

The only teaching that a professor can give, in my opinion, is that of thinking in front of his students.

*Henri Lebesgue*

Men occasionally stumble over the truth, but most of them pick themselves up and hurry off as if nothing ever happened.

*Winston Churchill*

In general, to learn a skill (golf, driving car):

- Skill is demonstrated to student

- Student is directed and guided while practicing

What about analytical reasoning skills?

- It goes on inside the head – hard to demonstrate

- Hard to direct and guide student

The most effective way to expose the process is to verbalize our thinking process

- This is hard work! Not our normal mode

- Need to be careful to explain every step

- Need to address alternative valid analyses

- Also need to create and discuss blind alleys

Demonstrate analytical reasoning by watching problem solvers solve problems while thinking aloud

Practice problem solving by thinking aloud to a partner

We will use the technique of Whimbey & Lochhead

The partners have distinct roles:

- One partner should read and think aloud.

  - On some assignments, will be the *scribe* as well

- The other partner is the listener

  - Continually check accuracy

  - Demand constant vocalization

Thinking is a skill... but it is largely invisible

- So we need to do everything possible to make it visible during this process

Adaptation to small groups

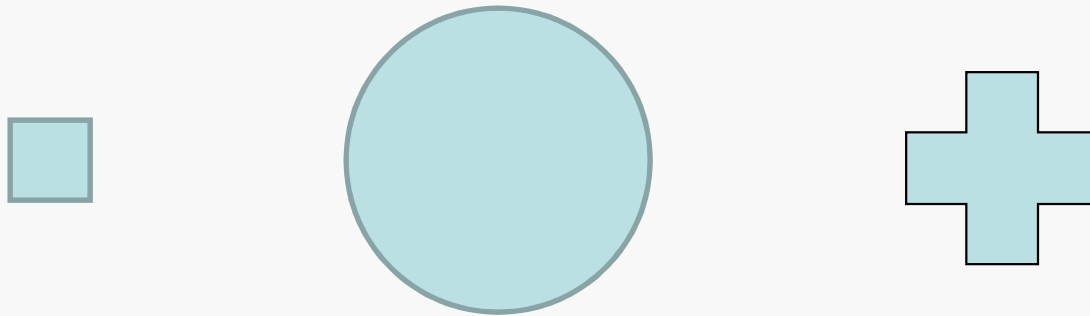
- May have single solver and multiple listeners, or

  - multiple solvers and multiple listeners, and/or

  - assign role of scribe to a different group member

# Problem 1

If the circle below is taller than the square and the cross is shorter than the square, put a K in the circle. However, if this is not the case, put a T in the second tallest figure.



K

T

## Positive attitude

Belief that academic reasoning problems can be solved through persistence, as opposed to believing “either you know it or you don’t”

Engage a confusing problem

## Concern for accuracy

Actively work to check your understanding

## Decompose the problem into simpler parts

## Avoid guessing

And don’t jump to conclusions

## Active in problem solving

Do more things as part of the process

If the word *sentence* contains less than 9 letters and more than 3 vowels, circle the first vowel. Otherwise circle the consonant that is farthest to the right in the word.

s e n t e n c e

Crucial role, hard work. Not a passive role!

1. Continually check accuracy

- Catch errors
- Must work along/understand every step
- Don't let solver get ahead of him/herself
- Point out errors, do not correct

2. Demand constant vocalization

- Solver must spell out EVERY step
- On assignments, solver must make notes on EVERY step

3. Use Socratic questioning (Fogler/LeBlanc, p. 89—92)



Bill, Judy, and Sally have the occupations of teacher, plumber, and teamster but not necessarily in that order. Bill is shorter than Judy but taller than Sally. The plumber is the tallest and teamster is the shortest. What is Judy's occupation?

## Problem 4

Solver and Listener 10

If the second letter in the word *west* comes after the fourth letter in the alphabet, circle the letter A below. If it does not, circle the B.

A

B

## Problem 5

Solver and Listener 11

Give a rough estimate of the number of telephones on the Virginia Tech campus.

## Problem 6

Solver and Listener 12

You drive a car at a constant speed of 40 mph from A to B, and on arrival at B, you return immediately to A but at a higher constant speed of 60 mph.

What was your average speed for the whole trip?

“Eighty percent of success is showing up.”

Woody Allen

“Success is 1% inspiration and 99% perspiration.”

Thomas Edison

To successfully solve any problem, the most important step is to get actively involved.

The Principle of Intimate Engagement: You must commit to the problem

“Roll up your sleeves”

“Get your hands dirty.”