

When was the last time*
you did math? What
were you *doing*?

*not including teaching, coaching, tutoring

Inclusive Visions of Doing Math

NCTM 2024

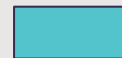
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Senior Program Officer



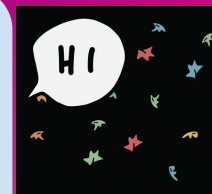
Our Agenda

- Who we are
- What *doing* math is, means and looks like?
- Inquiry as a process for investigating doing
- Early ideas about doing math
- A more inclusive vision of doing math
- Next steps



Joshua Thurbee

Program Officer for Teacher Development, Phase I



I'm obsessed with Heartstopper. Feel free to talk to me about it anytime



My cat Henry likes to join Zoom meetings. He's happy. I swear



Moved out east 6 years ago when I joined the Knowles team




Moved to Chicago when I was 16
Undergrad in Physics & Math education
Graduate degree in school leadership while in Chicago



Anna and I were hired at the same time and don't enjoy



I've been teaching for 24 working together. years. Which is shocking because I look so young. Nor do we have big heads.

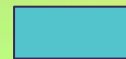
 I'm STILL teaching - I teach methods classes at Penn



Grew up in Southern California. Mildly fun fact: I'm the shortest of my siblings (I'm 6'6")



That's my older, taller brother!



February 2024 @ Disney's Animal Kingdom
My husband Chris, daughter Zoe (12), & me

Support Your Local Everything

LocalSpirit.org

Gina Wilson
Program Officer for
Teacher Development



How many kayaks can you get on a Subaru? Usually the bikes are on the back too.

I started this quilt before Zoe was born and just finished it!



And we've finally kept some herbs and plants alive!



I taught through Covid and the return to campus before coming to Knowles



2 years

It's a Pandemic You Say?

Let's teach high school & write a dissertation



PhD Education Leadership

Taught middle school math for 3 years & high school math for 15 years (at an early middle college)



This is not 100% true...but close enough



My happy place is outside by the water. Luckily Michigan has lots of water! Trees work too!

Hometown - the beach & ocean!!

B.S. Chemical Engineering (math was always my 1st ❤️) And I met Chris here.



M.S. Chemical Engineering Thought we'd be in MI for 4 years - it's been almost 25!

KNOWLES TEACHING FELLOWSHIP



Transforming Mathematics & Science Education

35 FELLOWS



**NEW MATH AND
SCIENCE TEACHERS**

**GREAT DISCIPLINARY
KNOWLEDGE**

**CAPACITY, DRIVE
AND COMMITMENT TO
TEACHING**

**LEADERSHIP
POTENTIAL**



1st

PHASE

REFLECT

AND DEEPEN KNOWLEDGE

INCREASE

LEARNING OPPORTUNITIES
FOR ALL STUDENTS

ENGAGE

IN INQUIRY WITH OTHERS

2nd PHASE



ENGAGE

COLLEAGUES IN THE WORK

LEAD

FOR EQUITABLE OUTCOMES

UNDERSTAND

THE WHOLE SYSTEM

What does it
mean to “*do*”
math?

What *doing* math is, looks like, and means

Doing math is

Engaging in meaningful mathematical experiences that inform a person's identity and ability to use math to make sense of the world.

01

Our identities inform what we believe math is, means, and looks like

What *doing* math is, looks like, and means

Doing math is

Engaging in meaningful mathematical experiences that inform a person's identity and ability to use math to make sense of the world.

Doing math looks like

Recognizing how and when to apply the mathematical practices to engage in mathematical experiences

01

Our identities inform what we believe math is, means, and looks like

02

A more inclusive vision of doing supports teachers in ***disrupting harmful applications of dominant culture in their classrooms***

What *doing* math is, looks like, and means

Doing math is

Engaging in meaningful mathematical experiences that inform a person's identity and ability to use math to make sense of the world.

Doing math looks like

Recognizing how and when to apply the mathematical practices to engage in mathematical experiences,

Doing math means

Different things to different teachers and while there is overlap, much is determined by our identities as humans, learners, and teachers.

01

Our identities inform what we believe math is, means, and looks like

02

A more inclusive vision of doing supports teachers in *disrupting harmful applications of dominant culture in their classrooms*

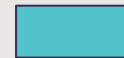
03

Doing math is also informed by the ways *dominant culture works in concert to privilege white ways of doing*

Inquiry as a process for investigating doing



What does it
mean to be a
doer of
mathematics in
my classroom?



Inquiry as a process for investigating doing



What does it
mean to be a
doer of
mathematics in
my classroom?

My *Evolving* Definition of "Doing"

Over the course of the year, you'll be invited to revisit this document and respond to the questions with any new ideas, understandings, and/or information you develop as your definition of "doing" mathematics and science changes and expands over the year. As you add to the definition, we'll ask you to use different colors to highlight the different times of the year.

