The Global Math Circle

Engagement is Key

Keeping Learner-Driven Inquiries Alive

Taylor Yeracaris

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Roadmap

1. About The Global Math Circle
2. Goals of a math circle
3. Adaptive plot hooks
4. Questioning Strategies
5. Other thoughts for keeping up engagement

Bob and Ellen's vision

Engage all kids in math circles in order to share the creative, collaborative nature of mathematics, our lost native language.

Our program

- Online math circles for ages 5-13
- 7-week courses
- Groups of 5-7
- Collaborative sessions
- The goal: a true experience of doing math

What does it mean to do math?

- **Asking** questions
- **Refining** questions
- **Exploring** phenomena
- **Conjecturing** structure
- **Proving** theorems

Training Institute

- Developed over decades of iteration
- Eight 1.5-hour sessions over Zoom
- Current institute just started; date of next TBD
- Current syllabus:

1. What it's like to participate in a math circle	5. Game breaks and celebrations
2. Planning and running a math circle	6. Classroom culture and reaching everyone
3. Getting the party started: Plot hooks	7. Challenging situations
4. Questioning strategies and board work	8. Bringing it together

Engagement is key

- If we want kids to be *creators* and *doers* of mathematics, it must be voluntary
- In other words: they need to be engaged!

Starting a math circle: accessible mysteries

- Just beyond their competence
- Inherently intriguing
- Natural (honest; no secret agenda)
  - Poorly-worded
- Leads to deep, productive inquiry
- It’s okay to stick to the classics!

Accessible mystery examples

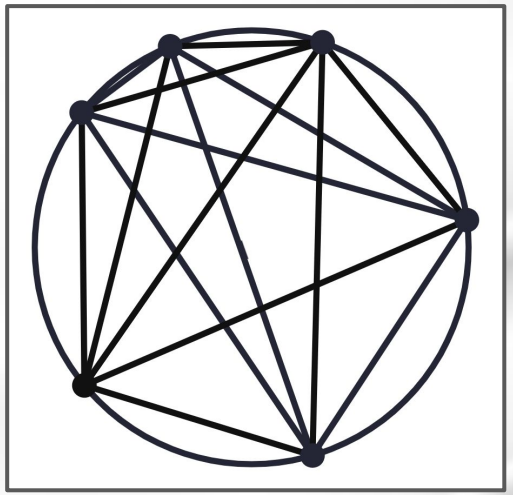
- Are there numbers between numbers?
- How many corners does a 10-dimensional cube have?
- Which squares can we draw on a grid?
- What's i^i?
- Can we find a path through a 5x5 grid?
- Where's the center of a triangle?

Constructing an accessible mystery

- Inherently fascinating (aiming high)
  - *Are there numbers between numbers?*
  - *How many corners does a 10-dimensional cube have?*
  - *What's i^i?*
- "Aiming past" the inquiry

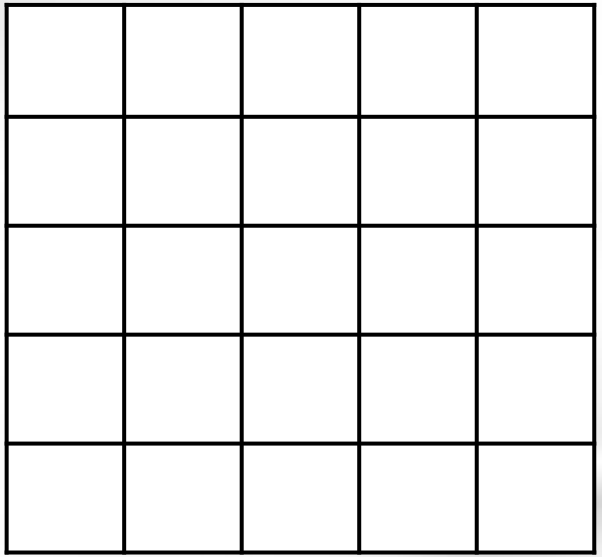
Executing an accessible mystery

- Lulling them into a false sense of security
  - *Which squares can we draw on a grid?*
  - *Where's the center of a triangle?*
  - *Counting dots*
  - *Complete graph regions*



Executing an accessible mystery

- Questions from play
  - *5x5 grids*



Following the children

- Their interests = engagement, math ownership
- Questions that are boring or too hard are great!
- They lead the math, you lead the social
- Staying in the realm of productive inquiry

Adaptive plot hooks

- Generally, want to have a mystery (“plot hook”) at all times
- Balance: wandering vs. direction
- This mystery can change and evolve!

