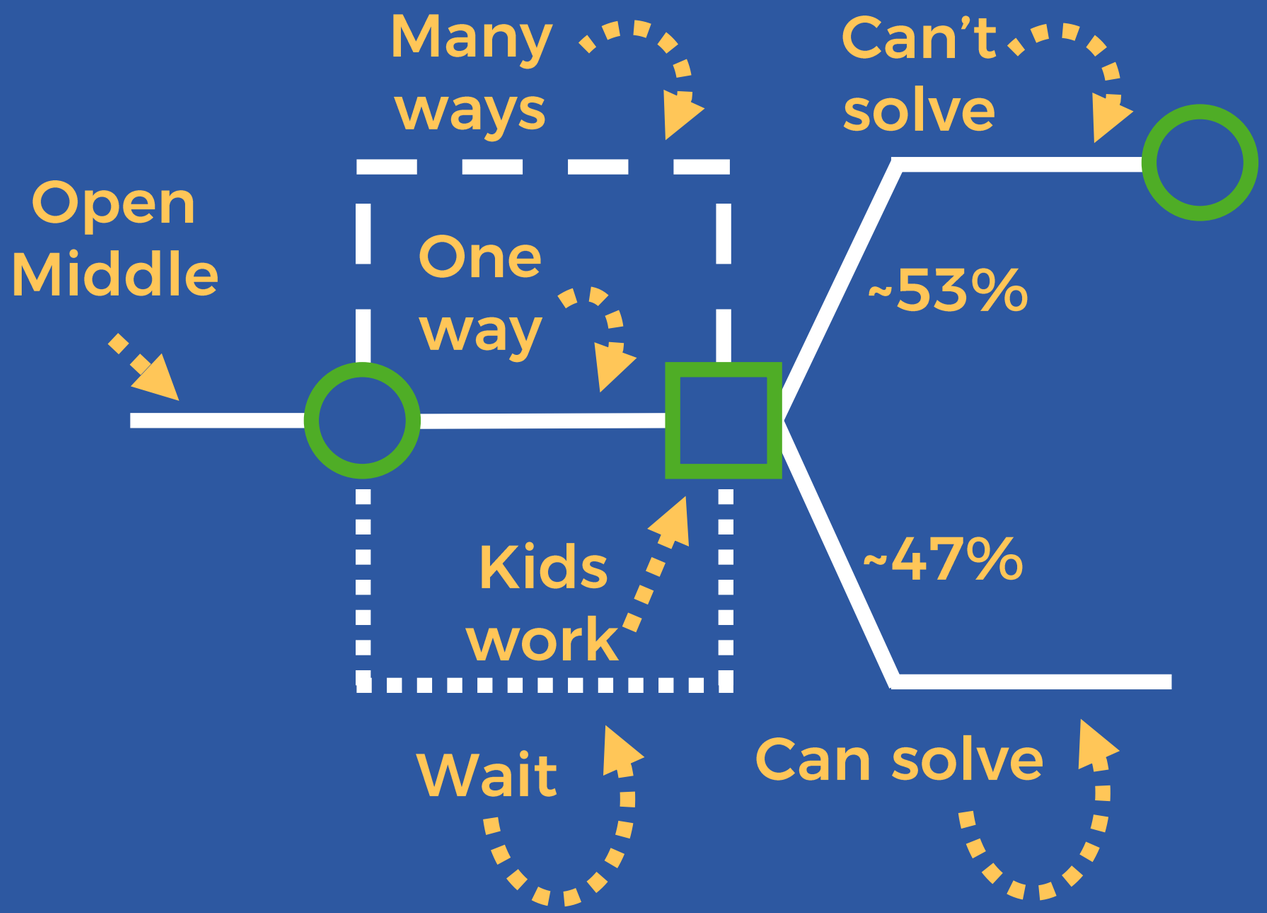
- How will your choice about doing the Open Middle problem ahead of time impact the rest of the lesson?

