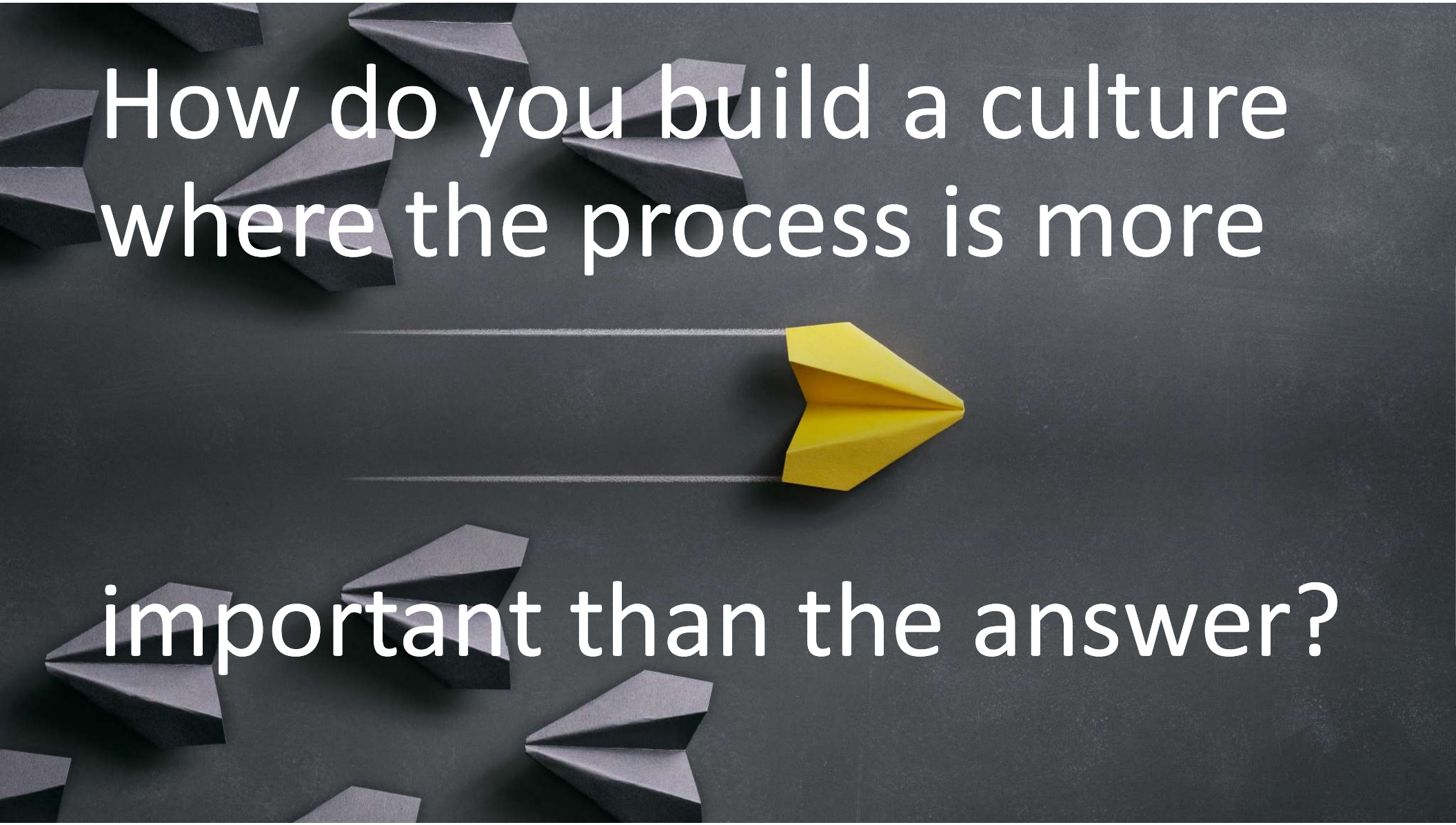
Closing the Learning Gap

Promoting Equitable Learning Practices through

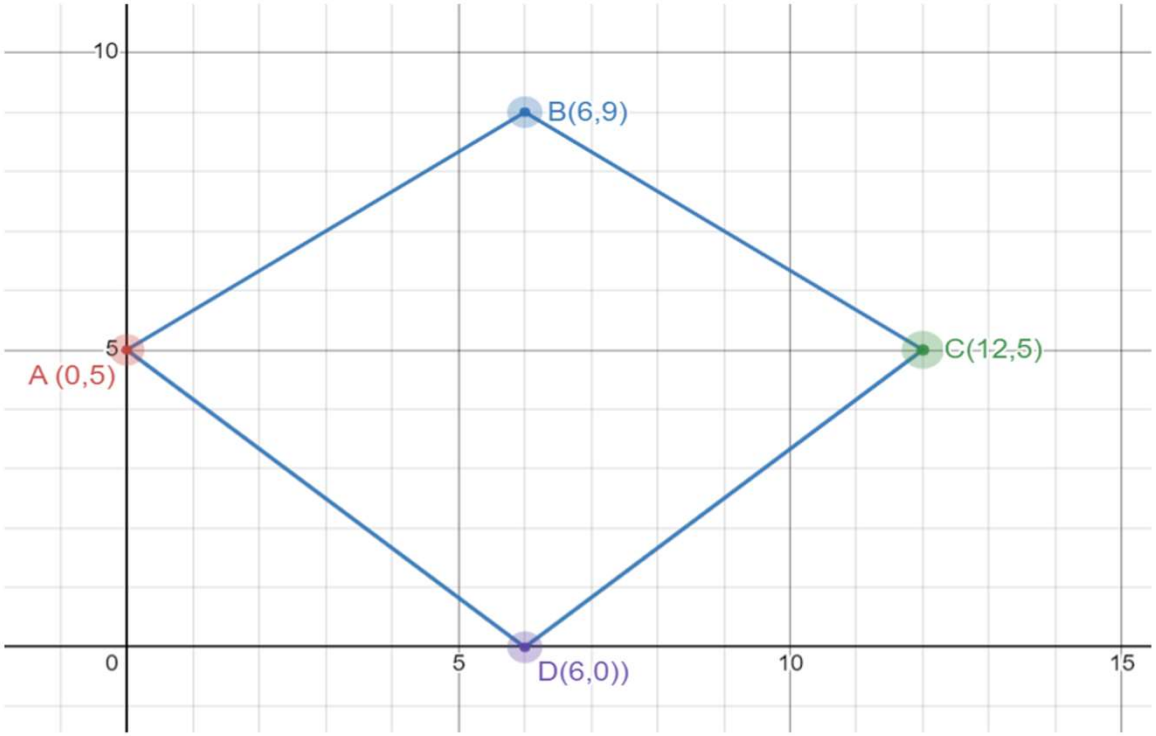
Building Thinking Classrooms

Lisa Arnholt & Ezra Gonzales

What is a Thinking Classroom?


