Engaging Students –
The Devil is in the Details

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While waiting–
If you came alone, please find a partner and introduce yourselves!

Recall a favourite professor who made you think in class, or who provoked great discussions.

- What three things did he/she do to make that happen?
- Identify one specific action that made her/his methods work, while other professors may have failed?
- (Keep your notes!)

Example of a PRE-TEST
-No way to lose
-Positive memories
-Immediate engagement with 100% safety.
-Invokes personal experience and observation

What is Active Learning?

- Instructional activities which involve students in doing things

AND

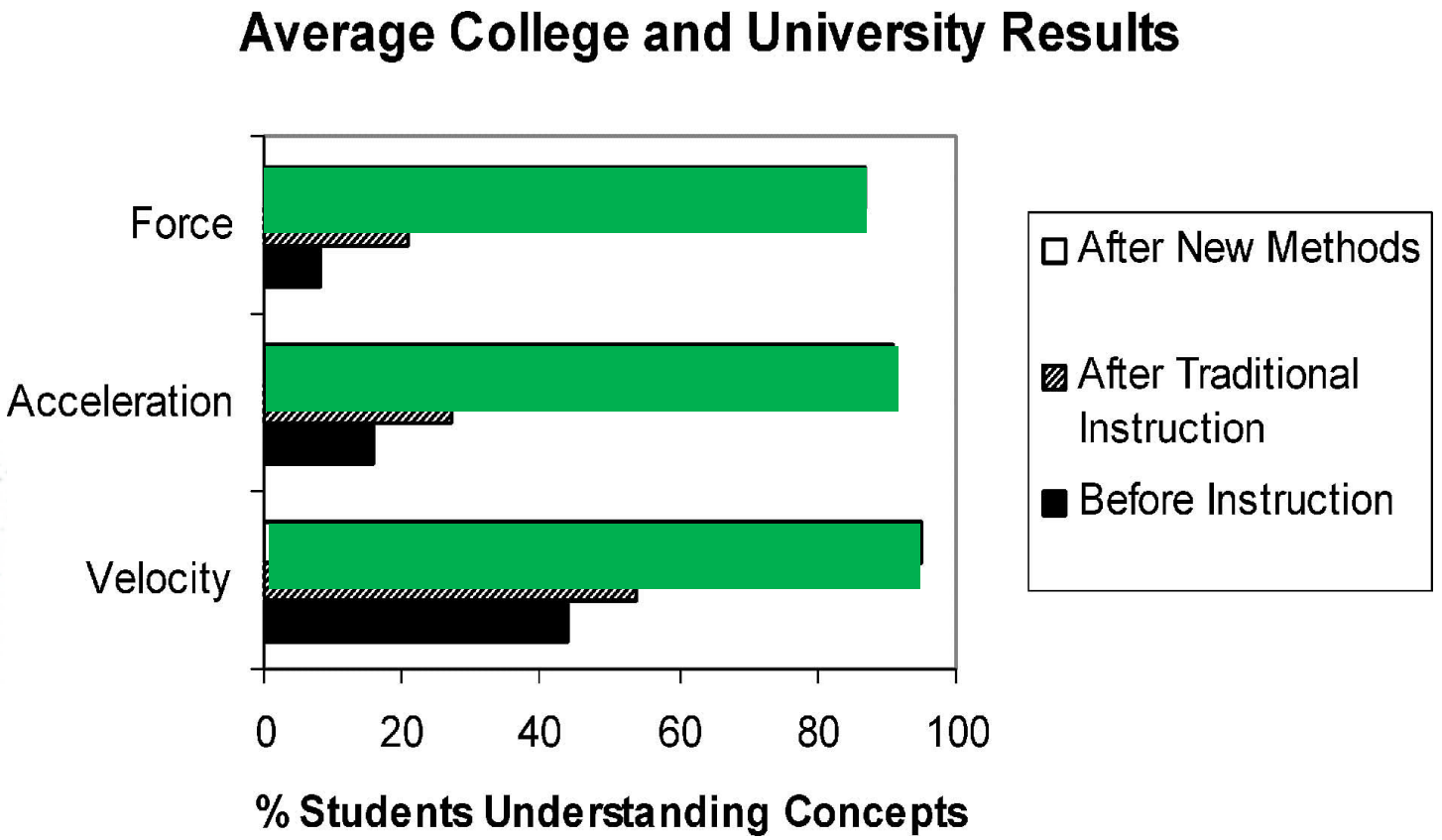
- Questions which get them thinking about what they are doing.