OPEN MIDDLE PROBLEM PATH





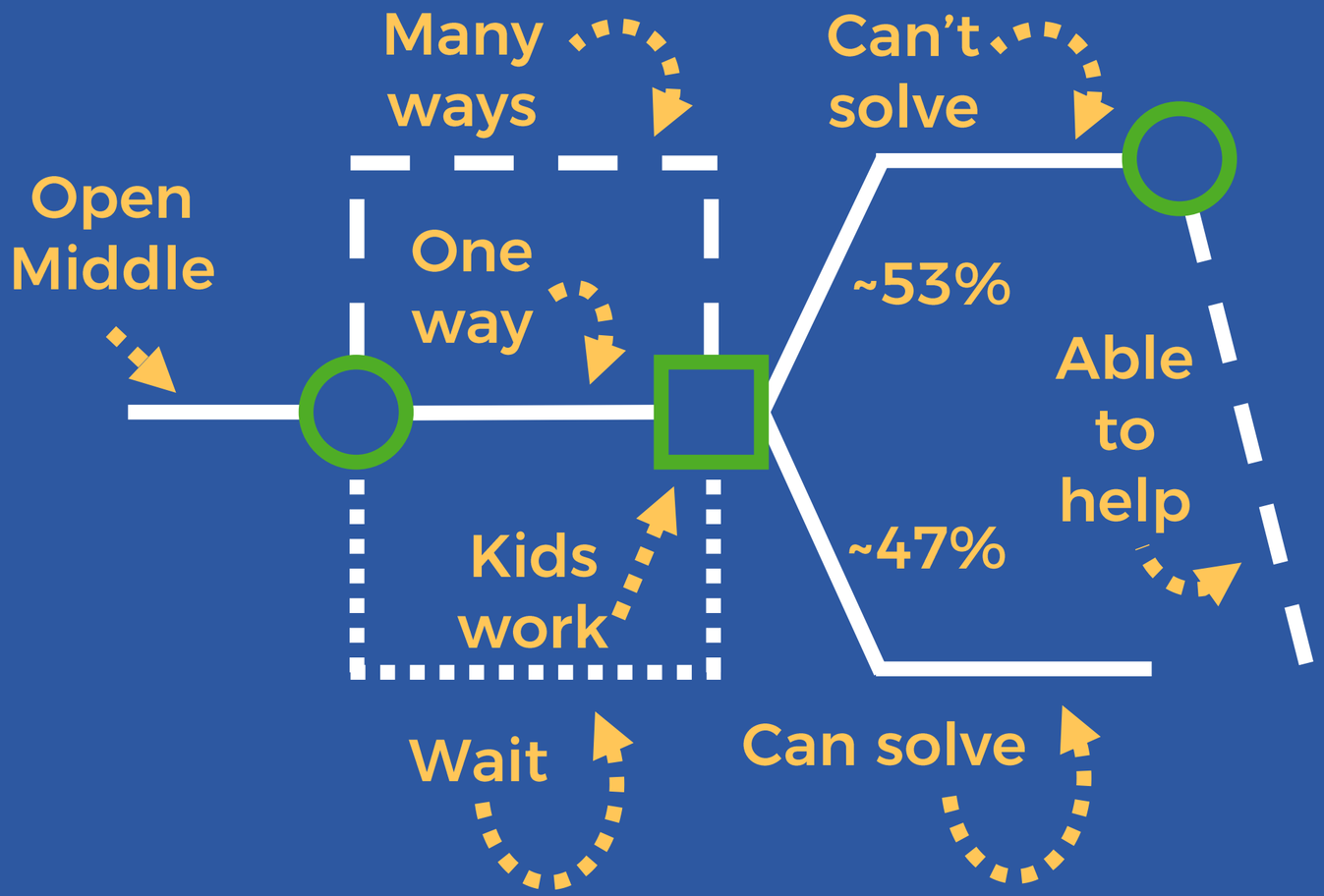
OPEN MIDDLE PROBLEM PATH



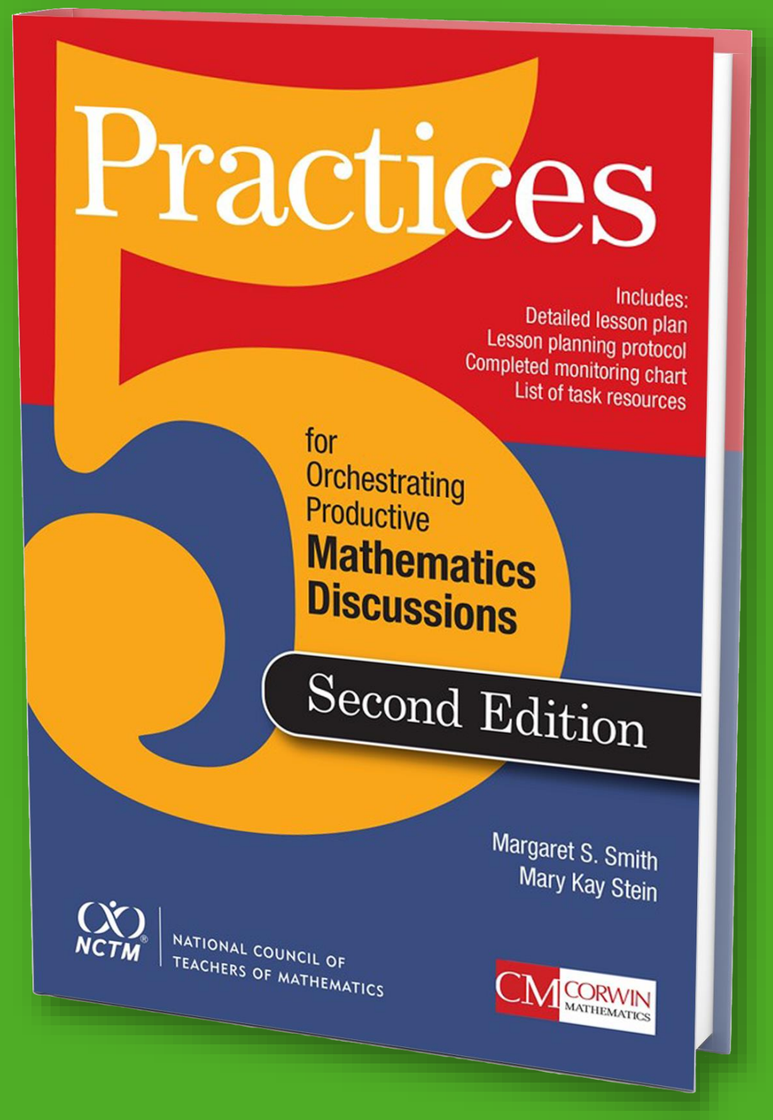
DISCUSSION TIME

- How will your choice about doing the Open Middle problem ahead of time affect your ability to help the ~18 struggling students?

OPEN MIDDLE PROBLEM PATH



Strategy	Student Name(s) and Notes	Order


Practices
Includes:
Detailed lesson plan
Lesson planning protocol
Completed monitoring chart
List of task resources
5
for
Orchestrating
Productive
Mathematics
Discussions
Second Edition
Margaret S. Smith
Mary Kay Stein
NCTM
NATIONAL COUNCIL OF
TEACHERS OF MATHEMATICS
CM
CORWIN
MATHEMATICS

Strategy	Student Name(s) and Notes	Order

Closest to 1000 - Google Slides | Presentation Session

app.peardeck.com/presenter/tvfkmygyt/dash?returnTo=gslides

Sort by: Time | xtsnc | 11/12 Students

Directions: 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.

What did you learn from this attempt? How will your strategy change on your next attempt?

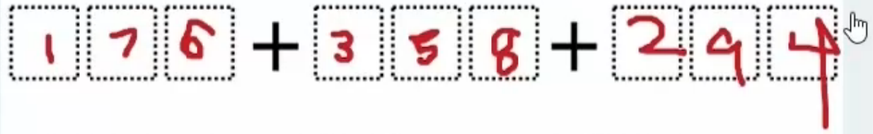
1044

Students, draw anywhere on this slide!

Pear Deck Interactive Slide
Do not remove this bar

Robert Thomas

Directions: 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.



What did you learn from this attempt? How will your strategy change on your next attempt?

i tried

10 of 12 Responses | Student-Paced | Show Responses | Stop Student-Paced | END

Student Strategy Tracker (Grades

docs.google.com/document/d/11It6LAhlKZLAZUFn70QsiXL1cr8mc1Ffs4FGWd...

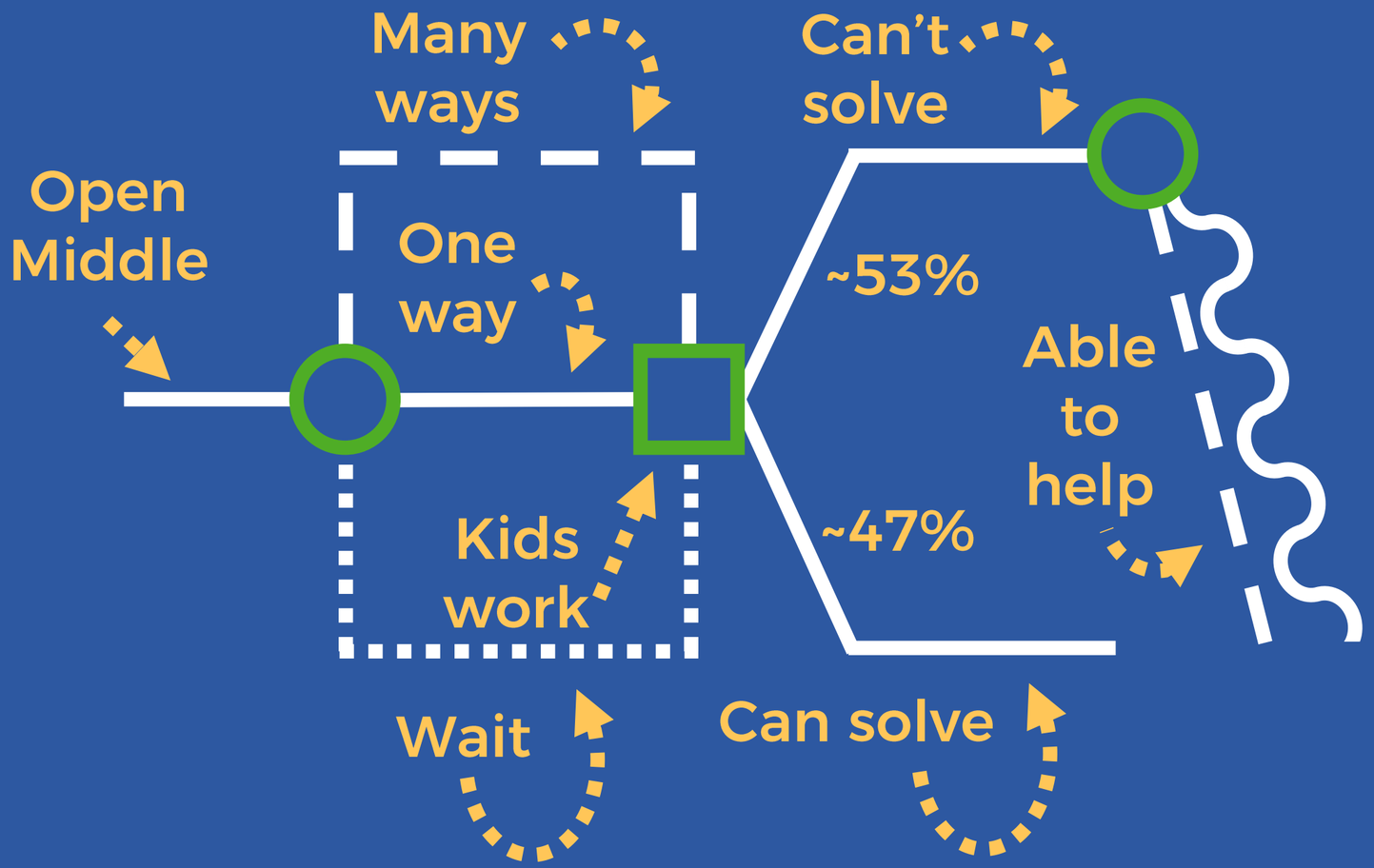
Student Strategy Tracker (Grades 6 to 12)

File Edit View Insert Format Tools Add-ons Help Last edit was yesterday at 11:...