Initial Summer: **Black**
End of Summer: **Green**
Fall: **Orange**
Spring: **Blue**

What does it mean to be a doer of math or science?

What does "doing" look like?

What does "doing" not look like?

How do I know my students are doers of math or science?

What part of doing might you put into practice?

Inquiry as a process for investigating doing



What does it mean to be a doer of mathematics in my classroom?

My *Evolving* Definition of "Doing"

Over the course of the year, you'll be invited to revisit this document and respond to the questions with any new ideas, understandings, and/or information you develop as your definition of "doing" mathematics and science changes and expands over the year. As you add to the definition, we'll ask you to use different colors to highlight the different times of the year.

My Ongoing Conversation with AI:

- Take what you've written and paste the entire conversation into an AI of your choice [chat.openai.com, <https://claude.ai/>]
- Ask the AI some questions (treat it like a true assistant):
 - *What might I be missing in my reflections?*
 - *What might be 3 good next steps for me?*
 - *What's something I'm not thinking about?*
 - *What's a blindspot that you see?*
 - *How do you see equity (identity/culture) showing up in my responses? (or not showing up in my responses)*
 - *How might you answer these questions?*
 - *Does it appear that I'm writing with a specific population in mind? Who am I not thinking about?*
- Add your AI conversation below. This will be an ongoing conversation.

How do I know my students are doers of math or science?

What part of doing might you put into practice?

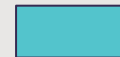
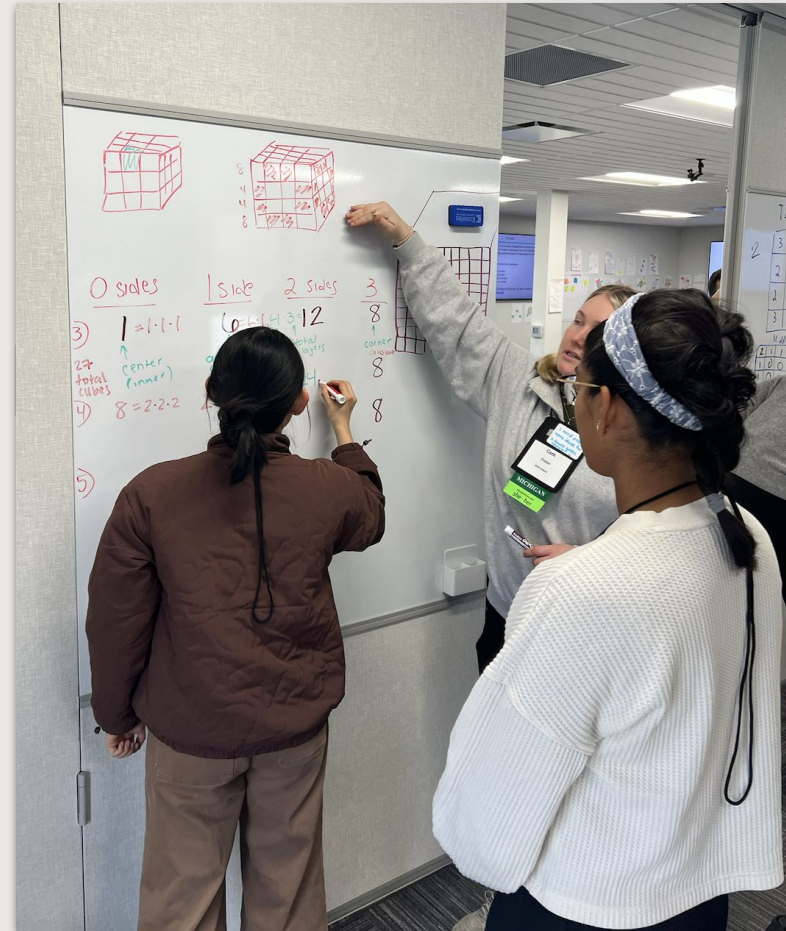
Inquiry as a process for investigating doing



Look for instances of doing in your own engagement



What does it mean to be a doer of mathematics in my classroom?



Inquiry as a process for investigating doing

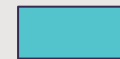
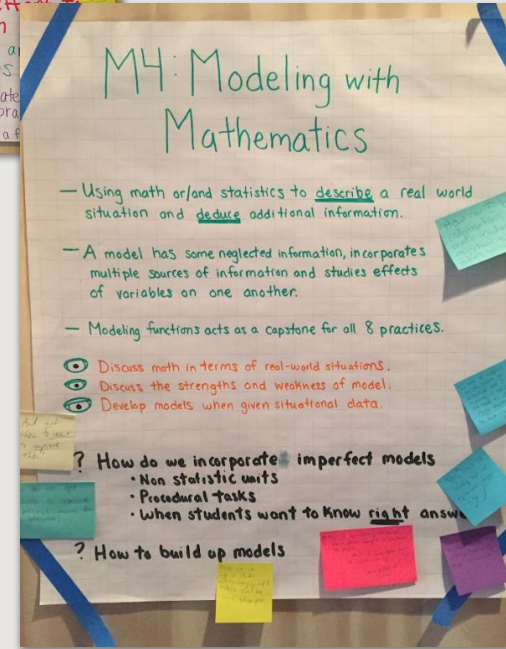
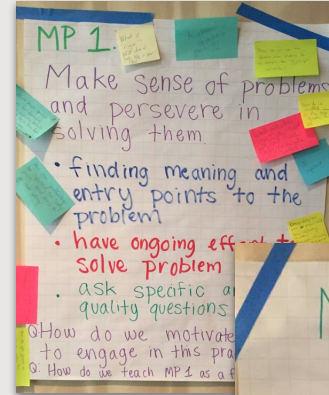