From Chickering, Arthur W., and Zelda F. Gamson. March 1987. "Seven Principles for Good Practice." AAHE Bulletin 39: 3-7. ED 282 491. 6 pp. MF-01; PC-01.

How many of your favorite professors did this?

(Note the anonymous show of hands with the correct answer already revealed!)

Does it really make a difference?



- *Active-engagement vs. traditional instruction for improving students' conceptual understanding of basic physics concepts* (Laws, P., D. Sokoloff, and R. Thornton, "Promoting Active Learning Using the Results of Physics Education Research," *UniServe Science News, Vol. 13, July 1999; see also Carl Weiman's work at UBC.)*

Why NOT active learning?

- It is scary because it is a new skill.
- It can make you excruciatingly vulnerable because you have to learn in front of your students.
- Some of the students will not engage.
- Sometimes you have to give up control over what happens!
- Time is needed for debrief so you cover “less material”.

….wow.

Who is having the best learning experience during a lecture?

- What learning styles does a 50 minute lecture address or not address for the students?
- What learning styles does lecturing address or not address for the instructor?
- *Note: some learning style preferences include visual, verbal, reflective, active, kinesthetic, global, sequential, sensing, intuitive etc.*
- *Please discuss this with your partner.*

Now get the students TALKING to each other
-Leading questions
-Very specific tasks.
-Prompt with some necessary information.
-Note that the physical barriers were removed before class started!

…sad but true.

- Lecturing is a fantastic way to learn.
- But it is not such a fantastic way to teach!

- Lecturing is a lot of fun to do.
- But (with some rare exceptions) it is not as much fun to watch!

"Please stop your learning so that I can talk!"
STLHE Keynote, Calgary, 1999

How and When to do it?

- Do it early in the course.
- Do it regularly.
- Always do it when there is a tough concept to master, or you want to reach affective domains of learning.
- It is OK to implement this slowly!

Some Examples

1. Review of unit conversions and basic concepts eliminated 3 (boring) review lectures and show students the next level of thinking expected. *THINK-PAIR-SHARE*
2. Psychrometric Charts – a Freaky Friday toward the end of term when they are encouraged to color in their textbooks – *trouble shooting/critique*.
3. *TAPPS – thinking aloud paired problem solving* – a great way to move through a long example or analysis in one class!

Units and Conversions Handout

CME 265 Lecture 2: Units and Conversions

Answer the following questions as far as you are able on your own. Then compare your answers with a neighbour. After 10 minutes, we will discuss the answers.

1. Conversions. 1000 bbl/day of oil flows through a 4.00 inch internal diameter pipe. What is its volumetric flow rate in m^3/s? What is its velocity in m/s?
   (bbl=barrel=42 gallons, $1m^3$=264.17 gal, 1m=39.37in)

Outcomes

- Discussion puts the emphasis on changed expectations
  - *Complex, multistep unit conversions*
  - *Getting velocity from volumetric flow rate*

Think-Pair-Share allows the students to continue to build confidence:

-First they understand the question on their own

-Then they can compare their answer with a friend

-Now they are ready to have a discussion as a group and to ask questions!

-In the first 30-50 minutes of the course, (I hope) we have built a culture of trust and engagement.

The Devil is in the Details!