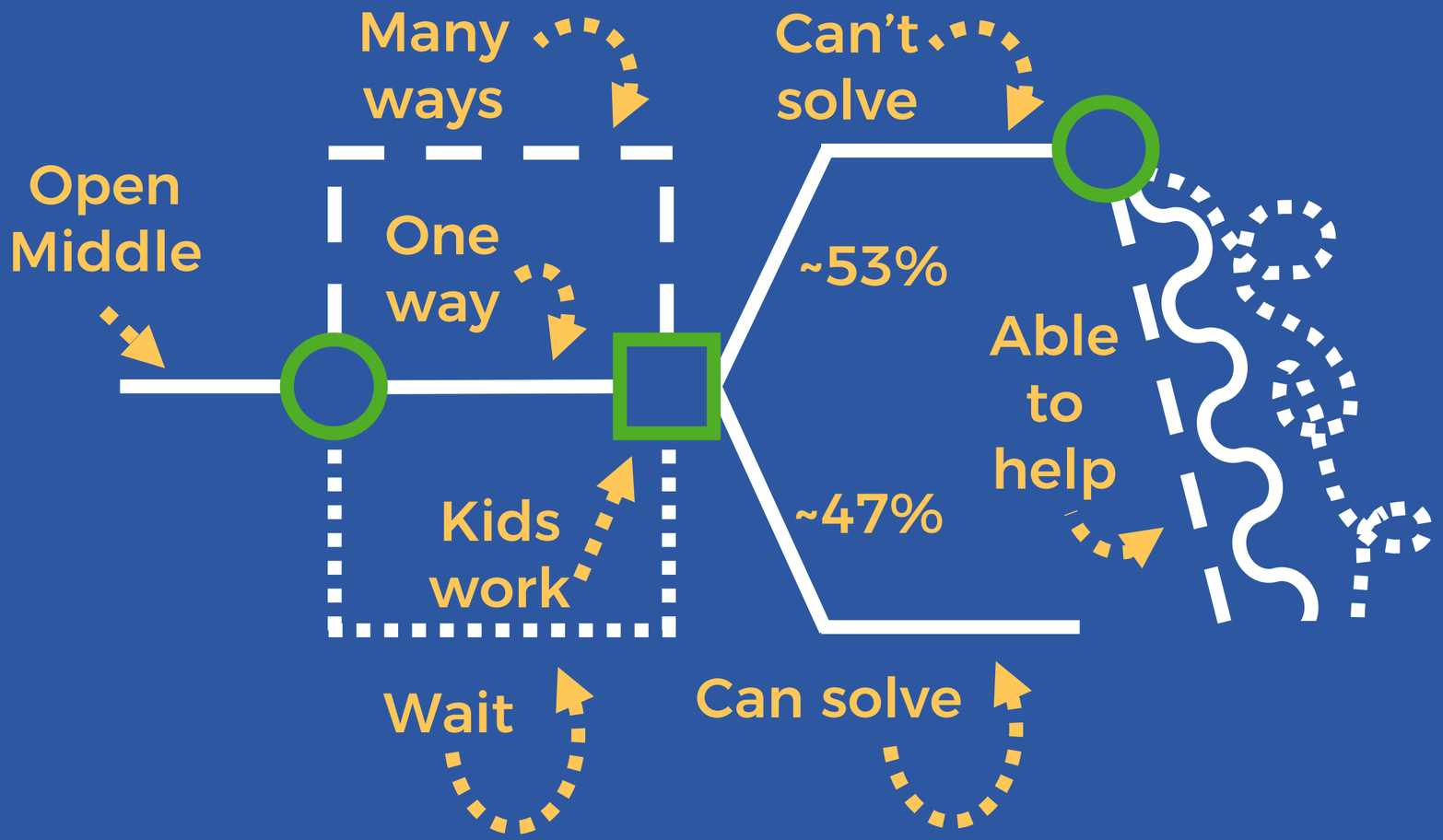
Share

Strategy	Student Name(s) and Notes	Order
Guess and check (Students are picking all digits randomly)		
Guess and check followed by strategic digit swapping		
Begin with estimated values that roughly sum to 1000 and then try to make the numbers accordingly.		
Begin with estimated values that roughly sum to 1000 and then try to make the numbers accordingly followed by strategic digit swapping		
Students don't understand which digits can be swapped to without changing values.		
Students don't understand which digits can be swapped to change values.		