How do you build a culture where the process is more
important than the answer?

Todd, a graphic designer, has plotted the following as the foundation of the logo he is designing for a client. He thinks his design is a rhombus. His co-worker says that it looks like a kite. Who is right?




EXPERIENCE
FIRST
FORMALIZE
LATER
STATS MEDIC


① Begin w/ a Problem
Give a problem-solving task
To start:
Problems should be
☐ engaging
☐ non-curricular
☐ collaborative
↳ promote talking
Later:
Problems can be curricular
eg textbook problems

Can you name & verify the quadrilateral?

- Given: A(1, 2), B (7 ,1), C (9, 4), D (3, 5)

1. Graph the points and draw segments DC, AB, BC, & AD.
2. Which lines look parallel? Find the slopes of the lines. Are the lines parallel?

$$slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} \qquad a^2 + b^2 = c^2$$

3. Do any 2 sides look like they are perpendicular? Multiply their slopes. Did you get -1? Repeat for any others.
4. Find the lengths of each side.
5. So what kind of quadrilateral is it?

The bacteria count in a heated swimming pool is 1500 bacteria per cubic centimeter on Monday morning at 8 AM, and the count doubles each day thereafter.

What bacteria count can you expect on Wednesday at 8 AM?

Suppose we want to know the expected bacteria count at 2 PM Thursday…

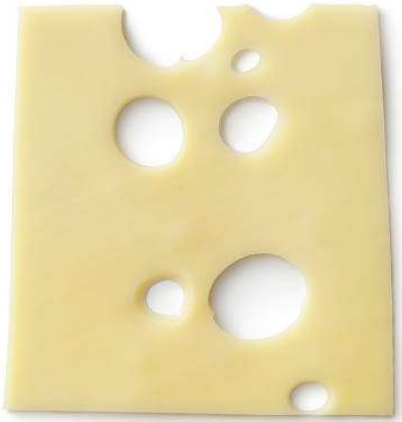
If nothing is done and the bacteria continue to double, how long will it take for the count to reach 3 million bacteria?

Can you write an equation or pattern to represent this situation?

② Visibly Random Groups

- ☐ Randomly assigned
  eg playing cards
- ☐ Daily & in front of students
- ☐ 2 or 3 students / group

- ☐ Sit & stand together



③ Vertical NonPermanent Surfaces

- ☐ Vertical
- ☐ Erasable

- ☐ 1 marker or chalk per group
  - ↳ promotes discussion

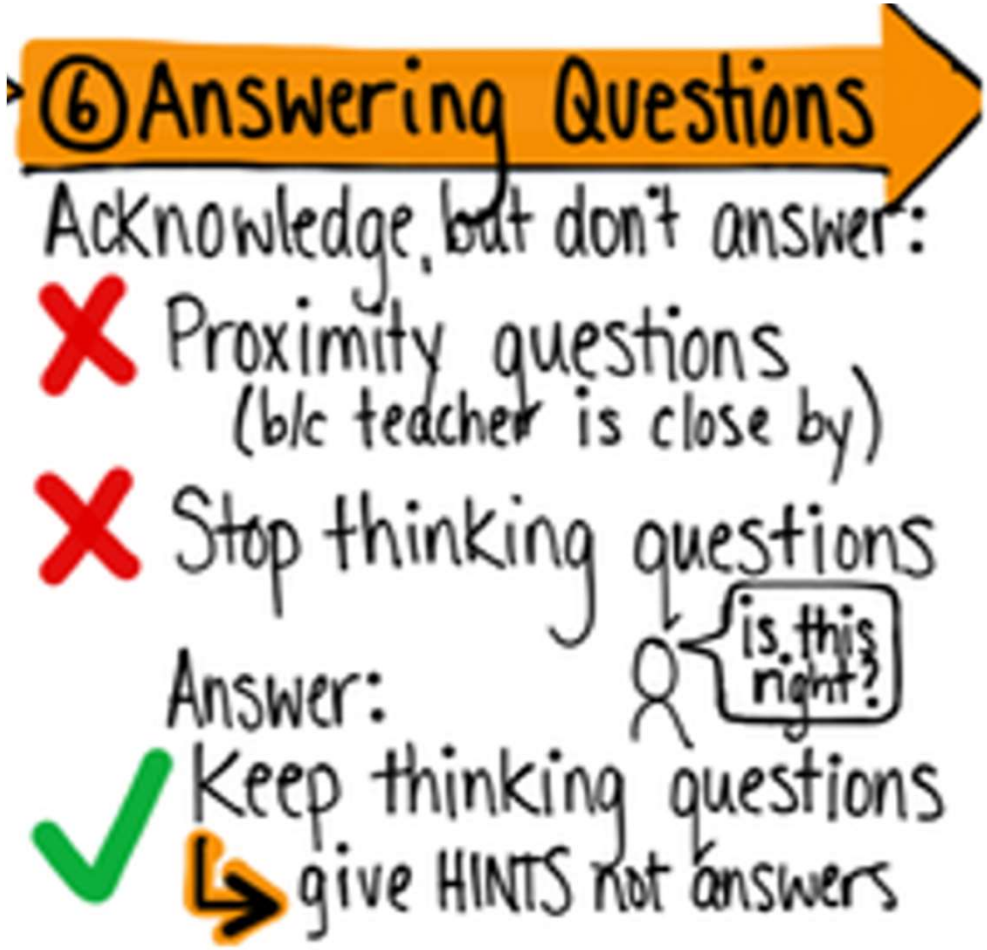

④ Oral Instructions
give instructions orally
Project
data
long expressions
diagrams
groups will discuss (instead of decoding text)