- Identify a single learning objective
- Focus your question – clear and short
- Prepare materials so that no time is spent copying things down
- Allow twice as much class time for debriefing as you think will be needed
- Present the task clearly, and give a time limit (5 minutes works well)
- Debrief – find out what the students learned and where they got stuck – don’t give away the answer, find out what their answers are.

Example 2: Psychrometric Chart

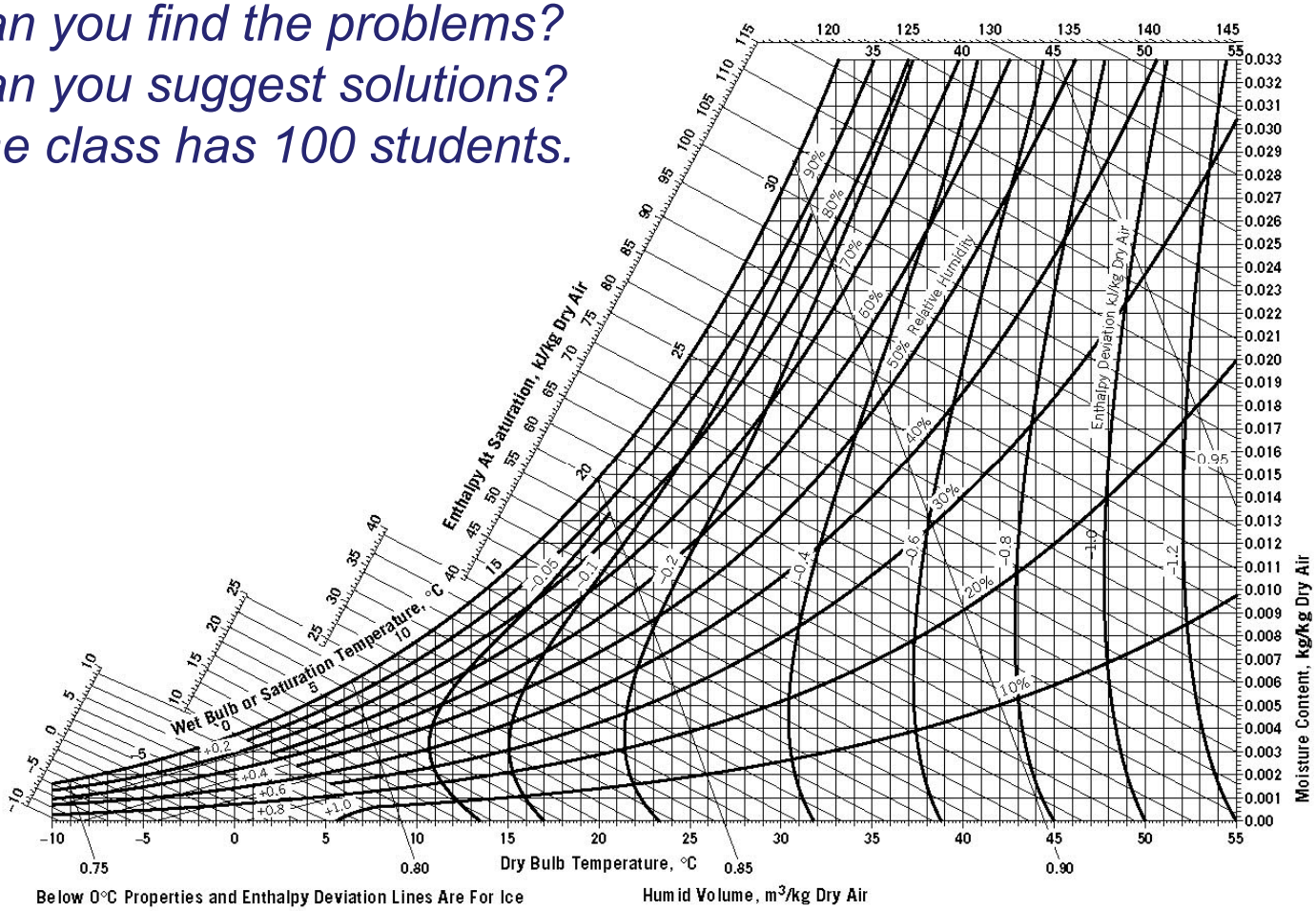
Think-Pair-Share again.