Look for instances of doing in your own engagement



Read about the practices to determine what behaviors are and aren't representative

What does it mean to be a doer of mathematics in my classroom?



Inquiry as a process for investigating doing



Look for instances of doing in your own engagement



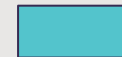
Gather data about doing mathematics from their classrooms



What does it mean to be a doer of mathematics in my classroom?



Read about the practices to determine what behaviors are and aren't representative



Inquiry as a process for investigating doing

Group Member & Source	Observations	Interpretations
Data Source 1: Pictures [Mathers]	<ul style="list-style-type: none"> • Student notes • Top of each page has SWBAT, warm up problem, review of symbols, calc steps, vocab, marker check (with initials) • Students up writing at the whiteboards (problems are pasted up on the board) • "I am a mathematician" • Desks groups of 3 	<ul style="list-style-type: none"> • SWBAT → students taking ownership of what they're learning and their goal • Organized notes • Whiteboards (BTC), not just 1 person leading the group, each student has to contribute, gives students opportunity to work without sitting down traditional style •
Data Source 2: Assessment [Miles]	<ul style="list-style-type: none"> • I notice that there are six multiple choice questions • I notice that there are 3 non-MC questions with numerical answers • I notice that there is a section of 3 questions that asks students to 'show' and 'explain' • I notice that there are several word problems • I notice that students must show their work in order to receive full credit 	<ul style="list-style-type: none"> • I noticed that the directions mentioned correct answers but not partially correct answers, which leads me to wonder if partial credit is given in this course • I noticed that work must be shown, which leads me to think that this assessment values the process students use • I notice that students must explain their answers, which leads me to believe that communicating mathematical ideas is important in this course
Data Source 3: Survey [Moe]	<ul style="list-style-type: none"> • Self reflections • Multiple options • Written options 	<ul style="list-style-type: none"> • Self assessment + SEL / self advocacy • Written options help gauge perception without impositions • Multiple choice options perhaps better help think about blindspots or voice commonalities
Data Source 4: Syllabus [Sonia]	<ul style="list-style-type: none"> • "Mathematical reasoning", "problem solving", "collaborative learner" • Grading Categories: what is HOLL? • Reference to state test: Regents • Websites section: google classroom, delta math, desmos, jupiter ed • Grading Policy: 4 point scale, percent conversions labels • Allows quiz corrections 	<ul style="list-style-type: none"> • Those key words set the tone of the learning environment • This course utilizes many online resources, tech heavy • Quiz corrections, allows opportunity to learn from mistakes • Class seems applicable to the real world (real world → math model, then math model → real world)

and aren't representative

Inquiry as a process for investigating doing



Look for instances of doing in your own engagement



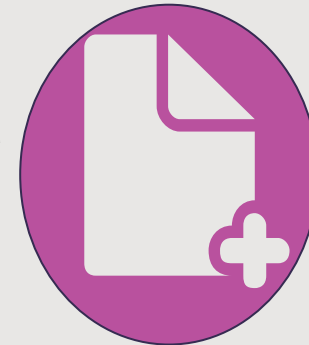
Gather data about doing mathematics from their classrooms



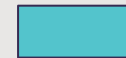
What does it mean to be a doer of mathematics in my classroom?



Read about the practices to determine what behaviors are and aren't representative



Analyze classroom data to understand what doing looks like across many math classrooms



Inquiry as a process for investigating doing



What does it mean to be a doer of mathematics in my classroom

and aren't representative

Analyze classroom data to understand what doing looks like across many math classrooms

- New perspectives
- Uncover gaps, assumptions, biases, blind spots
- Raise questions

Make the Familiar Strange

- Knowledge generation about our practice
- Protocols less a tool, more a way of thinking