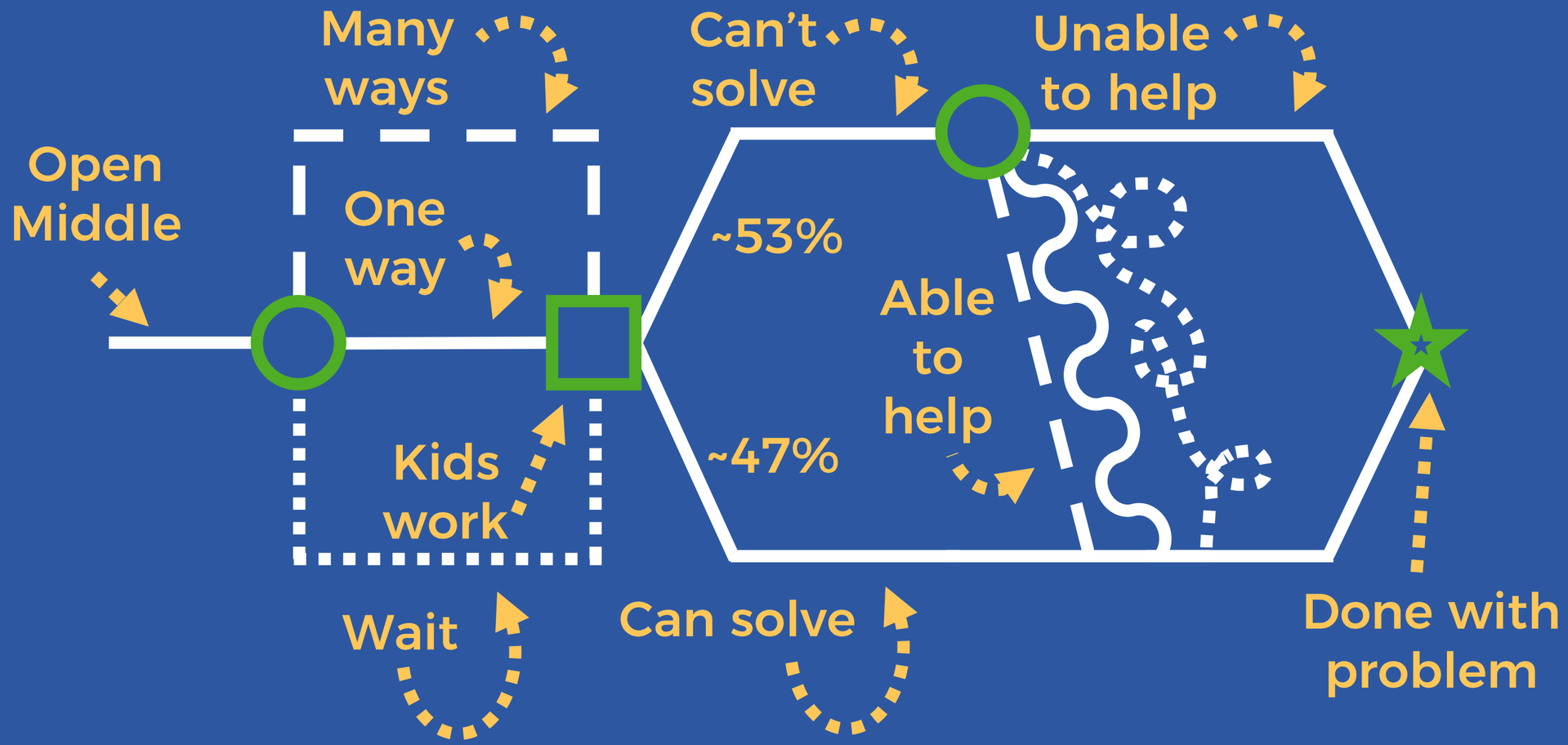
OPEN MIDDLE PROBLEM PATH



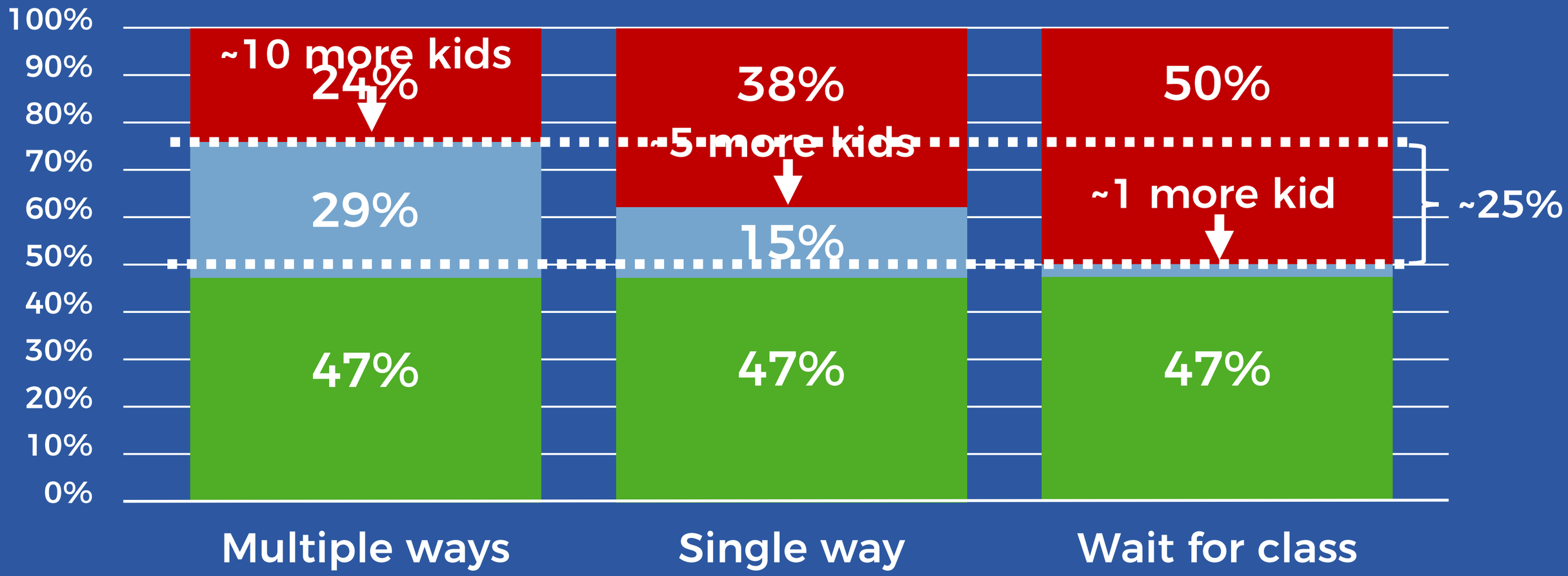
OPEN MIDDLE PROBLEM PATH



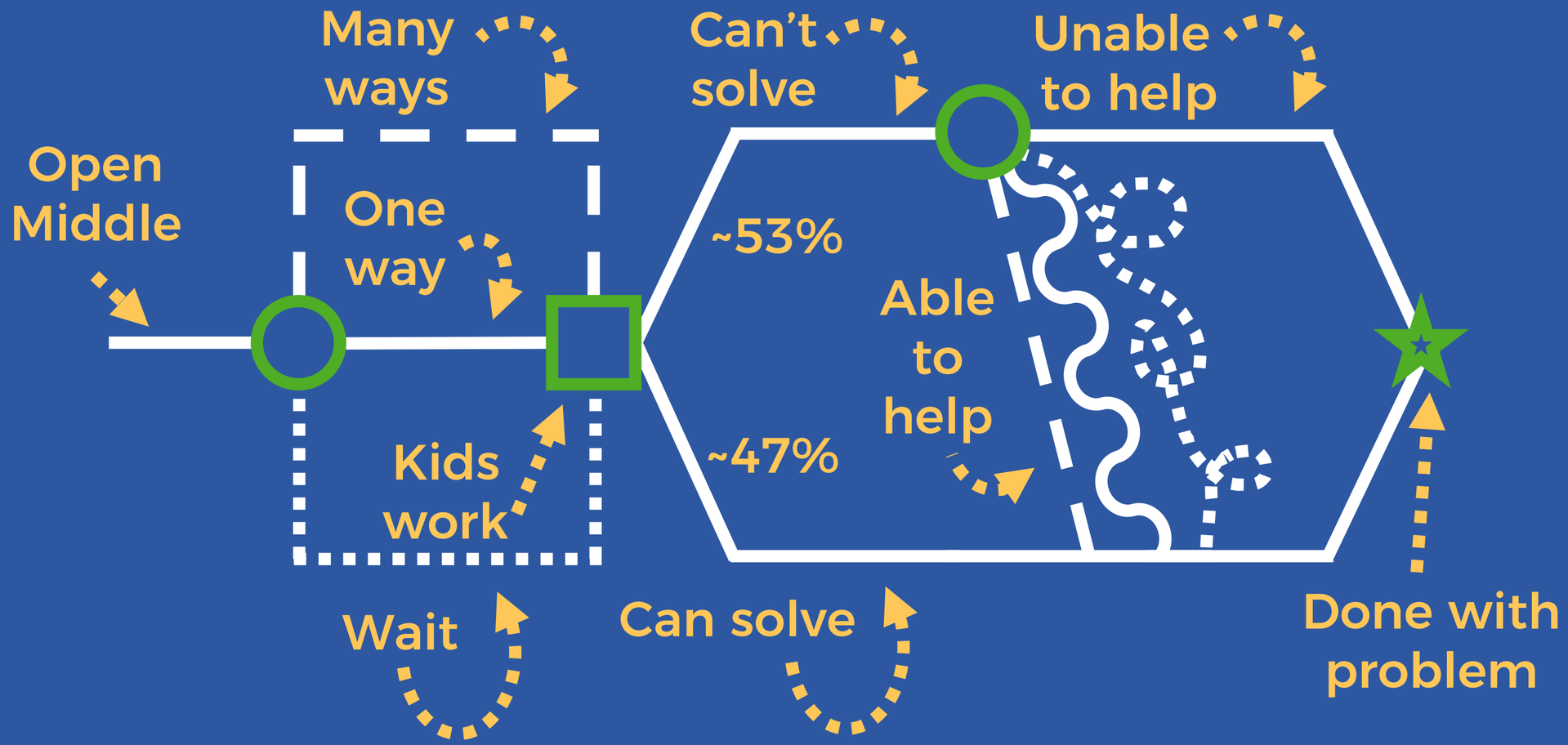
OPEN MIDDLE PROBLEM PATH



CHOICE CONSEQUENCES



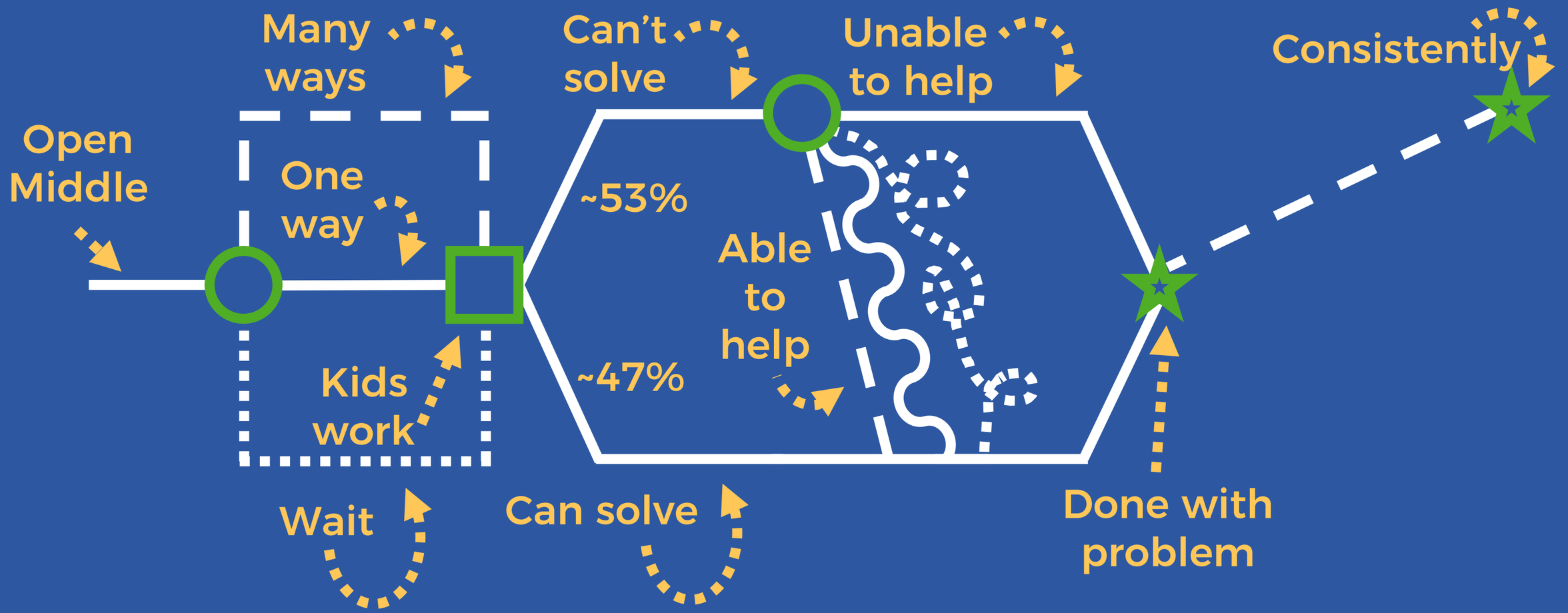
OPEN MIDDLE PROBLEM PATH



DISCUSSION TIME

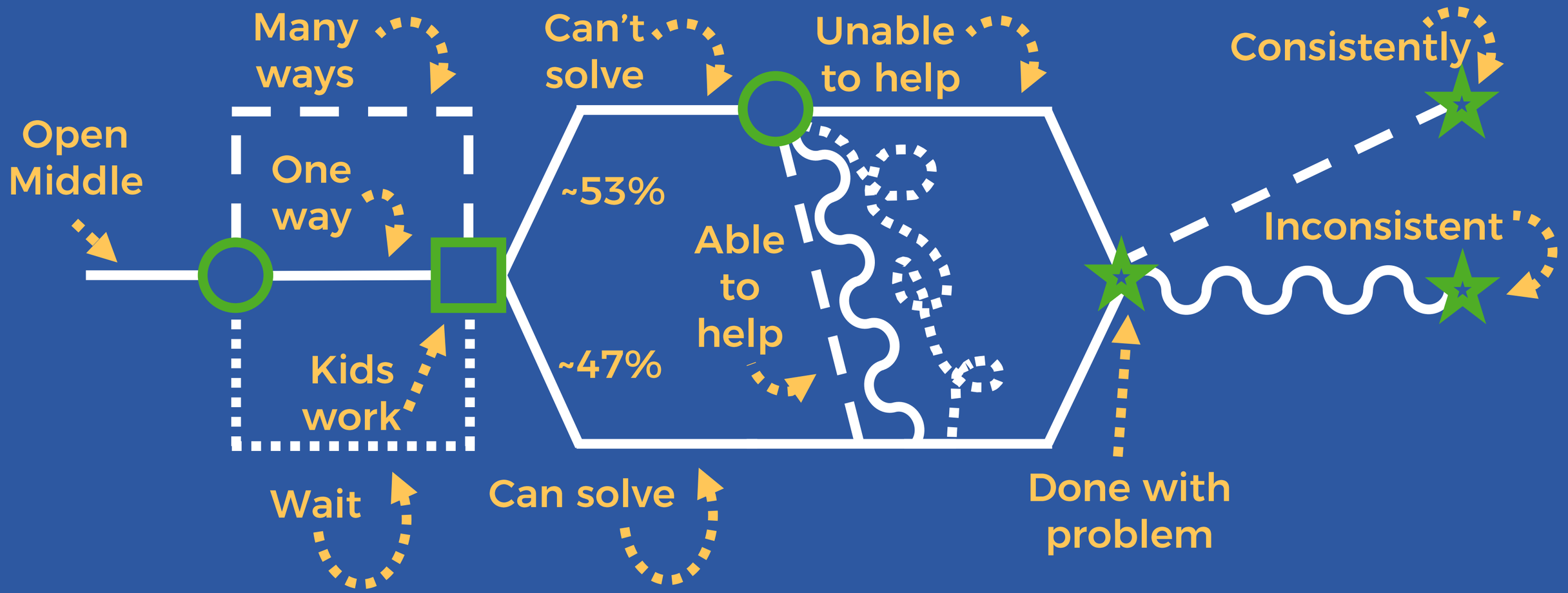
- How will your choice about doing the Open Middle problem ahead of time affect your ability to facilitate a conversation?

OPEN MIDDLE PROBLEM PATH

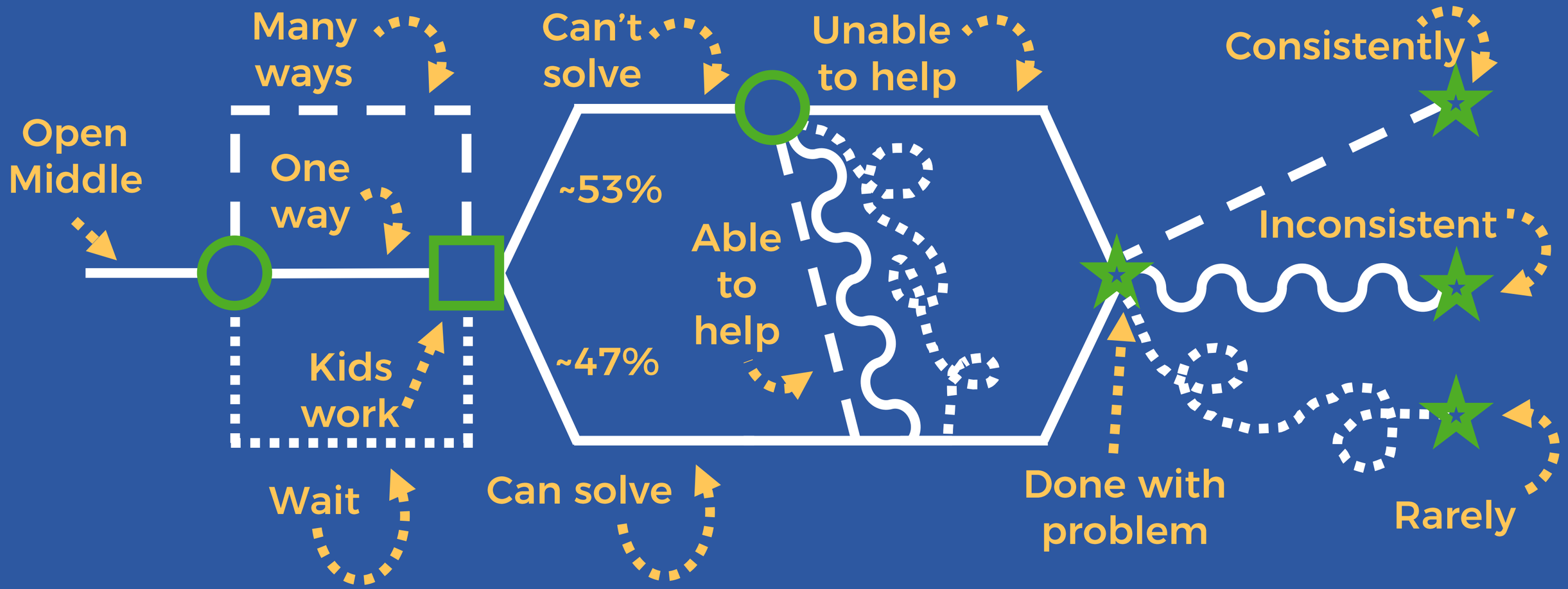


Strategy	Student Name(s) and Notes	Order
Guess and Check (students randomly place digits in each box until they have both a positive and negative solution, hopefully with many incorrect attempts)		1 2
Swapping Constants (students get their second equation by keeping the coefficients in the same place and swapping the location of the constants) Swap Both Sides (students swapped the entire left and right sides!)		3
Swapping Coefficients (students get their second equation by keeping the constants in the same place and swapping the location of the coefficients)		3

OPEN MIDDLE PROBLEM PATH



OPEN MIDDLE PROBLEM PATH



DISCUSSION TIME

- How does the way we prepare for our lessons impact our ability to facilitate rich student conversations?