-This form of the example failed.

-Can you find the problems?

-Can you suggest solutions?

-The class has 100 students.



Psychrometric Chart

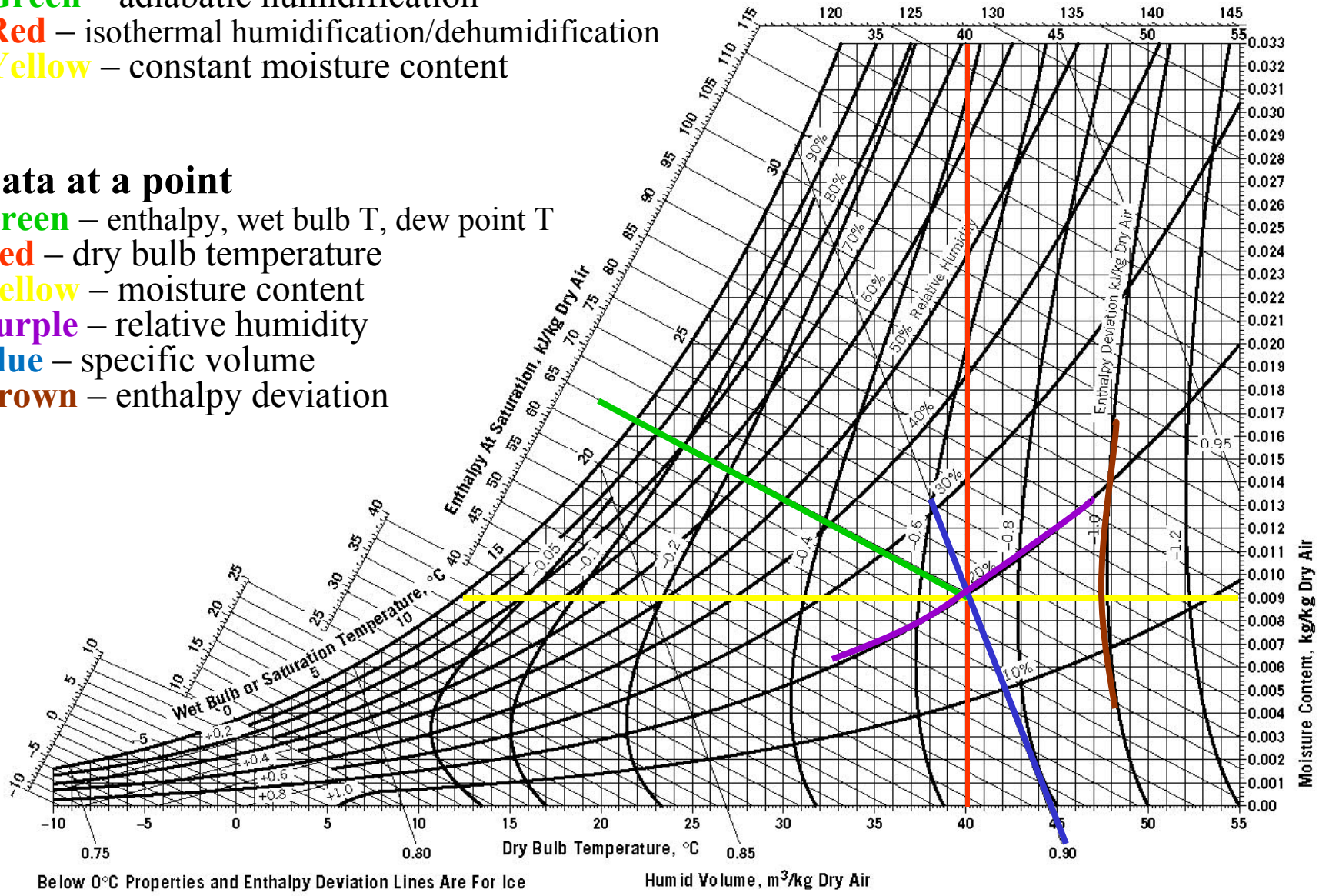
- Hand out copies of the chart and lots of color pencils
- Assignment: Navigate the Charts
  - *First the students color the charts*
  - *Then discuss the meaning of each line*
  - *In coloring the charts, they become familiar with which line belongs where, and in the discussion they become acquainted with the physical meaning of each line*
- Follow up in the Monday lecture with two examples.