Hear all voices and Ideas

Why PROTOCOLS

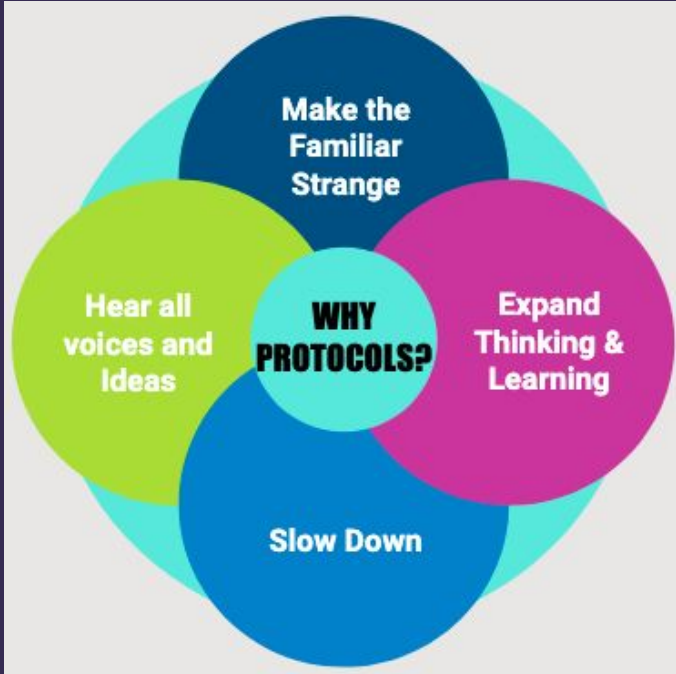
Expand Thinking & Learning

- Protected times for each person
- Active listening
- Equity emphasized so all voices are heard and valued

Slow Down

- Protected time as a group
- Time to dig deep into the data
- No judgement- what do we see “notice” and raise questions “wonder”

Vulnerability



“Imperfections are not inadequacies; they are reminders that we’re all in this together”

-Brene Brown

Who am I?

&

How does who I am
impact how I see the
world and how the world
sees me?



Fellows engage in a content task

Identity Work Surfaces Learner Identity, including

- moves they make as a learner
- vulnerabilities they experience
- dominant culture influences

Content Understanding Supports Learning Teacher Moves That

- support learning
- disrupt dominant culture norms
- invite the use of the mathematical practices

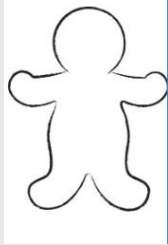
Learning to teach students to *do* math



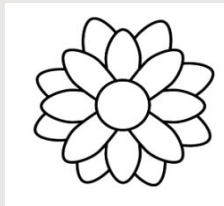
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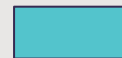
Hand identity:
How you describe yourself and
how the world describes you



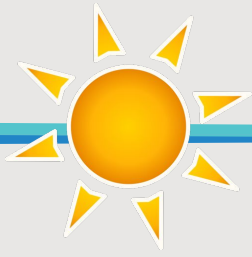
Gingerbread People Protocol



Identity flower:
Label each petal with an event that
shaped your math teacher self
Color the petal to show aspects of
identity (e.g. gender, class)



Learning to teach students to *do* math



Focus Questions for Mathematics Autobiography

The questions below are only guides and not required. Modified from Aguirre, Mayfield-Ingram, & Martin (2013)

- **What is your earliest Mathematics memory?** Who was with you in this memory? What makes this memory so memorable? What did others do to help you engage in mathematics?
- **What was learning Mathematics like for you in school?** For example, was Mathematics easy, or was it hard? Why? Did you always like it or not like it? Why?
 -
- **Were most students in your Mathematics classes of the same ethnicity, race, gender, or linguistic or socioeconomic background as you?** Be specific in your identification of yourself and others.
 -
- **How was your Mathematics learning supported at home and in your community?** Did you do any Mathematics activities outside of school (for example, in sports, hobbies, or games)? In what ways were you like or different from the other students in your Mathematics classes in this respect?
 -

Math Autobiography:
Focus questions to
support reflection on
how their experiences
with math resulted in
them becoming math
teachers





Fellows engage in identity discussions

Identity Work Illuminates

- their privileges/oppression associated with math
- the stories they tell about themselves
- dominant culture influences

Content Engagement Illuminates

- how teacher content decisions impact student identity

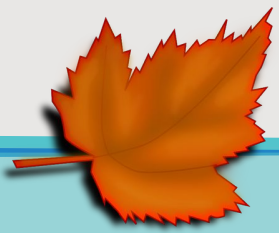
Learning to teach students to *do* math





The Summer Outcome

- Fellows see math practices as important, but are not yet connecting them to building content knowledge
- Fellows are able to name student actions, but these are generally surface level - not descriptive
 - Asking questions
 - Vulnerability, struggle, making mistakes
 - Different perspectives
 - One person felt isolated
 - Engaging with manipulatives
 - Explain reasoning



Fellows engage in a content task

Identity Work Surfaces Learner Identity, including

- moves they make as a learner
- vulnerabilities they experience
- dominant culture influences

Fellows are questioning how their identity is impacting their learning

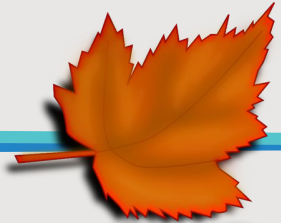
Content Engagement Supports Learning Teacher Moves That

- support learning
- disrupt dominant culture norms
- invite the use of the mathematical practices

Fellows are *thinking* about student actions & still unsure how teacher actions support student identity



Learning to teach students to *do* math



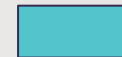
How does my identity shape how I engaged in the task?