⑤ Defront the room

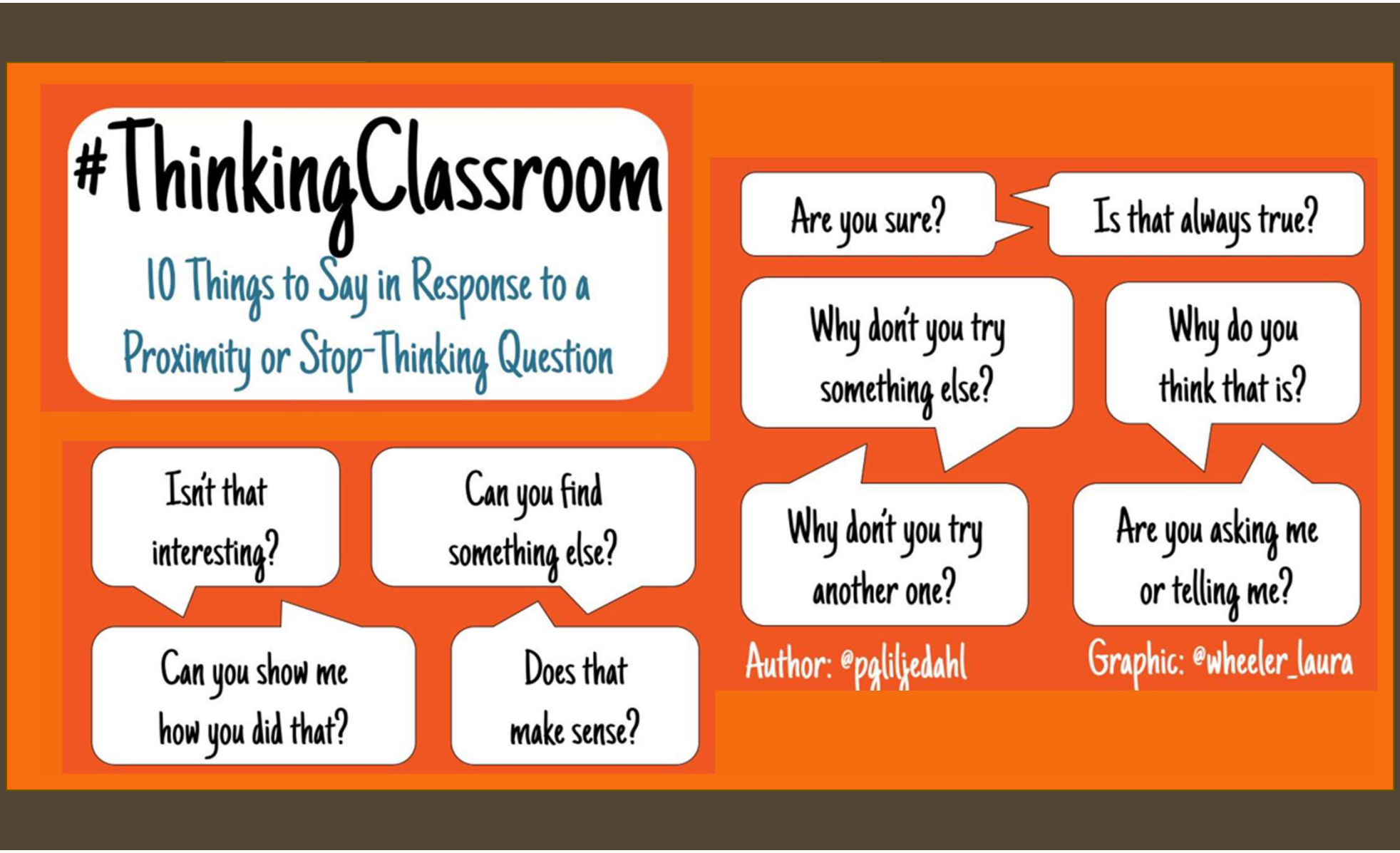
Desks

- orient in various directions
- pull away from wall (room to stand @ VNPS)

Teacher addresses the class from a variety of locations.



- It is not possible to make an example for every possible type of math problem.
- Students have to have foundational knowledge.
- Extend rather than answering any question other than a keep-thinking question


#ThinkingClassroom
10 Things to Say in Response to a Proximity or Stop-Thinking Question
Are you sure?
Is that always true?
Why don't you try something else?
Why do you think that is?
Why don't you try another one?
Are you asking me or telling me?
Author: @pgliljedahl
Graphic: @wheeler_laura
Isn't that interesting?
Can you find something else?
Can you show me how you did that?
Does that make sense?

⑦ Meaningful Notes

Student created:

- select
- synthesize
- reorganize

→ ideas

Based on their or others' boards

Provide time for this after levelling.