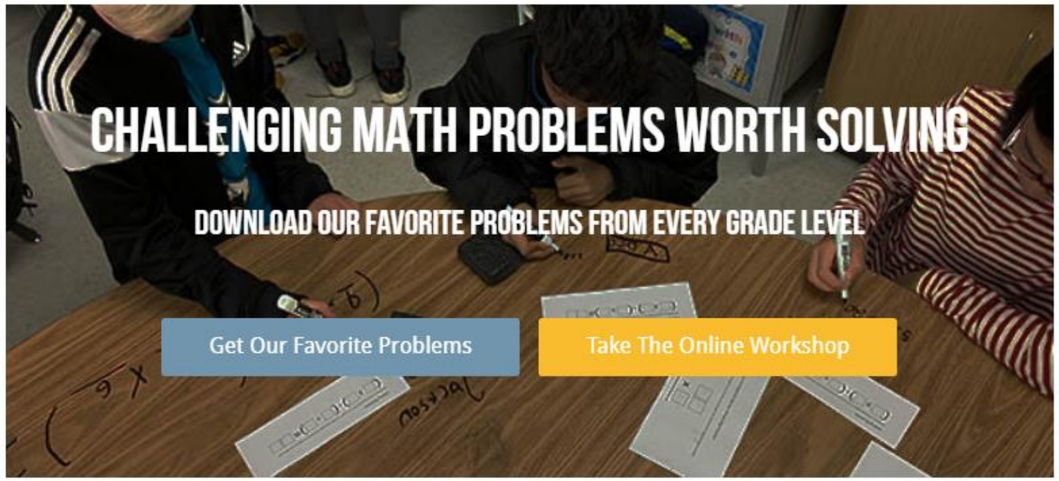
GOALS

- ☑ HOW DO WE CHOOSE OUR PROBLEMS?
- ☑ HOW DO WE USE THEM WITH STUDENTS?
- ☐ WHERE CAN WE GET MORE PROBLEMS?

OPEN MIDDLE

Take The Online Workshop

Home | Kinder | 1st Gr | 2nd Gr | 3rd Gr | 4th Gr | 5th Gr | 6th Gr | 7th Gr | 8th Gr | High School | About | Submit | English



WANT TO SHARE OPEN MIDDLE WITH OTHERS?

CHECK OUT THESE FREE WEBINARS TO HELP TEACHERS RETHINK CLASSWORK

Elementary Version | Secondary Version

Search

OPEN MIDDLE STICKERS

Get an Open Middle sticker

OPEN MIDDLE WORKSHEET

English (student version)
English (document camera version)
English (Google Doc version)
French (student version)
French (document camera version)
French (Google Doc version)
Spanish (student version)
Spanish (document camera version)
Spanish (Google Doc version)

NUMBER TILES

Printable PDF with the digits 0 to 9
Printable PDF with the integers -9 to 9

TWO-STEP EQUATIONS

Directions: Using the digits 1 to 9 at most one time each, place a digit in each box to find the greatest (or least) possible values for x.

Hint

How does each constant's value affect the solution's value?
How does the coefficient's value affect the solution's value?

Answer

Assuming x can be a negative value, 1x + 9 = 2 gives the least possible value of -7. The greatest possible value would be, 1x + 2 = 9

Source: Audrey Mendivil, Daniel Luevanos, and Robert Kaplinsky

Print

Search

OPEN MIDDLE STICKERS

Get an Open Middle sticker

OPEN MIDDLE WORKSHEET

English (student version)
English (document camera version)
English (Google Doc version)
French (student version)
French (document camera version)
French (Google Doc version)
Spanish (student version)
Spanish (document camera version)
Spanish (Google Doc version)

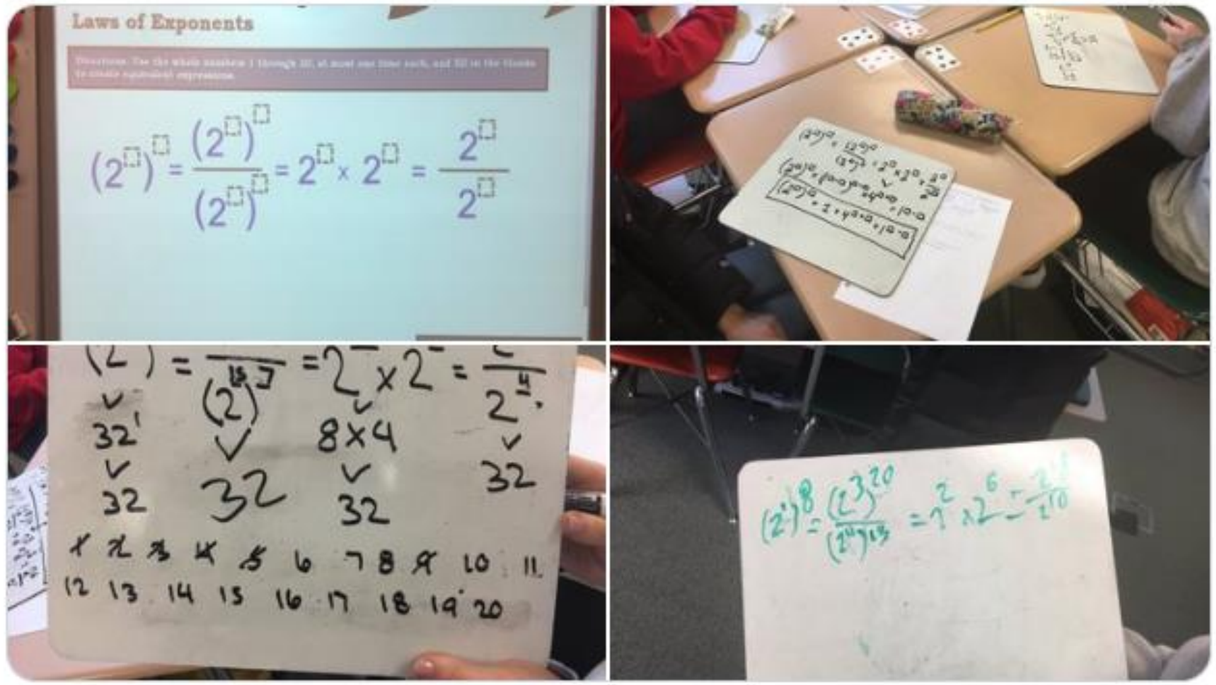
NUMBER TILES

Printable PDF with the digits 0 to 9
Printable PDF with the integers -9 to 9

BROWSE BY COMMON CORE STATE STANDARDS

Wendy Kozina
@wkozina

Kids begging for more time and yelling, “No” when I asked if they wanted a hint! Amazing activity @robertkaplinsky @openmiddle