How is dominant culture influencing my expectations of *doing*?

Characteristics of Dominant Culture

<p>Rugged Individualism</p> <ul style="list-style-type: none"> Self-reliance Individual is primary unit Independence and autonomy highly valued and rewarded Individuals assumed to be in control of their environment – “You get what you deserve” 	<p>Competition</p> <ul style="list-style-type: none"> Be #1 Win at all costs Winner-loser dichotomy Action Orientation Master and control nature Must always “do something” about a situation Aggressiveness and Extroversion Decision-Making Majority rules (when Whites have power) 	<p>Communication</p> <ul style="list-style-type: none"> “The King’s English” rules Written tradition Avoid conflict, intimacy Don’t show emotion Don’t discuss personal life Be polite
<p>Emphasis on Scientific Method</p> <ul style="list-style-type: none"> Objective, rational linear thinking Cause and effect relationships Quantitative emphasis 	<p>Future Orientation</p> <ul style="list-style-type: none"> Plan for future Delayed gratification Progress is always best “Tomorrow will be better” 	<p>Worship of the Written Word</p> <ul style="list-style-type: none"> if it’s not in a memo, it doesn’t exist the organization does not value other ways in which information gets shared those with strong documentation and writing skills are more highly valued, even in organizations where ability to relate to others is key to the mission
<p>Quantity over Quality</p> <ul style="list-style-type: none"> all resources are directed toward producing measurable goals little or no value attached to process; if it can’t be measured, it has no value no understanding that when there is a conflict between content (the agenda of the meeting) and process (people’s need to be heard or engaged), process will prevail (for example, you may get through the agenda, but if you haven’t paid attention to people’s need to be heard, the decisions made at the meeting are undermined and/or disregarded) 	<p>Perfectionism</p> <ul style="list-style-type: none"> more common is to point out either how the person or work is inadequate or even more common, to talk to others about the inadequacies of a person or their work without ever talking directly to them little time, energy, or money put into reflection or identifying lessons learned that can improve practice, in other words little or no learning from mistakes 	<p>Only one right way</p> <ul style="list-style-type: none"> the belief there is one right way to do things and once people are introduced to the right way, they will see the light and adopt it when they do not adapt or change, then something is wrong with them (the other, those not changing), not with us (those who ‘know’ the right way)
<p>Paternalism</p> <ul style="list-style-type: none"> decision-making is clear to those with power and unclear to those without it those with power assume they are capable of making decisions for and in the interests of those without power those with power often don’t think it is important or necessary to understand the viewpoint or experience of those for whom they are making decisions 	<ul style="list-style-type: none"> 	

Adapted from Judith Katz’s [Some Aspects and Assumptions of White Culture in the United States](#) and Tema Okun’s: [White Supremacy Culture](#)





Fellows engage in identity discussions

Identity Work Surfaces Learner Identity, including

- moves they make as a learner
- vulnerabilities they experience
- dominant culture influences

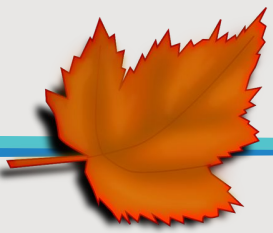
Fellows start recognizing dominant culture exists in their classrooms