Page Number: _____ *Name:* _____

Title: _____ *Example 1*

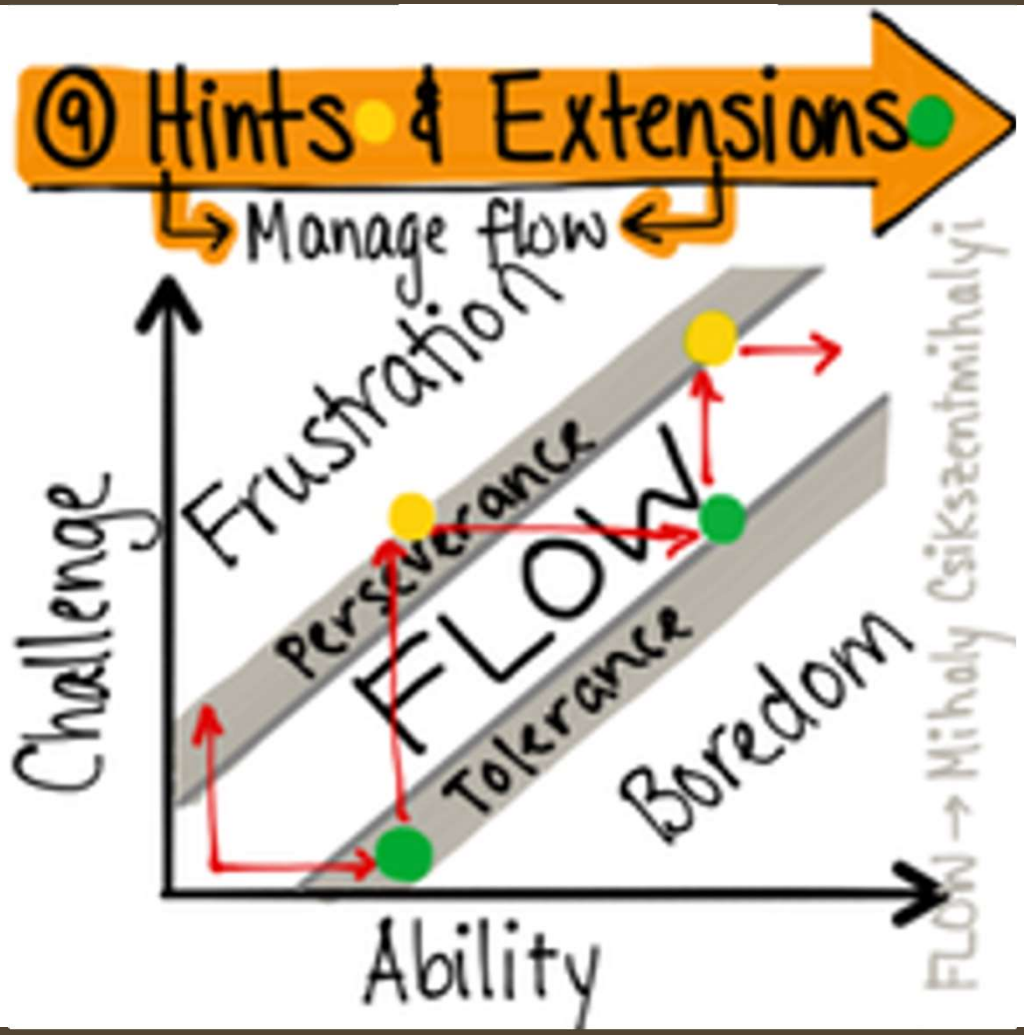
Things to Remember! *Example 2 (Your own)*

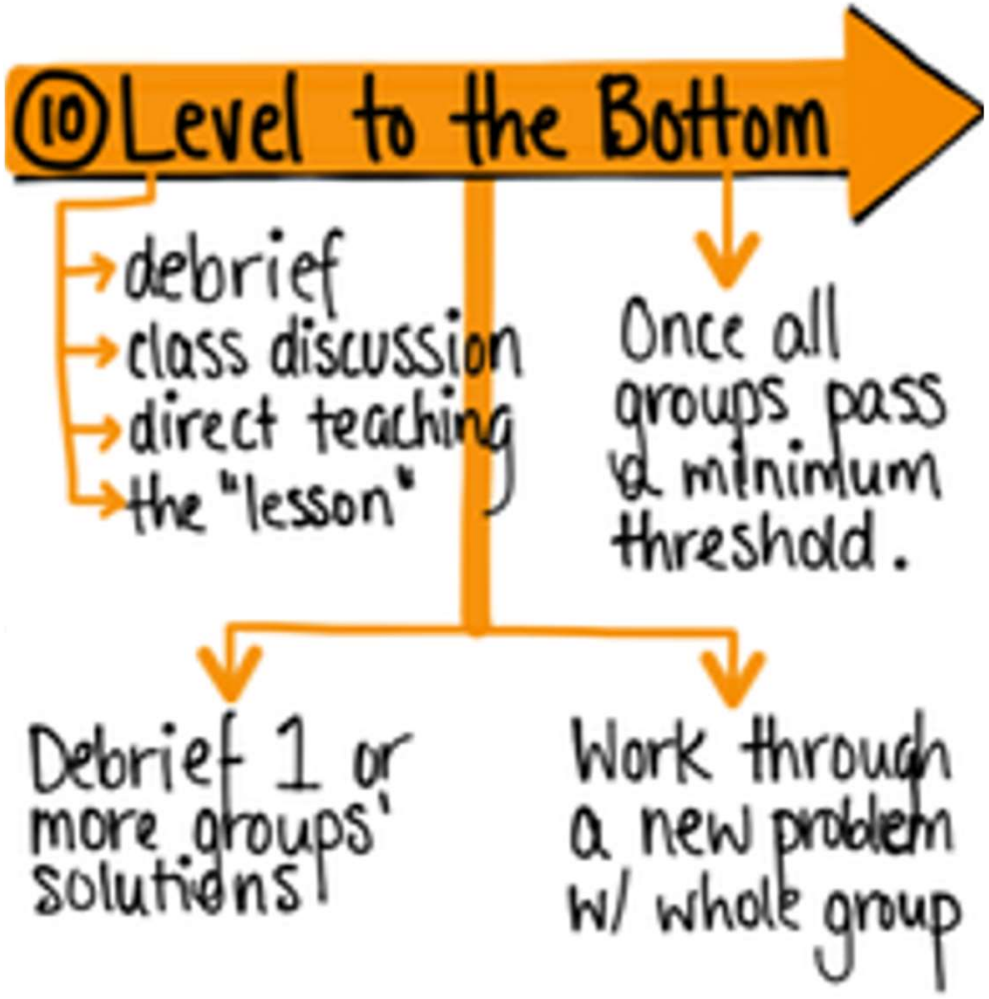
1)

2)

