MANAGING COLLEGE GROUP WORK & CREATING GROUPWORTHY TASKS

Eric Hsu
Director, Center for Science and Math Education
Professor of Mathematics
MY BACKGROUND

➤ Teaching college math since 1989, tenure track since 2001
➤ Work with ES, MS, HS, 2YC, Univ instructors, pre-service and in-service
➤ 1993-95. Treisman PDP Workshops
MATH TEACHER FOLK BELIEFS
I AM THE TEACHER BECAUSE I CAN DO MATH MORE QUICKLY, CORRECTLY AND PRECISELY THAN YOU.

➤ responsible for creating a learning environment, not defeating students in math showdowns

➤ very threatening to make mistakes or not know (confirm imposter syndrome)

➤ incentive to reduce risk, display superiority
We hate spiraling back and reviewing.

Cultural teacher norm to complain: "Can you believe students can't do X?"

Hard to conceive of college level algebra.

by definition, it’s stuff you "got past" in high school.
MATH IS A LADDER. TEACHING MEANS GETTING STUDENTS “BEYOND” MATERIAL.

➤ Contrast: English Composition
➤ Get past essays? Sentences?
➤ Bigger words, write faster under pressure?

➤ Want complex, creative argument
➤ fluent metaphors & representations
➤ beyond rote recipes (5 para)
➤ address novel situations
➤ understand/convince arguments of others
MATH TEACHER FOLK BELIEFS 3

SLOW STUDENTS JUST Aren’t “MATH PEOPLE” OR ARE “LAZY”. FAILING A LOT OF STUDENTS MEANS I HAVE “HIGH STANDARDS”.

➤ Fixed / growth mindset
➤ Self-control is fragile
➤ Double Marshmallow Test, bad crayons/stickers, 4x wait
  ➤ Suspicion breeds suspicion. It’s a trap!
➤ https://doi.org/10.1016/j.cognition.2012.08.004
➤ Belonging - 30% drop in IQ w “alone” prediction
MATH TEACHER FOLK BELIEFS 4

REAL MATH IS INCOMPREHENSIBLE.

➤ Research Talks culturally required to baffle.
  ➤ Talks must lose people in 10:00, 30:00 max.
  ➤ Else, your work is trivial and you are dumb.
  ➤ (Also have to lose people or they might find a mistake.)
  ➤ Baffling = hard math, not horrible communication
➤ Many of us survived courses where 50+% failed
  ➤ High standards! Proud & survivor remorse.
➤ In this culture, grad students learn to teach.
MY METHOD OF GROUP WORK
CLASS OVERVIEW

➤ Minor setup or debrief or review of last class
➤ Team problem solving on large surfaces
➤ Whole class discussions at checkpoints
➤ More group work / whole class cycles
  ➤ Group work: brain exercise, reorganizing, curiosity, inventing, idea play, prep to understand checkpoint
  ➤ Whole class checkpoints (including wrap up) for closure, academic language, consolidation, status
➤ Online HW, computer graded, symbolic aerobics.
➤ (once) flipped class videos - no one watched
LARGE SURFACES

➤ The groups work at large surfaces.
➤ Bring breath mints, friendly way to circulate
➤ Blackboards/Whiteboards
  ➤ When wall space is available, I use static paper which turns walls into whiteboard space.
  ➤ Lacking wall space, you can use easels or small whiteboards.
NORMS AND FRAMING

➤ Tend to model through enforcement rather than have an explicit covenant.
➤ Equity of voice
➤ Be present
➤ Criticize ideas not people
➤ Groups leave no one behind, no solo questions
➤ "If you solve my task right away, I gave you the wrong task."
➤ "Working out your brain muscles requires resistance. I'm your personal trainer."
➤ I’m not the border patrol trying to catch them.
GROUPING STUDENTS

➤ Some approaches by others:
➤ Set roles, like in Complex Instruction.
   ➤ Organizer, reporter, questioner, resource monitor
➤ Heterogenous or homogeneous “ability” grouping
➤ My approach
   ➤ Alternate between openly random groups (no more than 4) and letting them pick.
   ➤ I don't do any "ability" based algorithms, on purpose.
       ➤ Student speed depends on the task.
➤ Also, toxic to guess you're in the "low" category
SOME OPENLY RANDOMIZING METHODS

➤ count off modularly to $N$
➤ count off by compass direction
➤ count off and divide by $N$ and find your remainder (hard)
➤ group by last name, by birth month
➤ hand out cards when they arrive
➤ find at least one person you haven't worked with
MANAGING GROUPS OVERVIEW

➤ Three parallel managements
➤ Class progress triage
➤ Group equity and integrity
➤ Group's task progress
CLASS PROGRESS TRIAGE 1

➤ Give tasks on worksheets (can pace selves)
➤ Sometimes give quiet time to begin on own.
➤ Send groups to large work surfaces. Scan the room. Listen.
➤ Classify groups into Done, In Progress, Stuck
➤ (Later, different recipes for each)
➤ Circulate quickly and probe. 1-2 min per group.
➤ “I'll be back in 2 minutes.”
➤ Leave no one behind. No free-riding on dominants.
  ➤ “Is this everyone's answer? So everyone can explain this?”
  ➤ Ask a random person to respond, Fickle Pen of Fate
  ➤ Ask a random to continue
  ➤ “I want you to come to an agreement.”
➤ No solo questions
  ➤ “Did you discuss this together?”
  ➤ “Is this a group question?” (“Hey, X has a good question I’d like you all to focus on.”)
  ➤ “Let’s talk after class.”
VIDEO EXAMPLE

DAY 1 TASK: FLAG HOIST
TASK 1: FLAG HOIST
Spread status, appreciate different strengths
Symbolic speed, but also...
Graphic skill, synthesizing ideas, facilitating a group, thinking out of the box, communicating well, bravely asking the “stupid” question.