Content Engagement Supports Learning Teacher Moves That

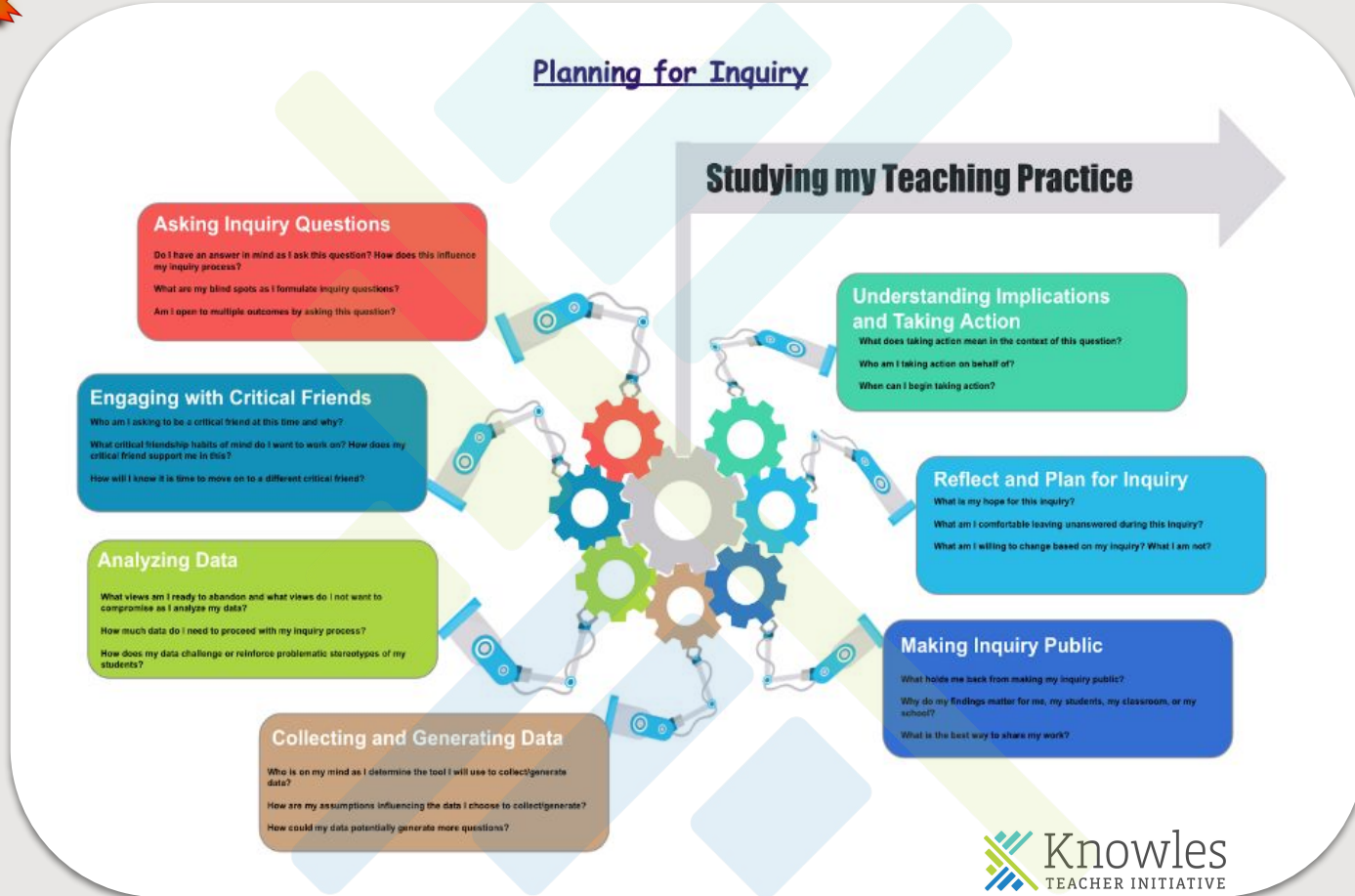
- support learning
- disrupt dominant culture norms
- invite the use of the mathematical practices

Fellows begin to understand their influence on student actions





Learning to teach students to *do* math





The Fall Outcome

- They see math practices as important, but are not yet connecting them to building content knowledge
- They're able to name student actions, but these are generally surface level - not descriptive
- Now confident that engaging in math practices contributed to building content knowledge
- Able to name student actions, but still struggling with teacher actions that support those



Fellows engage in a content task

Identity Work Surfaces Learner Identity, including

- moves they make as a learner
- vulnerabilities they experience
- dominant culture influences
- questioning how their identity is impacting their learning

Fellows noticing links to student identity

Content Engagement Supports Learning Teacher Moves That

- support learning
- disrupt dominant culture norms
- invite the use of the mathematical practices

Fellows recognize a strong link and provide evidence of teacher actions that support specific student actions





Learning to teach students to *do* math

Characteristics of Dominant Culture

Rugged Individualism

- Self-reliance
- Individual is primary unit
- Independence and autonomy highly valued and rewarded
- Individuals assumed to be in control of their environment – “You get what you deserve”

Competition

- Be #1 Win at all costs
- Winner-loser dichotomy
- Action Orientation
- Master and control nature
- Must always “do something” about a situation
- Aggressiveness and Extroversion
- Decision-Making Majority rules (when Whites have power)

Communication

- “The King’s English” rules Written tradition
- Avoid conflict, intimacy
- Don’t show emotion
- Don’t discuss personal life
- Be polite

Emphasis on Scientific Method

- Objective, rational linear thinking

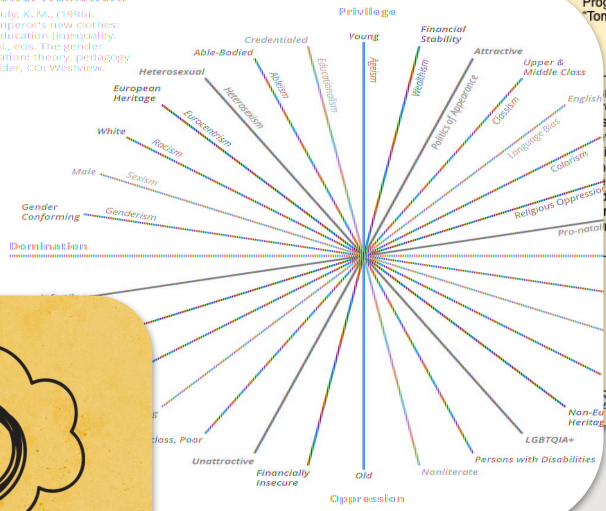
Future Orientation

- Plan for future
- Delayed gratification
- Progress is always best
- “Tomorrow will be better”