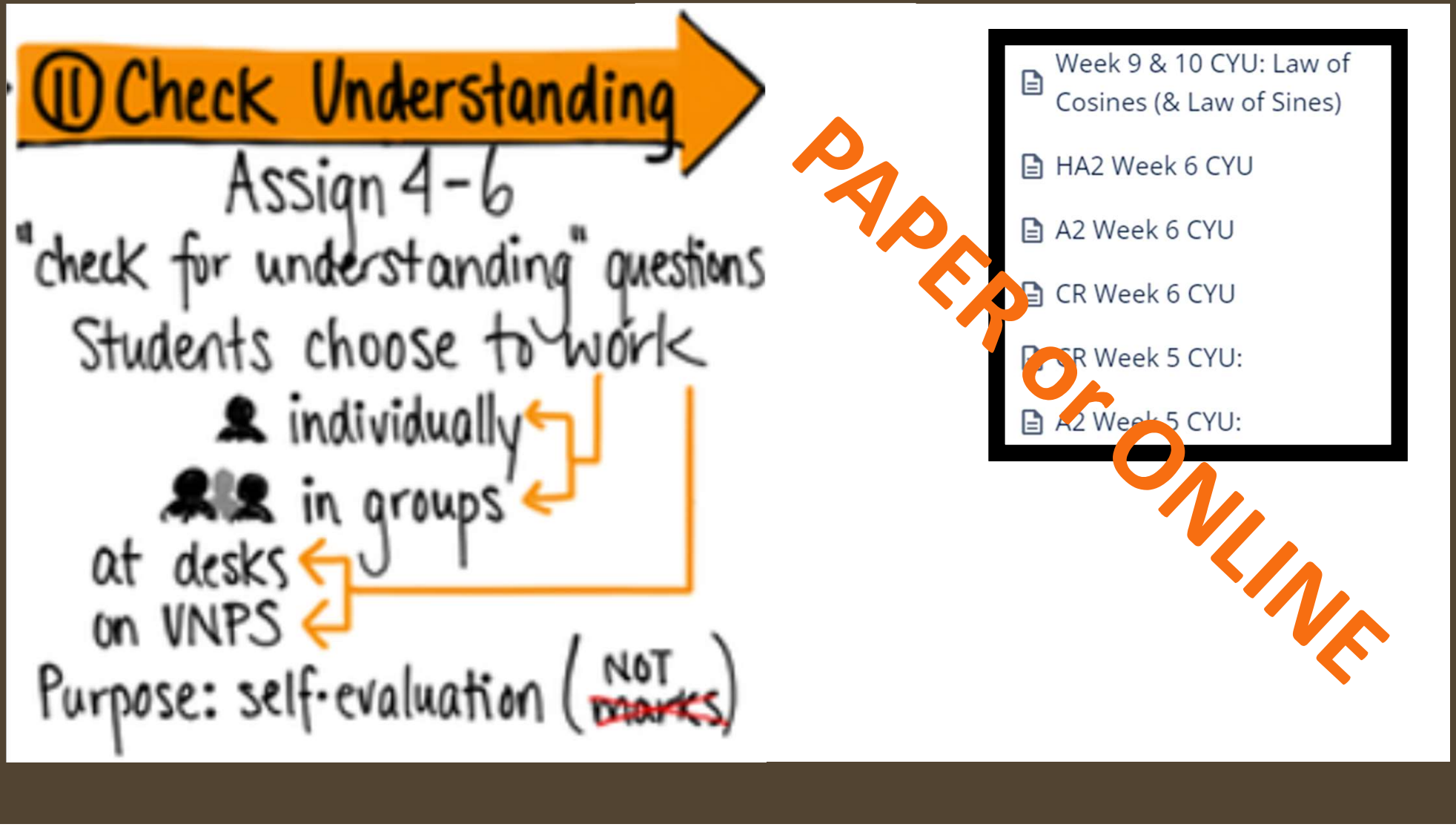
3)

Anything else?


⑨ Hints & Extensions
Manage flow
Challenge
Frustration
Perseverance
FLOW
Tolerance
Boredom
Ability
FLOW → Mihaly Csikszentmihalyi



Consolidation


⑪ Check Understanding
Assign 4-6
"check for understanding" questions
Students choose to work
individually
in groups
at desks
on VNPS
Purpose: self-evaluation (NOT ~~marks~~)
Week 9 & 10 CYU: Law of Cosines (& Law of Sines)
HA2 Week 6 CYU
A2 Week 6 CYU
CR Week 6 CYU
CR Week 5 CYU:
A2 Week 5 CYU:
PAPER or ONLINE

(12) Formative Assessment

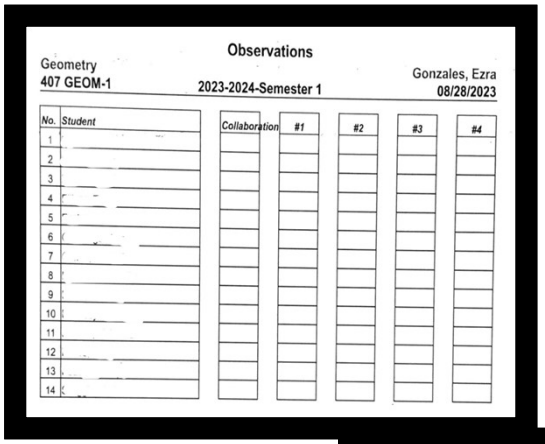
~~measure~~ → communicate

where student is currently ↔ where student is going

Multiple & varied opportunities to demonstrate learning

can't
doesn't
isn't
dis...

fully
very
completely
always



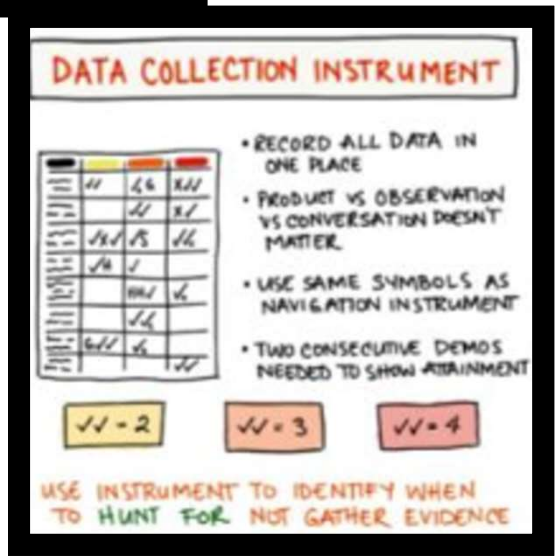
Observations

Geometry
407 GEOM-1

2023-2024-Semester 1

Gonzales, Ezra
08/28/2023

No.	Student	Collaboration	#1	#2	#3	#4
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						



DATA COLLECTION INSTRUMENT

- RECORD ALL DATA IN ONE PLACE
- PRODUCT VS OBSERVATION VS CONVERSATION DOESN'T MATTER
- USE SAME SYMBOLS AS NAVIGATION INSTRUMENT
- TWO CONSECUTIVE DEMOS NEEDED TO SHOW ATTAINMENT

√√ - 2 | √√ - 3 | √√ - 4

USE INSTRUMENT TO IDENTIFY WHEN TO HUNT FOR, NOT GATHER, EVIDENCE

⑬ Summative Assessment

PROCESS > product

Evaluate what you value!