Don't steal their thunder.

Why help other students?

Employers say “Students are smart. Can you explain? Can you work with people?”

“I understood math a lot better once I started teaching it.”
GROUP PROGRESS: STUCK AND IN-PROGRESS

➤ Stuck, In Progress, Done.
➤ “What have you tried?”
  ➤ If multiple efforts, try to get group entirely behind a productive one.
  ➤ If promising work, tell them to keep trying that.
  ➤ If lost, encourage. Give a sub-problem or instructive simple example to work out.
  ➤ Last resort, give a direct hint on an approach.
➤ In-Progress = Stuck, but optimistic and want less help.
  ➤ Same treatment, get them on productive path.
GROUP PROGRESS: DONE

➤ “Is this a group answer?”

➤ Make sure everyone can explain it. Fickle Pen of Fate. Rotate to continue the answer.

➤ If multiple answers or group troubles, “Please get on same page.” Treat as In Progress.

➤ If wrong answer, “Isn’t it strange that…?” An absurd consequence of the wrongness. Now In Progress.

➤ Probe beyond “right”. Check that they understand their answer with a followup Q (if time)

➤ “Take a minute to pat yourselves on the back.” "Do you want a bonus task?" "What would be a good task for you?" Then extension or next task.
WHOLE CLASS CHECKPOINTS 1

➤ If most of class is stuck, whole class discussion.
➤ “Let’s check in about Problem 2.”
➤ (for common pitfalls) “Why do groups have different answers for part (a)? Who is right?”
➤ “Look around the boards to see people’s graphs.”
➤ “What are approaches we know to find X?”
➤ “What have people tried?”
➤ “Can a group that made progress please give a hint?”
WHOLE CLASS CHECKPOINTS 2

➤ When most of the class has made enough progress to benefit from a discussion
  ➤ Lock in academic language, a standard approach, or a definition
  ➤ Harmonize multiple approaches and representations
  ➤ Harmonize answers with different conclusions or generality
  ➤ Give status to crazy, creative answers
  ➤ “I’ll wait for four brave volunteers to report.”
➤ Volunteer groups if you’re going to give them high status. (Sometimes interesting wrong answers.)
  ➤ Thumb polls & questions. "How many of you follow this?"
VIDEO EXAMPLE

FLAG HOIST PART 2
WHICH IS THE MOST REALISTIC FLAG HOIST?

(C) 

(D) 

(E) 

(F)
SCANNING THE ROOM & TAKING HANDS
GIVE STATUS TO CREATIVE, CRAZY ANSWERS
FLAG HOIST GOALS

➤ Draw a proper graph (height as function of time)
➤ Verbal argument *attending to features of graph*
➤ Care around Academic language
  ➤ Constant / non-constant, Slope and Increasing/decreasing, Concave down/up
➤ Connect physical intuition, common sense
➤ Feel brave diving into non-rote problem
➤ Accept inventive, crazy answers
➤ Work together better, establish norms
  ➤ Four hands, give reasons, convince each other

➤ Want complex, creative argument
➤ Fluent metaphors & representations
➤ Beyond rote recipes
➤ Address novel situations
➤ Understand/convince arguments of others
GROUPWORTHY TASKS
ROUTINE TASKS

➤ Bore the quick and give them oversize status
➤ Depress the slower
➤ Make group work forced and artificial
➤ Not inspire argument / convincing
A GROUPWORTHY TASK

➤ has a “mysterious” part that is mathematical.
➤ is hard.
➤ has little visible scaffolding.
➤ has multiple ways to start.
➤ has multiple ways to be solved.
➤ has interesting partial solutions.
➤ has natural extensions.
➤ encourages getting your hands dirty with data.
➤ gives teachers information about student thinking.
➤ is open enough to let students be ingenious.
WAYS TO CREATE A GROUPWORTHY TASK

➤ Un-structure a scaffolded task. Take the scaffold and turn them into pocket hints.
   ➤ Flag hoist hints: “now estimate the slope at three points”, “describe what the hoister is doing at t=0, 2 and 4.”
➤ Ask them to interpret, or decide something due to a calculation (most realistic, speeding ticket)
➤ Convert between representations
   ➤ Graphs, tables, verbal, symbolic, kinesthetic
   ➤ Good side-effect: Easy to scan the room
➤ Routine tasks, prematurely. Before official algorithm.
   ➤ Then mini-lecture the routine recipe.
MORE ON RICH, GROUP WORTHY PROBLEMS