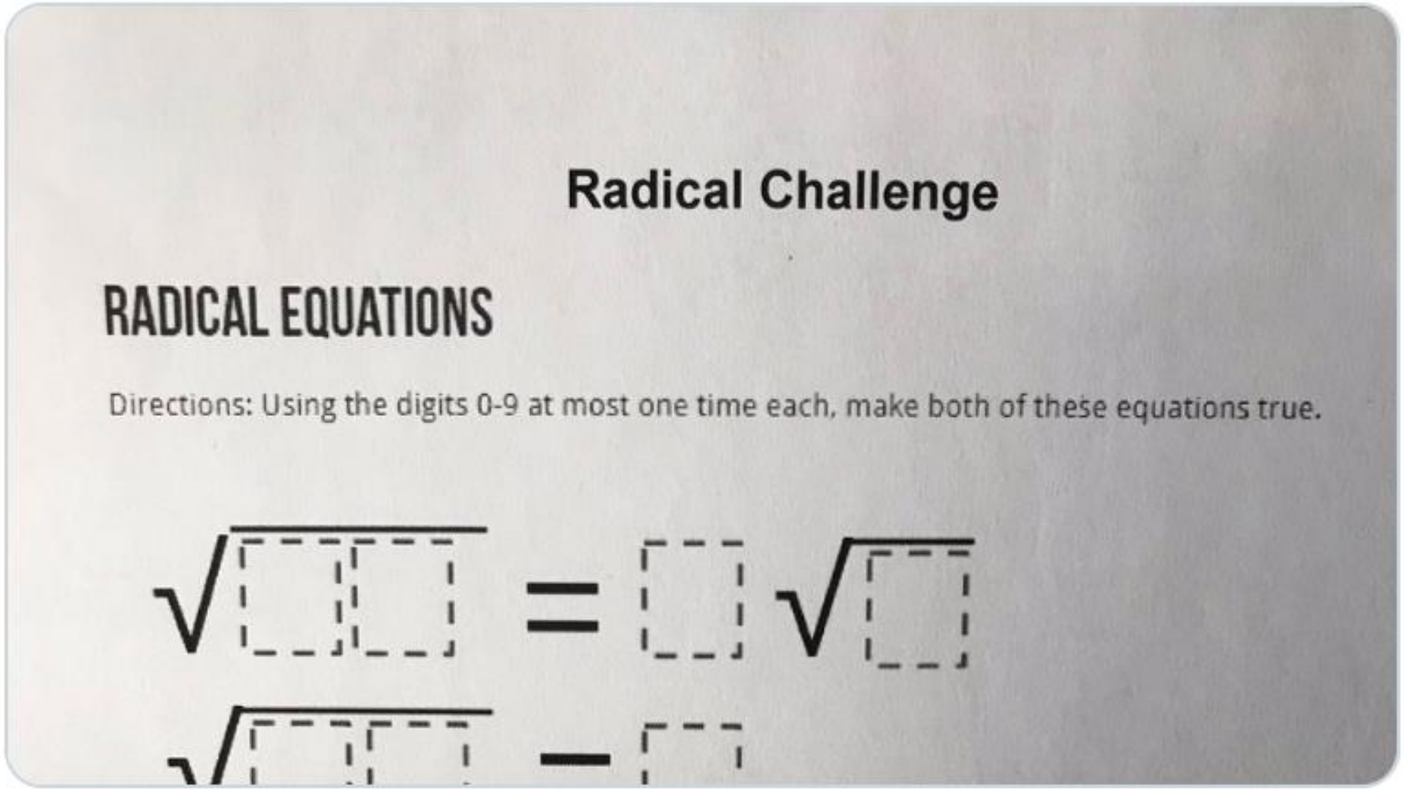


1:30 PM · Mar 8, 2019 · Twitter for iPhone

14 Retweets **98** Likes

Marguerite Spriggs @mspriggs30 · Nov 16, 2018

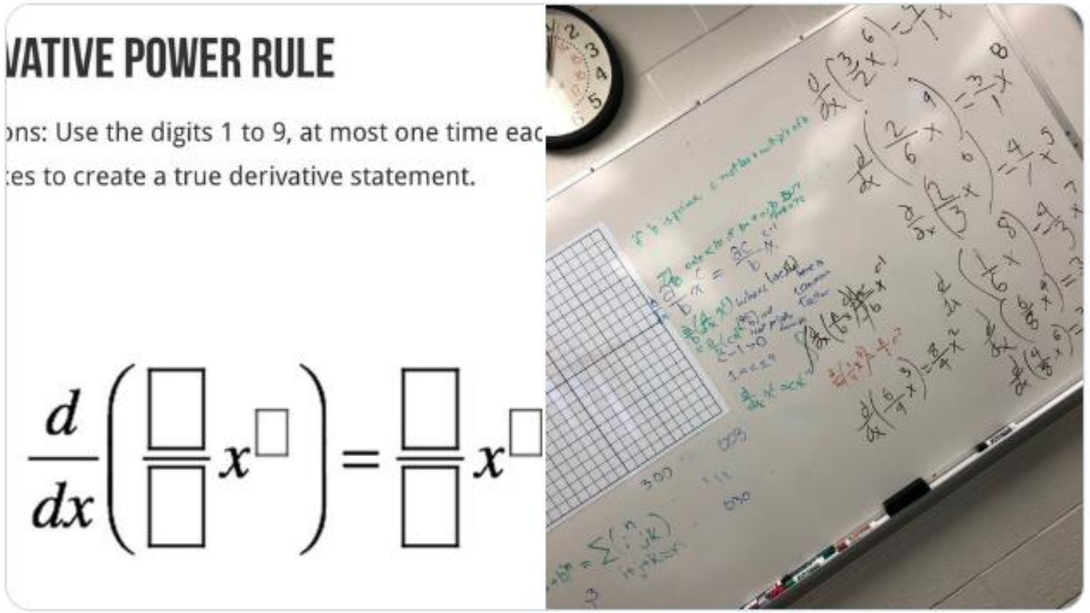
My **first time trying** an **@openmiddle** problem with my students today. Wasn't sure how it would go or if they'd solve it. After a few minutes going at it (and coming up with more than one solution) they asked "can we do another one?" "That was fun - we should do it more!"



1 1 7

Katherine MacKenzie
@kmackenzie7

Tried an @openmiddle problem (for the 1st time) with my calculus crew. Left it on the board went to grab a photocopy before class start. Came back and Ss were crowded around the board sharing ideas. It's was magical. I *must* bring these to all my classes #MTBoS #iteachmath



2:17 PM · Apr 18, 2019 · Twitter for iPhone

20 Retweets **156** Likes

MrsDill
@MrsDill2

Replying to @robertkaplinsky @openmiddle and @And02B

My students live for these! Nearly every day I'm asked, "You got anymore of those open problem things for us to solve?"