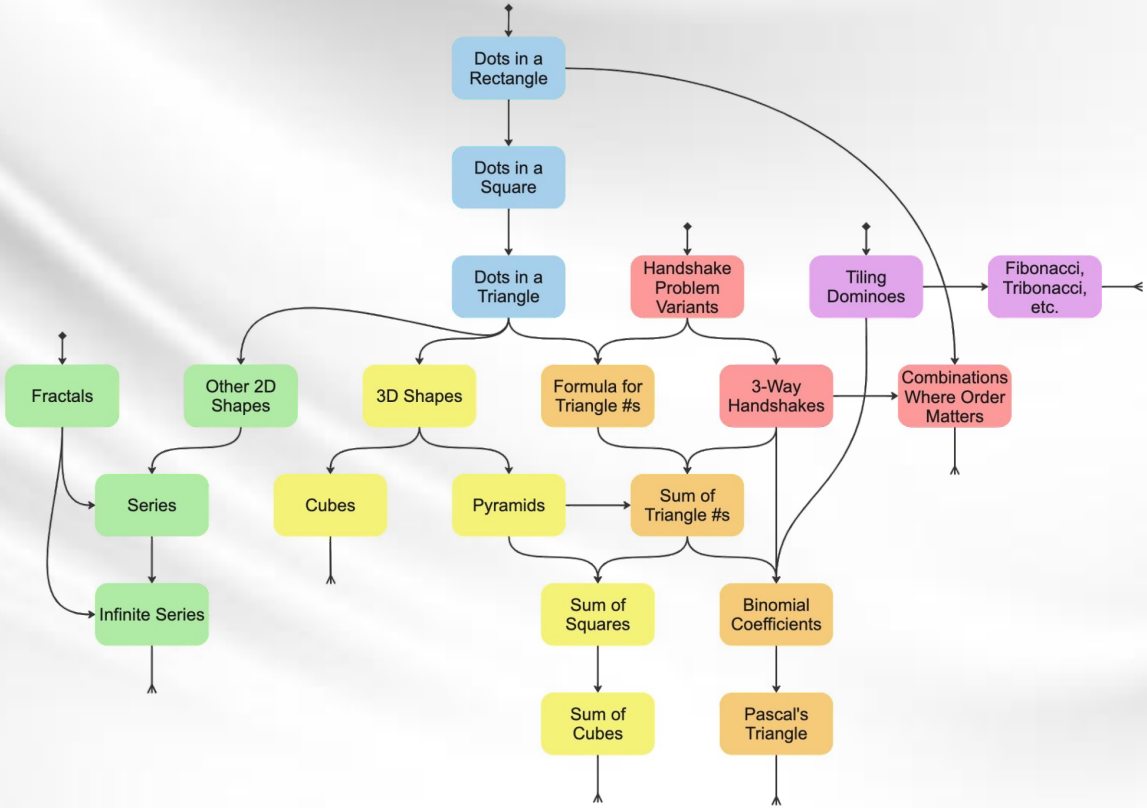
Why might engagement lag?

- Lack of interest
- Too hard
- Too easy
- Tired
- Feeling like they can’t participate
- …