Include:

 group + individual 

work

Spicy Chart

	Description	Point Equivalent	Percentage Equivalent
🌶	Mild Basic problems	2.0- 2.24	70-72
		2.25-2.94	73-79
🌶🌶	Medium Intermediate problems	3.0-3.44	80-89
🌶🌶🌶	Spicy Advanced Problems	3.5-4.0	90-100

	MILD	MEDIUM	SPICY
Constructions	1	3	2
Point, Lines, & Planes	6	4	5
Quadrilateral Proofs	8, 9	7	11
Lines, Angles & Transversals	10	14, 15, 18, 19	12, 13, 16, 17, 20

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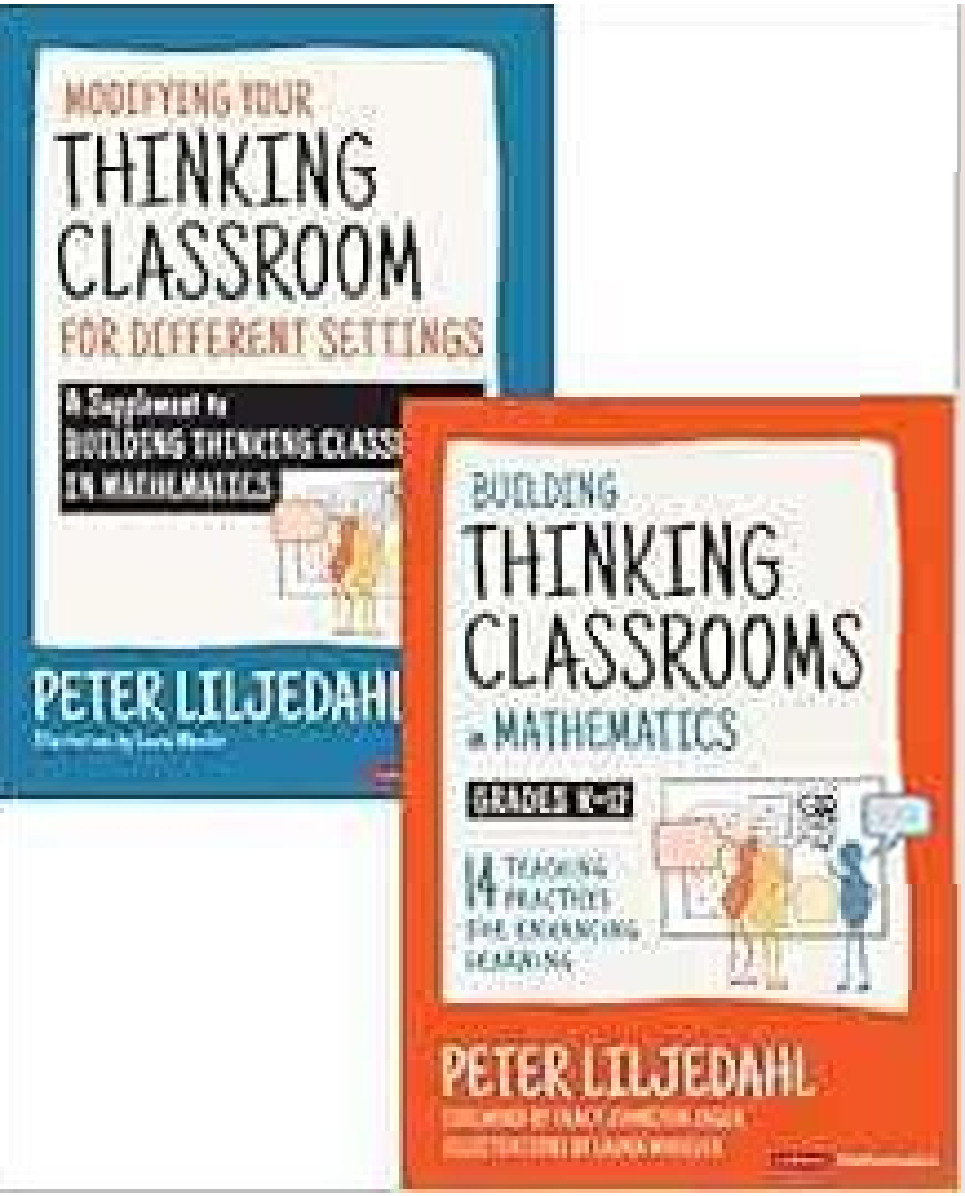

Scan the QR code to receive the PowerPoint

64th Annual Georgia Mathematics Conference
Rekindle the JOY!
2023

Scan the QR code or use the link for the session evaluation form.

https://tinyurl.com/2023GMCsessions

Scan the QR code

Math Tournament

BUILDING THINKING CLASSROOMS

Research: @pgliljedahl
Sketchnote: @wheeler_laura

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Give a problem-solving task

To start:
Problems should be
- ☐ engaging
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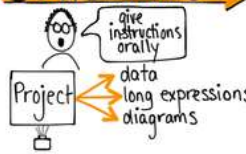


→ groups will discuss (instead of decoding text)

⑤ Defront the room

Desks
- orient in various directions
- pull away from wall (room to stand @ VNPS)

Teacher addresses the class from a variety of locations.

⑥ Answering Questions

Acknowledge, but don't answer:

✗ Proximity questions (b/c teacher is close by)

✗ Stop thinking questions (is this right?)

Answer:

✓ Keep thinking questions
  - ↳ give HINTS not answers

⑦ Meaningful Notes

Student created:
- select
- synthesize → ideas
- reorganize

Based on their & others' boards

Provide time for this after levelling.

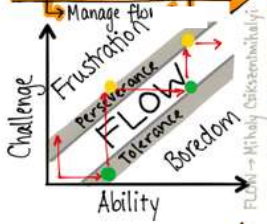
⑧ Build Autonomy

- ☐ Model how groups can visit other Groups when they are stuck or done.
- ☐ Hints & extensions come from peers (not just the teacher).

→ Helps manage flow

⑨ Hints & Extensions

↳ Manage flow



⑩ Level to the Bottom

- debrief
- class discussion
- direct teaching
- the "lesson"

Once all groups pass a minimum threshold.

