

## Math CEO's Training Framework

### The Best-Kept Secret behind the Success of a Math Circle for Underserved Students

Alessandra Pantano & Andres Forero, University of California, Irvine





















## Math CEO started in Fall 2014

Since Fall 2016, Math CEO has engaged

- **1062** youths
- 723 college
  - students



## Mentor = Teacher + role model + friend

A good mentor aims to promote:

Math Outcomes (math skills, knowledge, interest, motivation, persistence)

College knowledge Wellbeing hold high expectations make the math for kids, but scaffold collaborative make the math have trust relevant: show in the kids' applications to abilities make the math fun & enjoyable come daily life (promote growth mindset and prepared! celebrate effort) talk about your college share your story: what inspire the kids: tell them experience: how many classes helped you prepare for what you study in college do you take? do you have college during HS? & why you love it scholarships? where do you live? are you in a club? be a friend: be a open up and try be there for them! caring to **connect** to commit to come the kids mentor be supportive! each week

## ATTITUDES AND POSITIVE RELATIONS

- **Promote a safe, non-judgmental environment**: make sure that kids know that this is expected from everyone at your table.
- Connect with students: Be enthusiastic, smile, call students by name, share your personal interests, ask them about their day. Also, be fully engaged during the meetings.
- **Be supportive**: Encourage kids to take risks and remind them they will not be judged for making mistakes.
- Be vulnerable in a positive way: share times in which you struggled learning something (whether in a class, or a sport, or...)



## Training of our Math CEO Mentors:

- 1) Math Content
- 2) Math Pedagogy
- 3) Principles of Afterschool Education

#### EXPECTATIONS FOR MENTORS

• Attend all weekly teaching meetings with students (Wednesdays, 2:00 to 3:50).

Before each W meeting with the kids...

- Attend coaching, Mondays 2:00 to 3:50.
- Complete weekly coaching Pear Deck modules before meetings
- Communicate with your mentor buddies before the M and W meetings, through Slack.

After each W meeting with the kids ....

• Complete a meeting report



How are you feeling today?



Or Skip >

×	<u></u>	Interactive TM (Pear Deck)	<u>Link</u>
	یک PDF	TM (PDF)	<u>Link</u>
	Ð	TM (Slides version)	<u>Link</u>
UCI WEEK 6	). PDF	Student (PDF)	<u>Link</u>
	Ð	SW (Slides version)	<u>Link</u>
FEB 9 in person	D	Videos	<u>Link</u>
SECRET NUMBERS		Meeting Report (form)	<u>Link</u>
	Ð	Comments and Feedback	

## MENTORS: LET'S GROW TOGETHER!

ESTABLISH PERSONAL RELATIONS WITH STUDENTS IN A SAFE, CARING WAY

#### 1. CARING

1.1 BE WARM AND WELCOMING

1.2 ENGAGE ALL STUDENTS

1.3 Support struggle & growth

### 2. MATH TEACHING

FACILITATE LEARNING WITH STORIES, REPRESENTATIONS AND GUIDING QUESTIONS

# 2.1 Make it come alive .2.2 Draw it in various ways2.3 Ask thinking questions



MAKE GOOD DECISIONS TO MAXIMIZE LEARNING AND ADJUST TO YOUR STUDENTS

#### 3. LOGISTICS

3.1 WORK IN BALANCE WITH CO-MENTORS3.2 KNOW WHEN & HOW TO "MOVE ON"3.3 SHARE AND ANNOTATE EFFICIENTLY



## Our weekly **Pear Deck Activities** serve 3 goals:

• Set pedagogical expectations:

Align our mentor's teaching to the Math CEO Framework

- Engage mentors in reflections about their own teaching: *Reflect upon past experiences, and future teaching scenarios*
- Strengthen mentors math knowledge:

Familiarize students with core math ideas, so they are able to generate good thinking questions and guide the students through inquiry