Worship of the Written Word

- If it’s not in a memo, it doesn’t exist
- The organization does not value other ways in which information gets shared
- Those with strong documentation and writing skills are more highly valued, even in organizations where ability to relate to others is key to the mission

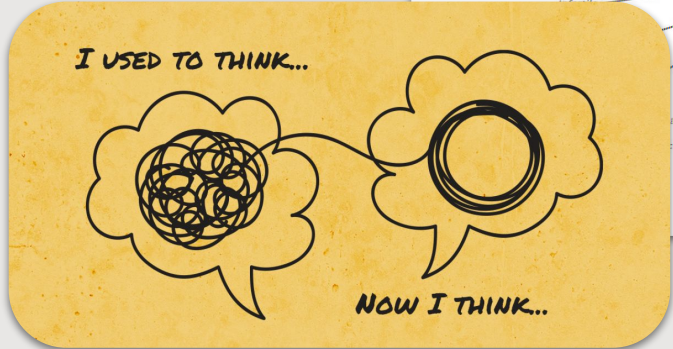
Systems of Power Framework
 Adapted from Pauly, K. M., (1998).
 Describing the Emperor’s new clothes:
 Three myths of education (inequality).
 In Ann Gitter et al., eds. The gender
 question in education: theory, pedagogy
 and politics. Boulder, CO: Westview.



It is common to point out either how the person or work is inadequate or to point out the inadequacies of a person or their work without ever talking directly to them. It is more common, to talk to others about the time, energy, or money put into reflection and identifying lessons learned that can improve practice, in other words little or no learning from mistakes.

Only one right way

- the belief there is one right way to do things and once people are introduced to the right way, they will see the light and adopt it
- when they do not adapt or change, then something is wrong with them (the other, those not changing), not with us (those who ‘know’ the right way)



[Culture in the United States](#) and Tema Okun’s: [White Supremacy Culture](#)





The Spring Outcome

- They see math practices as important, but are not yet connecting them to building content knowledge
- They're able to name student actions, but these are generally surface level - not descriptive
- Now confident that engaging in math practices contributed to building content knowledge
- Able to name student actions, but still struggling with teacher actions that support those
- Fellows self-identify as having a broader definition of doing
- Fellows are making connections to teacher and student identity
- ***Task and identity activities*** are what contributed to their expanded definition of doing



My *Evolving* Definition of "Doing"

Over the course of the year, you'll be invited to revisit this document and respond to the questions with any new ideas, understandings, and/or information you develop as your definition of "doing" mathematics and science changes and expands over the year. As you add to the definition, we'll ask you to use different colors to highlight the different times of the year.

Initial Summer: **Black**
End of Summer: **Green**
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Spring: **Blue**

What does it mean to be a doer of math or science?

What does "doing" look like?

What does "doing" not look like?

How do I know my students are doers of math or science?

What part of doing might you put into practice?

What Fellows have learned

How do I know my students are doers of math or science?

Because they exist. By existing they are doers of math and science. In each decision that they make daily.

They are failing

They're discussing, arguing, critiquing, making sense of their ideas and the ideas of others.

They are interacting with one another and tackling the process of understanding the problem presented to them

They are showing me they understand the "why" and not just the "what" of what they are doing

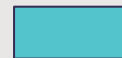
In particular, I learned a lot from my Knowles peers about the importance of revising as a way of attending to precision and being vulnerable when developing problem-solving perseverance.

I think working through the disciplinary practices gave me a greater understanding of things that I would like to see my students do, but I think I am still struggling to engage the students I am struggling to support. The students I am struggling to support don't engage in student actions and the teacher actions I am trying are not being successful. I did feel more confident about actions I should be looking for in students and similarly actions I can continue to use or try to help push them forward.

What we've learned



- Learning needs to be grounded in experience → content and identity tasks



What we've learned

JOSHUA JON-TOMAS THURBEE

JOSH

JOSHIE

FIRTREE

YOSH

BROTHER

MR. THURBEE

THURBATHON

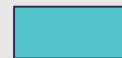
THURBEE!