Debrief 1 or more groups' solutions!

Work through a new problem w/ whole group

⑪ Check Understanding

Assign 4-6

"check for understanding" questions

Students choose to work
- individually
- in groups
- at desks
- on VNPS

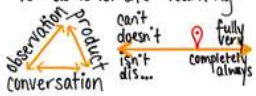
Purpose: self-evaluation (NOT ~~marks~~)

⑫ Formative Assessment

~~measure~~ → communicate

where student is currently ↔ where student is going

Multiple & varied opportunities to demonstrate learning



⑬ Summative Assessment

PROCESS > product

Evaluate what you value!

Include:

group + individual work

⑭ Reporting

Based on data (NOT ~~points~~)

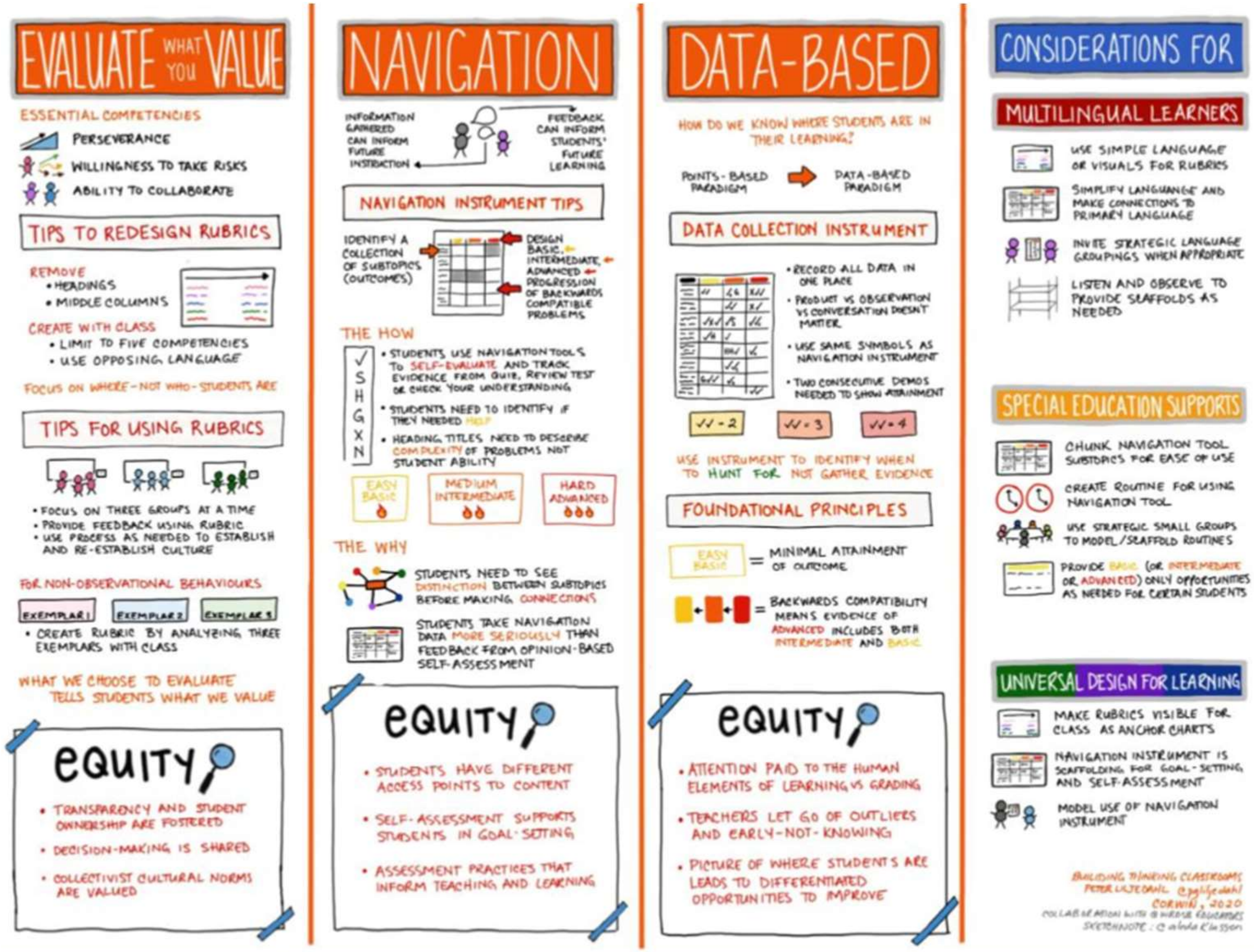
~~One aggregated mark~~

↳ disaggregated evidence

Analysis > Counting of points

What has this student learned?

What can they improve?