## MENTORS: LET'S GROW TOGETHER!

ESTABLISH PERSONAL RELATIONS WITH STUDENTS IN A SAFE, CARING WAY

#### 1. CARING

1.1 BE WARM AND WELCOMING LET'S LEARN ABOUT 1.1
1.2 ENGAGE ALL STUDENTS
1.3 SUPPORT STRUGGLE & GROWTH

FACILITATE LEARNING WITH STORIES, REPRESENTATIONS AND GUIDING QUESTIONS

#### 2. MATH TEACHING

2.1 Make it come alive .2.2 Draw it in various ways2.3 Ask thinking questions



MAKE GOOD DECISIONS TO MAXIMIZE LEARNING AND ADJUST TO YOUR STUDENTS

#### 3. LOGISTICS

3.1 WORK IN BALANCE WITH CO-MENTORS3.2 KNOW WHEN & HOW TO "MOVE ON"3.3 SHARE AND ANNOTATE EFFICIENTLY





## Let's Brainstorm 🧠 🧠

# During the meetings, how can you show your mentees that you care about them?



Students, write your response!

Pear Deck Interactive Slide 0 Do not remove this bar

## Share something about your mentees!

Tell us something (anything!) that you have learned thus far about a particular student in one of the previous meetings.

We would love to hear all about it!





# icebreaker

Think of an icebreaker that you will propose to your co-mentors during your next planning meeting, which will allow your mentoring team to *open-up* to your mentees

> Remember to keep it short (under 8 minutes)

## Mentors: Let's Grow together!

ESTABLISH PERSONAL RELATIONS WITH STUDENTS IN A SAFE, CARING WAY

#### 1. CARING

1.1 BE WARM AND WELCOMING1.2 ENGAGE ALL STUDENTS1.3 SUPPORT STRUGGLE & GROWTH

#### 2. MATH TEACHING

FACILITATE LEARNING WITH STORIES, REPRESENTATIONS AND GUIDING QUESTIONS

# 2.1 Make it come alive . This week's Focus 2.2 Draw it in various ways 2.3 Ask thinking questions



MAKE GOOD DECISIONS TO MAXIMIZE LEARNING AND ADJUST TO YOUR STUDENTS

#### 3. LOGISTICS

3.1 WORK IN BALANCE WITH CO-MENTORS3.2 KNOW WHEN & HOW TO "MOVE ON"3.3 SHARE AND ANNOTATE EFFICIENTLY



## **2.1: Make it come alive** *What does it mean?*

Making the task come alive means positioning yourself as a bridge between the activity and the students, to make sure that your mentees not only understand the activity, but they also engage with it and enjoy it



Here is an article to read about curiosity and learning: <u>Why Curiosity Enhances Learning</u>

## Successful habits include:

- Understanding the main goal of the task, to start directing students towards it.
- Adding a background story, or introducing an analogy.
- Adding humor or absurd things ("little confusions" that the brain likes).
- Changing the pace and tone of voice (drama, surprise, excitement, intentionality).
- Making/asking a "controversial" statement/question
  - Ex: "It's impossible to do this" (but it's actually possible).
- Using music, pictures, or short videos / animations.
- Polling students or having them make a simple choice, to make them invested from the start.





Let's Brainstorm 🧠 🧠

When you introduce a math problem to your students, how can you make sure that is does not feel like a test or a homework?



Students, write your response!

Pear Deck Interactive Slide10 Do not remove this bar

## 2.1 MAKE THE TASK COME ALIVE

Let's Brainstorm 🧠 🧠

What are the advantages of reading a problem word by word to students? What are the potential problems with that approach? How can you fix these potential problems?



Pear Deck Interactive Slide10 Do not remove this bar

#### Symmetric numbers

Let us say that an integer is **symmetric** if when read from right to left, you get the same number. Here are some examples of symmetric numbers:

## **393** 55 **1001 7 44877844**

- a) How many 3-digit symmetric numb
- b) How many 4-digit symmetric numb
- c) Is the sum of two symmetric numbersymmetric number?
- d) Think of any integer. Can you write i three symmetric numbers?
   Ex: 946 = 454 + 404 + 88

Plan some ways in which you can introduce the activity about symmetric numbers. Instead of just giving the definition and jumping to the problems, what would be a good story to tell about symmetric numbers or words?