Paths

Green – adiabatic humidification
Red – isothermal humidification/dehumidification
Yellow – constant moisture content

Data at a point

Green – enthalpy, wet bulb T, dew point T
Red – dry bulb temperature
Yellow – moisture content
Purple – relative humidity
Blue – specific volume
Brown – enthalpy deviation



Psychrometric Charts for Humid Air Material and Energy Balances

Coloring your own chart:

- Get into groups of six, and take a set of six pencils for your group: red, green, yellow, brown, blue and purple.
- Open your text to Figure 8.4-1
- Starting at the line “40°C” color the dry bulb temperature line red.
- Continue with the 5 other sets of lines following the color legend from the previous slide.
- Your job is to color code your chart accurately by swapping pencils within your group

Think-Pair-Share again.
-This form of the example failed.
-Can you find the problems?
-Can you suggest solutions?
-The class has 100 students.

Some problems and solutions

- Random color coding: group pencils with elastic.
- Instructions and chart on separate pages: repeat instructions twice and put all key information with the chart.
- Forgotten texts. Bring charts to class.
- Too slow. Buy more pencils and make smaller groups.
- Allow a whole class for coloring and discussing the chart.
- Pause for questions and discussion every 5-10 minutes.
- Post animated slides and example problems on the course website

Outcomes

- Visual learning - use of color as a memory aid is much easier than e.g. “horizontal lines”
- Builds concepts step by step
- Discussion of studying and how to use textbooks, value of keeping your book as a reference
- They get it, and they laugh about it, and then they use it at work.

Notice how this example felt – if your group really got on the playing field, you may have had some fun with brainstorming as well as with critiquing the “authority”.

TAPPS

- Thinking Aloud Paired Problem Solving
- Ideal for long problems, or complex discussion.
- One example:
  - *Work out the solution to a long example problem.*
  - *Hand out copies to the students, who work in pairs. (also works for text, essay, or other analysis)*
  - *For the first 5 minutes, student A explains the solution, while student B can only ask questions.*
  - *Pause for group discussion and clarification*
  - *Students trade roles.*
- Allows coverage of a 2 hour example in a 50 minute class, with the students critiquing my solution in the process!

Questions about TAPPS?

Classroom assessment: Measure learning results.

Did this group get to the point of mastering classroom engagement?

-Lots of simple questions about TAPPS are open

-Psychrometric chart critique was designed to build confidence and gives permission to speak and contribute solutions!

-Did we generate enough enthusiasm to get active engagement with a higher risk activity?

A final question

- Return to your notes about your favorite professor.
  - *Did he/she use active learning?*
  - *Where there methods they used that we did not cover here?*
  - *Under the "What made it work?" is there anything for us to add?*

Post test: Notice the impact the debrief has on the students!

Be generous with your discussion and listening time!

"If you do not allow your students to contribute to you, they will get you for it!
Shelley Newmarch, 1991

Thanks for a great session!

A final note.

When I do a "show" for a research conference, I use 35 slides in 20 minutes.

This presentation used 22 slides for 90 minutes.

You will have to trust your students to learn...