EVALUATE WHAT YOU VALUE
ESSENTIAL COMPETENCIES
PERSEVERANCE
WILLINGNESS TO TAKE RISKS
ABILITY TO COLLABORATE
TIPS TO REDESIGN RUBRICS
REMOVE
• HEADINGS
• MIDDLE COLUMNS
CREATE WITH CLASS
• LIMIT TO FIVE COMPETENCIES
• USE OPPOSING LANGUAGE
FOCUS ON WHERE – NOT WHO – STUDENTS ARE
TIPS FOR USING RUBRICS
• FOCUS ON THREE GROUPS AT A TIME
• PROVIDE FEEDBACK USING RUBRIC
• USE PROCESS AS NEEDED TO ESTABLISH AND RE-ESTABLISH CULTURE
FOR NON-OBSERVATIONAL BEHAVIOURS
EXEMPLAR 1
EXEMPLAR 2
EXEMPLAR 3
• CREATE RUBRIC BY ANALYZING THREE EXEMPLARS WITH CLASS
WHAT WE CHOOSE TO EVALUATE TELLS STUDENTS WHAT WE VALUE
EQUITY
• TRANSPARENCY AND STUDENT OWNERSHIP ARE FOSTERED
• DECISION-MAKING IS SHARED
• COLLECTIVIST CULTURAL NORMS ARE VALUED
NAVIGATION
INFORMATION GATHERED CAN INFORM FUTURE INSTRUCTION
FEEDBACK CAN INFORM STUDENTS' FUTURE LEARNING
NAVIGATION INSTRUMENT TIPS
IDENTIFY A COLLECTION OF SUBTOPICS (OUTCOMES)
DESIGN BASIC, INTERMEDIATE, ADVANCED PROGRESSION OF BACKWARDS COMPATIBLE PROBLEMS
THE HOW
✓ S H G X N
• STUDENTS USE NAVIGATION TOOLS TO SELF-EVALUATE AND TRACK EVIDENCE FROM QUIZ, REVIEW TEST OR CHECK YOUR UNDERSTANDING
• STUDENTS NEED TO IDENTIFY IF THEY NEEDED HELP
• HEADING TITLES NEED TO DESCRIBE COMPLEXITY OF PROBLEMS NOT STUDENT ABILITY
EASY BASIC
MEDIUM INTERMEDIATE
HARD ADVANCED
THE WHY
STUDENTS NEED TO SEE DISTINCTION BETWEEN SUBTOPICS BEFORE MAKING CONNECTIONS
STUDENTS TAKE NAVIGATION DATA MORE SERIOUSLY THAN FEEDBACK FROM OPINION-BASED SELF-ASSESSMENT
EQUITY
• STUDENTS HAVE DIFFERENT ACCESS POINTS TO CONTENT
• SELF-ASSESSMENT SUPPORTS STUDENTS IN GOAL-SETTING
• ASSESSMENT PRACTICES THAT INFORM TEACHING AND LEARNING
DATA-BASED
HOW DO WE KNOW WHERE STUDENTS ARE IN THEIR LEARNING?
POINTS-BASED PARADIGM
DATA-BASED PARADIGM
DATA COLLECTION INSTRUMENT
• RECORD ALL DATA IN ONE PLACE
• PRODUCT VS OBSERVATION VS CONVERSATION DOESN'T MATTER
• USE SAME SYMBOLS AS NAVIGATION INSTRUMENT
• TWO CONSECUTIVE DEMOS NEEDED TO SHOW ATTAINMENT
✓✓ - 2
✓✓ - 3
✓✓ - 4
USE INSTRUMENT TO IDENTIFY WHEN TO HUNT FOR NOT GATHER EVIDENCE
FOUNDATIONAL PRINCIPLES
EASY BASIC = MINIMAL ATTAINMENT OF OUTCOME
= BACKWARDS COMPATIBILITY MEANS EVIDENCE OF ADVANCED INCLUDES BOTH INTERMEDIATE AND BASIC
EQUITY
• ATTENTION PAID TO THE HUMAN ELEMENTS OF LEARNING VS GRADING
• TEACHERS LET GO OF OUTLIERS AND EARLY-NOT-KNOWING
• PICTURE OF WHERE STUDENTS ARE LEADS TO DIFFERENTIATED OPPORTUNITIES TO IMPROVE
CONSIDERATIONS FOR
MULTILINGUAL LEARNERS
USE SIMPLE LANGUAGE OR VISUALS FOR RUBRICS
SIMPLIFY LANGUAGE AND MAKE CONNECTIONS TO PRIMARY LANGUAGE
INVITE STRATEGIC LANGUAGE GROUPINGS WHEN APPROPRIATE
LISTEN AND OBSERVE TO PROVIDE SCAFFOLDS AS NEEDED
SPECIAL EDUCATION SUPPORTS
CHUNK NAVIGATION TOOL SUBTOPICS FOR EASE OF USE
CREATE ROUTINE FOR USING NAVIGATION TOOL
USE STRATEGIC SMALL GROUPS TO MODEL/SCAFFOLD ROUTINES
PROVIDE BASIC (OR INTERMEDIATE OR ADVANCED) ONLY OPPORTUNITIES AS NEEDED FOR CERTAIN STUDENTS
UNIVERSAL DESIGN FOR LEARNING
MAKE RUBRICS VISIBLE FOR CLASS AS ANCHOR CHARTS
NAVIGATION INSTRUMENT IS SCAFFOLDING FOR GOAL-SETTING AND SELF-ASSESSMENT
MODEL USE OF NAVIGATION INSTRUMENT
BUILDING THINKING CLASSROOMS
PETER LILJEDAHL @pgliljedahl
CORWIN, 2020

References

- Liljedahl, P. (2020). Building thinking classrooms in mathematics, grades K-12: 14 teaching practices for enhancing learning. Corwin Press.
- Boaler, J. (2016). Building a strong foundation in mathematics. Educational Leadership, 74(2), 10-15.
- Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. Proceedings of the National Academy of Sciences, 116(39), 19251-19257.
- Ferlazzo, L., & Hull-Sypneski, K. (2018, September 11). Differentiating instruction: It's not as hard as you think. YouTube. https://www.youtube.com/watch?v=h7-D3gi2lL8
- Gross, B., Tuchman, S., & Patrick, S. (2018). A national landscape scan of personalized learning in K–12 education in the United States. Vienna, VA, US: iNACOL. Retrieved from https://www.inacol.org/wpcontent/uploads/2018/06/iNACOL _ANationalLandscapeScanOfPersonalizedLearning.pdf
- Harris, A., & De Bruin, L. (2018). An international study of creative pedagogies in practice in secondary schools: Toward a creative ecology. Journal of Curriculum and Pedagogy, 15(2), 215-235.
- Nortvedt, G. A., & Buchholtz, N. (2018). Assessment in mathematics education: Responding to issues regarding methodology, policy, and equity. ZDM, 50(4), 555-570. Assessment in mathematics education: responding to issues regarding methodology, policy, and equity | SpringerLink.
- Seeley, C. (2015). Smarter than we think: More messages about math, teaching, and learning in the 21st century. Stenhouse Publishers.
- Selbach-Allen, M., Williams, C., & Boaler, J. (2020). What would the Nautilus say? Unleashing creativity in mathematics!. Journal of Humanistic Mathematics, 10(2), 391-414.
- Steele, M. D. (2019). Tools for facilitating meaningful mathematics discourse. Mathematics Teaching in the Middle School, 24(6), 354–361. https://doi.org/10.5951/mathteacmiddscho.24.6.0354
- Weispfennig, M. (2021). Developing mathematical thinking in high schoolers through "curricular thinking tasks" [Masters capstone project, Hamline University; St. Paul]. Digital Commons. https://digitalcommons.hamline.edu/hse_cp
- learning-in-the-loo-1.jpg (1632×1056) (wordpress.com)