Make sure to tell this to your comentors as well, in Slack.



## MENTORS: LET'S GROW TOGETHER!

ESTABLISH PERSONAL RELATIONS WITH STUDENTS IN A SAFE, CARING WAY

#### 1. CARING

1.1 BE WARM AND WELCOMING1.2 ENGAGE ALL STUDENTS1.3 SUPPORT STRUGGLE & GROWTH

#### 2. MATH TEACHING

FACILITATE LEARNING WITH STORIES, REPRESENTATIONS AND GUIDING QUESTIONS

# 2.1 Make it come alive .2.2 Draw it in various ways2.3 Ask thinking questions



MAKE GOOD DECISIONS TO MAXIMIZE LEARNING AND ADJUST TO YOUR STUDENTS

#### 3. LOGISTICS

3.1 WORK IN BALANCE WITH CO-MENTORS 3.2 KNOW WHEN & HOW TO "MOVE ON" 3.3 Share and animotate feelclenity

3.3 Share and annotate efficiently



THIS WEEK'S FOCUS

## **3.1: Work in Balance With Co-mentors** *What does it mean?*

This is all about being able to teach as a team, finding balance, and realizing that the whole is more than the sum of the parts.

This means recognizing what co-teaching adds to the teaching (things that you would not be able to do if you were the only mentor). It also means successfully overcoming the obstacles that arise when more

than 1 person

### Successful habits:

- 1. Gently "interrupting" fellow mentors (each time it will feel less like interrupting, and more like *flowing together*).
- 2. When talking, be mindful of other mentors and try to involve them.
- 3. Supporting the current "most active mentor" by reading other people's ideas in the chat, and revoicing what's being said.
- 4. Switching from "lecture mode" to "conversation / exploration mode" to make the session more interactive.

UNPRODUCTIVE BELIEFS	PRODUCTIVE BELIEFS	
If I am teaching with my comentor, the best way to plan is to divide the lesson into small parts and each plan our part separately.	Coteaching means that "both are teaching"; so the best way to plan is to go over the manual <b>together</b> and anticipate the session, exchanging ideas.	
I should not ask questions to other mentors because they may not know the answer, and things could get out of control.	I should ask lots of questions to my comentors. It can help them be engaged, collaborate with me, and add ideas. I should be curious about my students and my peer mentors	
If a mentor is taking care of all the teaching, I should let her keep going because things are perfect like that and I don't want to disrupt her flow.	Even if my comentor is doing a great job, she appreciates my I session. My part to my students, a Productive: Instead, I should	

## **)** Our mentors' responses...

UNPRODUCTIVE BELIEF	PRODUCTIVE BELIEF
I should quickly dive into the activity and start asking for answers from students.	Do a welfare check! Ask students how they're doing and after asking the question for the activity, give students "wait time" so they can digest what is required of them.
When my comentor is teaching, I can just disengage and take a break.	I should always be actively engaged with the discussion, even when I'm not the one teaching. I can still participate by annotating or writing in the chat.
It's a more unified message if one person presents it.	Extra approaches to a problem and many perspectives help students develop more types of math intuition.
If a mentor is struggling when explaining something, let them figure it out themselves.	Jump in at any time to help a fellow mentor!
I should not speak during my co-mentor's assigned teaching section even if I have a good explanation to add.	When my co-mentor is done speaking I can add my comment in order to reinforce what they just said. This may help the students gain a better understanding.
If I have some confusion regarding what my mentor said, I should not say anything to them as it might lessen their credibility.	If I have anything I wanted to ask my mentor, I should address it because this could be an opportunity to demonstrate effective communication. It's always good to clarify things because it could make the latter parts of the meeting run smoother.
If two mentors are taking the lead in guiding a lesson, I should simply let them do their thing and interfere as little as possible.	Since mentoring is done with so many mentors, everyone can contribute to the lesson either sharing their participation in an activity or being active in the chat with students and mentors to promote a positive environment for students.
I get scared of messing up my explanations, so I choose not to speak a lot and let other mentors do it.	I volunteer to explain/talk because practice is the only way I can improve my explanations.