6:44 PM · Apr 17, 2019 · Twitter for iPhone

5 Likes

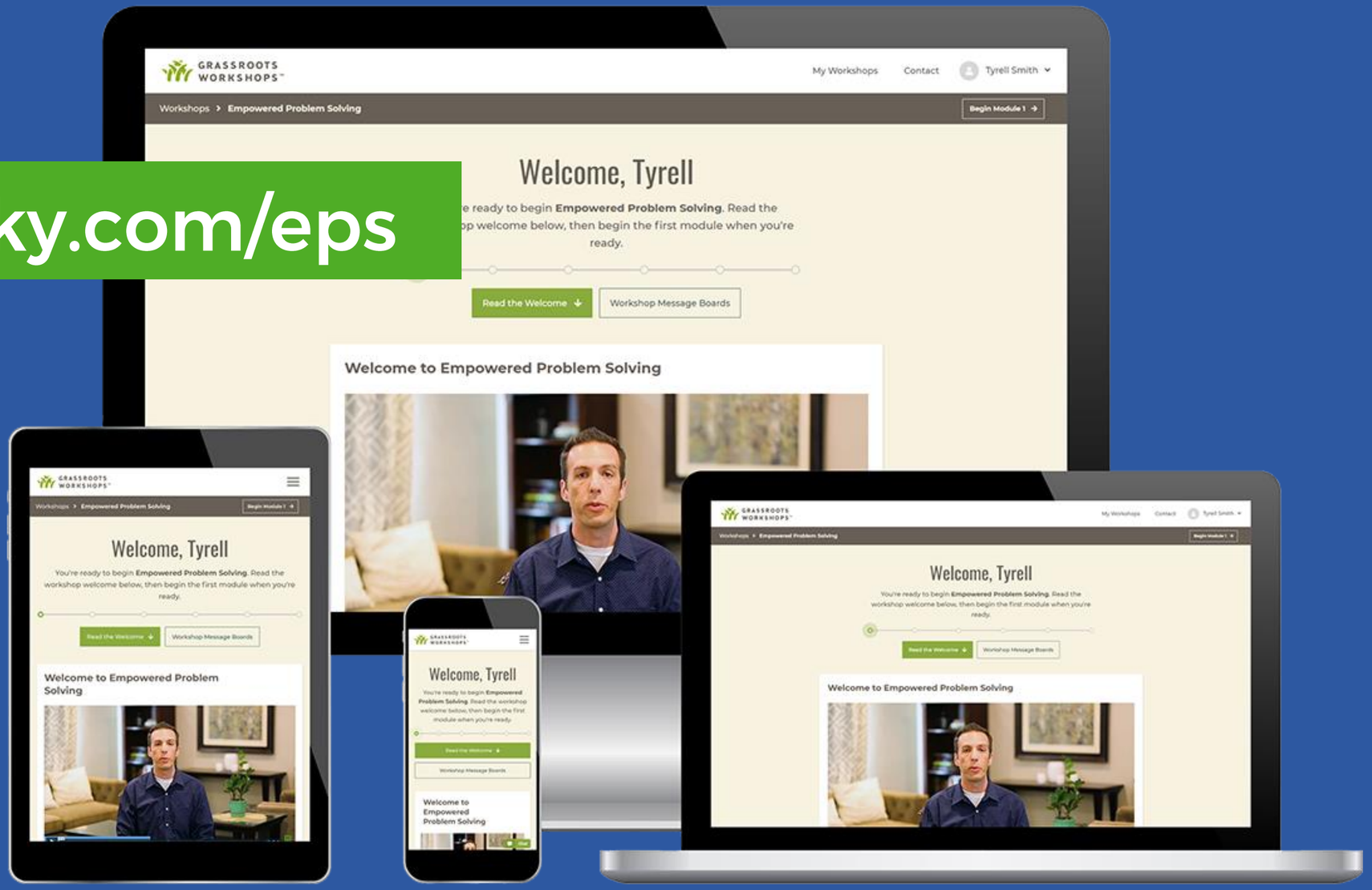
GOALS

- [x] HOW DO WE CHOOSE OUR PROBLEMS?
- [x] HOW DO WE USE THEM WITH STUDENTS?
- [x] WHERE CAN WE GET MORE PROBLEMS?


2013-10-01 16:27:35
KAM 1


2013-10-01 16:27:35
KAM 1

robertkaplinsky.com/eps



Closest to 1000 - Google Slides | Presentation Session

app.peardeck.com/presenter/tvfkmygyt/dash?returnTo=gslides

Brooklyn Evans
Thaddius Williams
Robert Thomas
Tehya Whitfield
Guadalupe Paz
Konvia Hayes

Sort by: Time | xtsnc | 10 Students

Deleted Response

Robert Kaplinsky

1 of 10 Responses | Student-Paced | Show Responses | Stop Student-Paced | END

Student Strategy Tracker (Grades

docs.google.com/document/d/11lt6LAhIKZLAZUFn70QsiXL1cr8mc1Ffs4FGWd...

Student Strategy Tracker (Grades 6 to 12)

File Edit View Insert Format Tools Add-ons Help Last edit was yesterday at 11:...

Share

Strategy	Student Name(s) and Notes	Order
Guess and check (Students are picking all digits randomly)		
Guess and check followed by strategic digit swapping		
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Students don't understand which digits can be swapped to without changing values.		
Students don't understand which digits can be swapped to change values.		

How Much Does A 100×100 In-...

teacher.desmos.com/dashboard/5f107667f4227174872854fa#teacher/step/1

How Much Does A 100×100 In-... GYGPMH +

Snapshots | Summary | Teacher | Student

Anonymize | Pacing | Pause

10 students | Time Entered

1 What is t... 2 What is t... 3 What is t... 4 What is t... 5 What qu... 6

Stop

Screen 1 of 14

What is this a picture of? #1

kenvia

a ummmmm burger

Student Strategy Tracker - 100x1

docs.google.com/document/d/1RmgvH76P7M4bEe_l8cNstM_AwX92w1cr4ItlC7...

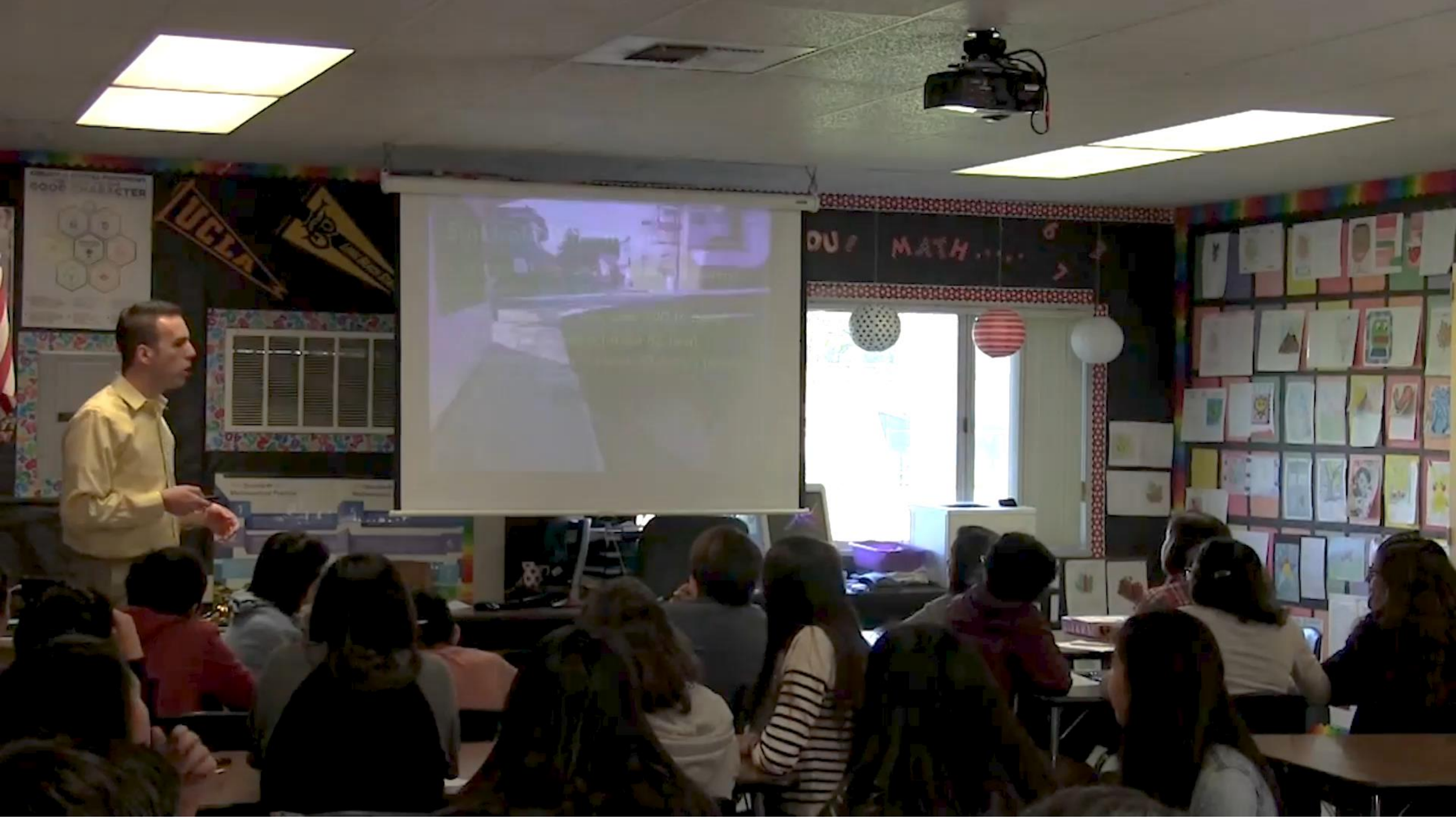
Student Strategy Tracker - 100x100

File Edit View Insert Format Tools Add-ons Help Last edit was 23 minutes ...

Share

100% Normal text Times New... 12

Strategy	Student Name(s) and Notes	Order
Thinks 100x100 is the same as 100 cheeseburgers		
Thinks 100x100 is the same as 50 Double-Doubles		
Finds the cost by starting with a cheeseburger		
Finds the cost by starting with a Double-Double		
Finds the cost by starting with just the bun and produce.		


UCLA
MATH


00:25:50:91
"So how would you make a formula that's based on this?"

Robert Kaplinsky

Empowered Problem Solving Online Workshop

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