3SEAT

YOSH

JOSH

- Learning needs to be grounded in experience → content and identity tasks
- Facilitators need to model the level of vulnerability this takes



What we've learned

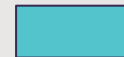
What worked for you as a learner today? *

Long answer text

What could have better supported your learning today? *

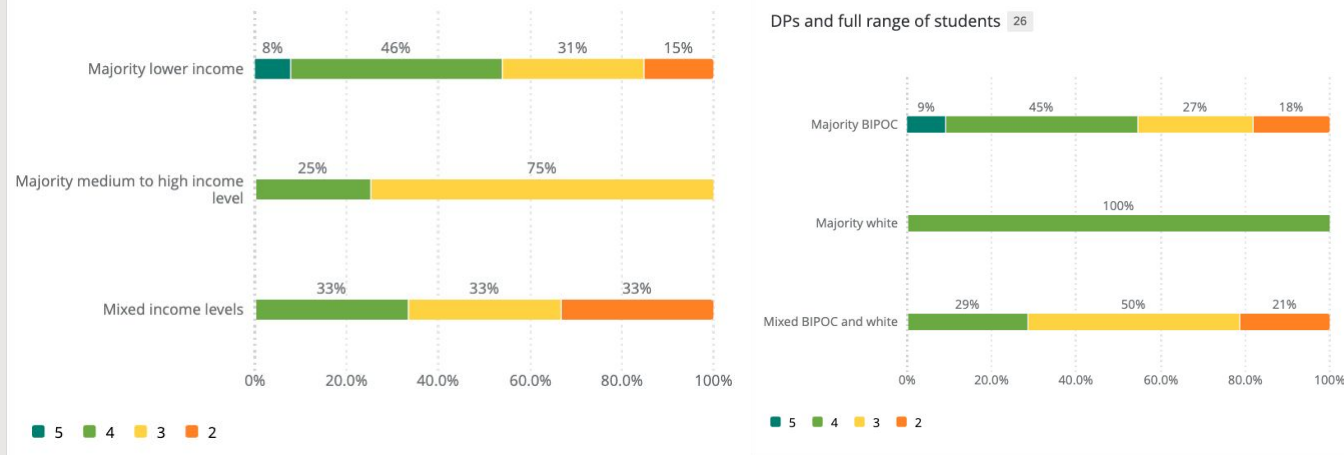
Long answer text

- Learning needs to be grounded in experience → content and identity tasks
- Facilitators need to model the level of vulnerability this takes
- Safe-enough spaces need to be created and nurtured



Where we're headed

To what extent do you feel your fall work with the disciplinary practices will help you better support the full range of students you teach to engage as doers of math/science, especially those you might be struggling to support?



How do we better differentiate for our Fellows so that they are better able to support each and every student they teach in their classrooms?

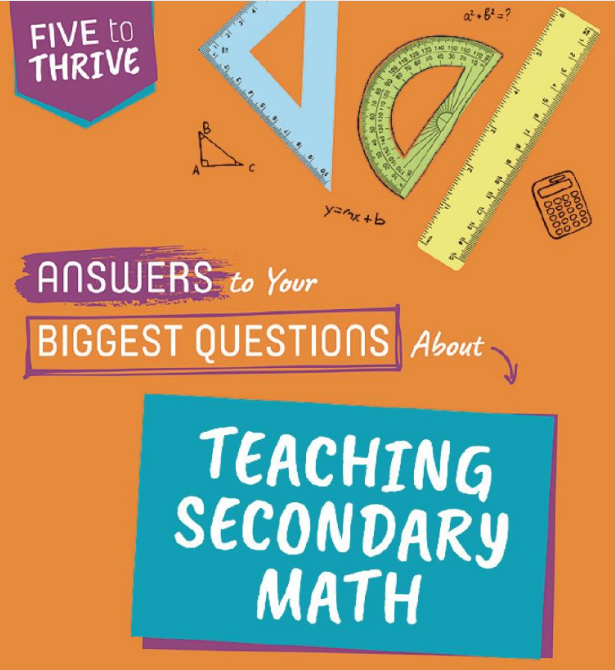
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TEAM GUDETAMA

Problem Statement:

We, car safety engineers, seek to build safety systems in order to prevent injury and fatality for drivers/eggs/gudetamas.

Table 1. Preliminary Drops

HEIGHT	RESULTS
1'	3x stable falls
2'	3x stable falls
3'	3x stable falls
4'	flipped one trial
5'	3x stable falls
6'	one trial
7'	cap difficulty

Table 2. Outside drops

HEIGHT	RESULTS
10'	one trial

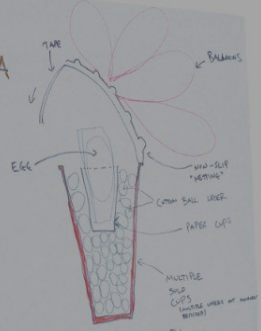


Figure 1. Safety Device Diagram

CLAIM:

TESTING PROCEDURE
 HEIGHT OF DROP
 TIME
 SHOWED WHAT GUESSES
 TO IMPROVE STABILITY +
 DESIGN BASED ON OBSERVATIONS
 (see tables 1-2... accuracy)

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