## Interrupting vs Disrupting



In Math CEO, we promote and welcome mentors interrupting their comentors during their teaching.

However, we don't want to disrupt the teaching of other mentors. Rather, we want productive interruptions that improve the quality of the meeting, and are beneficial to all students, and all mentors as well.

Give an example of a "good interruption" or a "disruption", and describe why you categorized it as such.

This reflection will help you find opportunities for productive interruptions during the meeting, and be encouraged to try!

## Co-teaching Situation Asking For Help





Chris, Laura and Ben are mentoring the same group of students.

Chris notices that he is doing all the talking, and he is the only mentor who is actively engaging students.

He would love to ask for help to his co-mentors, but does not know how to do it.

- What may be some reasons why Laura and Ben are not participating? List all that you can think of.
- 2) What may be some reasons why Chris is unable to ask for help? List all reasons you can think of.
- 3) Describe a system that would help your table prevent a situation similar to the one described here. What are some "agreements" or expectations that you could agree with your comentors?

## Mentors: Let's Grow together!

ESTABLISH PERSONAL RELATIONS WITH STUDENTS IN A SAFE, CARING WAY

#### 1. CARING

1.1 BE WARM AND WELCOMING1.2 ENGAGE ALL STUDENTS.1.3 SUPPORT STRUGGLE & GROWTH

#### 2. MATH TEACHING

FACILITATE LEARNING WITH STORIES, REPRESENTATIONS AND GUIDING QUESTIONS

2.1 Make it come alive .
2.2 Draw it in various ways .
2.3 Ask thinking questions This week's Focus



MAKE GOOD DECISIONS TO MAXIMIZE LEARNING AND ADJUST TO YOUR STUDENTS

#### 3. LOGISTICS

3.1 WORK IN BALANCE WITH CO-MENTORS3.2 KNOW WHEN & HOW TO "MOVE ON"3.3 SHARE AND ANNOTATE EFFICIENTLY



#### **2.3 Ask Thinking Questions** *What does it mean?*

Asking thinking questions means to ask a lot of questions that "advance student thinking", and are not just meant at checking whether students know some facts or calculations



#### Good Habits

- Avoid (mostly) the IRE Initiate-Response-Evaluate questions (see video)
- Ask more focusing questions than funneling questions (see video)
- Prepare thinking questions beforehand (just thinking about the thinking questions will make a difference!)
- Ask follow up questions whenever possible
- Be kind, but "hard to satisfy" to engage students into reasoning.
- Ask thinking questions to other mentors so that students can see examples on how they should answer a thinking question

Remember: our main goal is advance learning. That is why we need prompts and questions that engage students in thinking.

### Unproductive prompts and questions

Low chance of advancing learning

#### a) Is it clear to all?

Can be intimidating. Can send the message: "if you did not understand, you are not smart enough".

#### b) Do you have any questions?

Can send the message: "I hope everything was clear".

#### c) What is 10 divided by 2?

If you only ask this and not any conceptual question, it can send this message: mentors are responsible for reasoning, students are only responsible for the calculations.

d) Do you agree with this?It's not enough: we need the "why" part.

## **Productive prompts and questions** High chance of advancing learning

e) Monica, can you explain what Juan said in your words? Do you agree? Why? Specific to a student. Connects with Juan's previous ideas.

f) I will give you 1 minute to think about how to answer. Everyone be ready! Here is the question: ...

Gives students time to think creatively before answering.

*g) Monica, let's draw a picture! [draw a part...] Help me complete it!* Asks a specific student to practice representations, with a bit of help in the start. Helps check for understanding.

*h) But Juan, what would happen if we...* Triggers extra-exploration, which helps to check for understanding.

*i) How is this connected to the original spinner?* Demands that students understand the concept to answer.

*j) Juan, can you think of a different way to solve this?* Can help you see how much really Juan understands the concept: maybe he only gets the procedure...

*k) What are we trying to find?* Helps students focus on the task.

*I) Do you think that this works all the time?* Makes students stop and reflect.