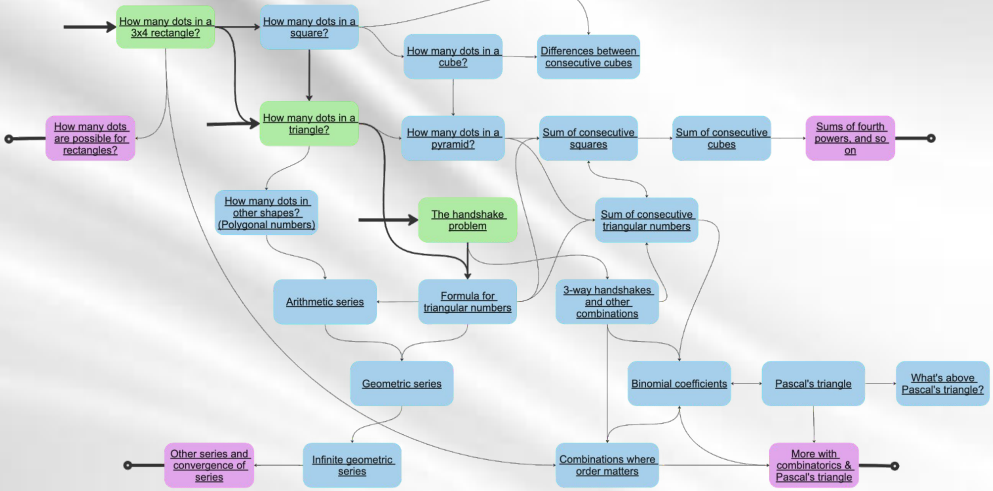
New plot hooks

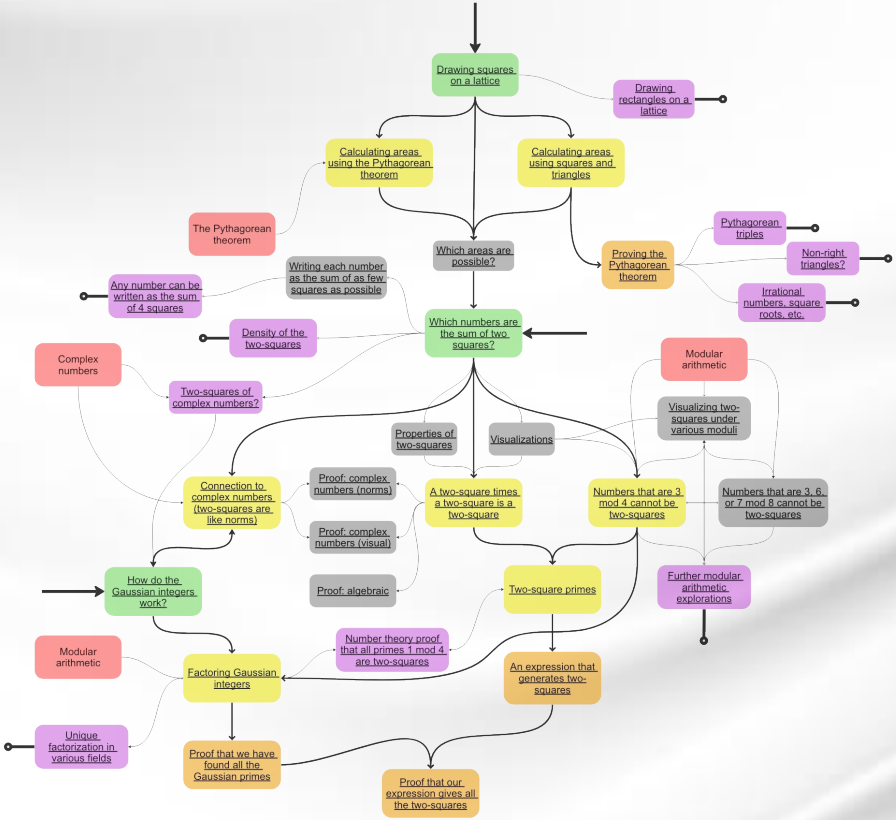
1. Refocusing (“what are we talking about?”)
2. Another question left previously (“earlier we were talking about…”)
3. A new accessible mystery (closely related, and only if needed)

Multiple entry points



Planning with flowcharts (The Nexus)

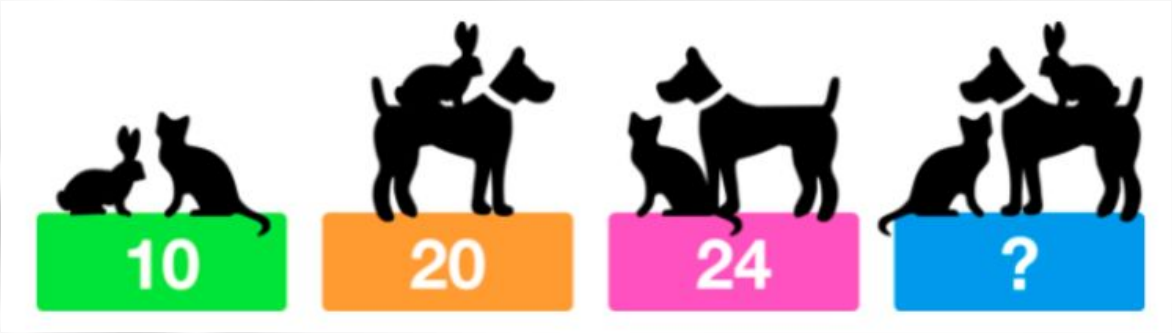




Questioning strategies

- How do we support mathematical exploration, while leaving the thinking to the kids?
  - Keep-thinking questions
  - “General advice for mathematical thinking”
- Ownership = engagement

Keep-thinking questions



Stop-thinking questions (funneling):

- How much do the dog and rabbit weigh together?
- How much do the cat and rabbit weigh together?
- How much do the dog, cat, and two rabbits weigh together?
- How much do the dog and the cat weigh together?
- How much do the two rabbits weigh?

Keep-thinking questions (focusing):

- What are some things you notice?
- What do you suppose the numbers mean?
- What's a question you could ask about this picture?
- What are some things you could do to figure it out?
- (Once you know what one animal weighs): how can you figure out the rest?
- What makes this so hard?

Keep-thinking questions

- What do you notice?
- What questions do you have?
- What do we know?
- Can we try a simpler version of the question first?
- How can we represent our information differently?
- What do we need to know? What information can we gather?
- What else could we try?
- Can we figure out something we know is wrong?
- Can somebody propose an idea that won't work?
- Why is this so hard?

Other thoughts for keeping up engagement

- Game breaks (mathematical, relevant)
  - Function machine
- Their approach, their terms
- Well-matched group

Culture of the group

- Dim friend
  - Wrong answers encouraged
  - Losing our egos
- Collaborative environment
- Every voice heard
- FUN :) (but not frustration-free)

Please keep in touch!

- Nexus project still in the works
- Math circle guide training institute
- Online math circles for anybody ages 5-13

Any questions?

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Thank you!

www.theglobalmathcircle.org
taylor@theglobalmathcircle.org