### Extending the Silence

Giving students several seconds to think after asl up to two minutes for some questions—improves

By John McCarthy

January 10, 2018



How long do you think teachers pause, on average, after

## Waiting for your students

## Read this article:

Extending the Silence <u>https://www.edutopia.org/article/extending-silence</u>

Based on your own reflections, write a bullet list of things that you will plan when asking thinking questions to your mentees. Keep that "Don't forget to..." list at hand!

Not every learner processes thinking at the same speed. Quality should be measured in the content of the answer, not the speediness. External Thinkers, may be shaping their ideas as they talk—they haven't had sufficient time to fully process but speak out anyway. Internal Thinkers have also had insufficient time to process, but don't feel comfortable responding. Life is **not** a 30-minute game show with rapid-fire questions that require low-level answers, plus commercial breaks.



## Co-teaching Situation #2 Making deeper mathematical Questions



Please start watching this Video: <u>Asking Mathematical Questions</u>

Huang is your co-mentor. He is very well communicating with students and is keeping all students participating. However, you notice that all the mathematical questions that he asks are "closed": he only asks for the answer, and some times for the computation, but never for the reasoning, or a connection to the context of the problem.

- Do you think that students are more likely, or less likely to answer the types of questions that Huang is asking, compared to reasoning questions? Why?
- 2) As a co-mentor, describe which action steps would you take to help Huang and the room to switch to a more exploratory style, in which students go beyond procedures without any connections.



### Example

## Populations and proportions

Generating new math questions

M4 Winter 2021



#### Diving into the math: Samples



In a large set of phone numbers, 50% are from LA. In a sample of 60, you got 32 from LA. Is this what you would expect?

A population of trees has 5,000 members and in a sample of 100 members, 80 are pine trees. What could you reasonably conclude?

If we want to analyze a population (so a data set), why can't we just look at all the elements in it? Is there always a unique sample, or do we have more than one choice to grab a sample? A music band has 600 songs. How many should you listen to decide if you like the band? Explain.

I want to know what people in my city like to eat. I will interview all people in a Sushi restaurant. Is this a good idea? Why?



What are, in general, the strategies to pick a good sample that really represents the whole population? A sports site says that the LA Lakers have a 87.5% chance of winning. How do you think they get that number?



## Your Question We want help in adding to our diving into the math bank of Questions!

# Please write your question, and then its answer. You can even explain why you would ask this question.

Use Slack (your room channel) to promote your question if you want, by posting it there!



itudents, write your response!

#### Related

30% of the butterflies in this world are related to each other, and when you pick a sample of 100 butterflies, 90 of them are related. Is this what you should have expected?

**A**: No, if it is supposed to be only 30% related, there shouldn't be so many related butterflies in a sample of the population.

#### Do you like math?

I want to know how many students at Carr Middle School like math. Would it be a good idea to ask all of the Carr students in Math CEO. Why or why not? Would it be an over or underestimation of the true percentage?

A: This is not a good idea because students are more likely to attend a math enrichment program such as Math CEO if they tend to enjoy math.

Therefore, asking only the Carr Math CEO students will overestimate the true percentage of Carr students that enjoy math.

#### Hamburgers

I want to see what the best hamburger in the world is, so I ask 100 people from Southern California what they think is the best hamburger. Is this an effective (representative) sample?

#### **Sick Bees**

A population (large set) of 3000 bees have also gotten sick, so have also given the same medicine originally given to the butterflies. After taking a sample of 15 bees, the scientists discovered that 8 bees were sick

and 7 were not sick. Are there any issues with this sample? Why?

#### Small samples

I wonder what would happen if we picked a really small sample? Why don't we do this if this makes our calculations easier?

#### Samples in The ARC (Anteater Recreation Center)

You want to determine if the students at UC Irvine like to play sports. You go the ARC (UC Irvine's gym) and as the questions to 50 students. Is this a good idea?

A: It would not be a good idea since the sample would not be representative of most students at UC Irvine. Students at the gym will most likely like sports so this will create inaccurate conclusions about UC Irvine students as a whole.



# THANK YOU!!!

