

Problem-Solving through Think-Alouds

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Outcomes for today

- Tools: Create pencasts (think-alouds) using a Livescribe pen
- Tasks: Know how to design problem-solving tasks that incorporate think-alouds especially in science, technology, engineering and mathematics (STEM) classes
- Talk: Assess the quality and effectiveness of a previously recorded pencast using a rubric being developed by the presenters

The issues.....

- Students solving problems by attempting to mimic text book examples where mistakes are not valued or illustrated.
- Students who are focused only on the formula and how to do the problem without wanting to know how to think through the problem in Pre-Calculus at the college level.
- Students think memorization is an effective way to solve complex problems and have difficulties when they are presented with new, related problems.
- Teachers who only know how to teach math/science problem solving as a linear, step-by-step, process that does not mirror what mathematicians and scientists do when solving challenging and real problems.

A solution: think-alouds

- Think-alouds can help to make the internal problem-solving process explicit.
- Berardi-Coletta showed that with targeted instruction, verbalization led to more effective problem-solving.
- Verbalization helps students become aware of their thought process, thereby improving their ability to identify and correct own errors.

A practice task

- Analyze the task independently
- In a team of 3, collectively create a plan to solve the task

There are 12 cannonballs. All look alike, but one is the “oddball”. The oddball is either heavier or lighter than the other balls. You are supplied with a balance scale that can hold as many cannonballs as you would like on each side of the scale. The problem is, in 4 weighings (4 uses of the scale), find the oddball.

A technology: smartpens

- When used with Livescribe Dot paper, a smartpen records and synchronizes pen strokes and audio to create a “pencast.”
- Recorded pencasts can be transferred to a computer via a USB connection.
- From there, the recordings can be emailed or posted online.



A practice think-aloud

Choose someone in your group....

1. who will write and speak through finding a solution to the task (think-aloud)
2. To write down the steps followed for problem solving during the think-aloud.
Since they will be silent, imagine them asking :
 - What are you doing now?
 - Why are you doing that?
3. to write down words/phrases that indicate monitoring during the think-aloud.
I'm confused. Could you explain what you're doing?
 - Where did that come from?

A problem-solving process

- How do you go to:
 - 1600 Pennsylvania Ave NW, Washington, DC 20500
 - 1060 W. Addison St, Chicago, IL 60613
 - 130 W. Bruno St. Los Angeles, CA 90012
1. Determine where you are and where you want to go.
 2. Plan how to go from where you are to where you want to go.
 3. Get in car and drive along the planned route.

A role model

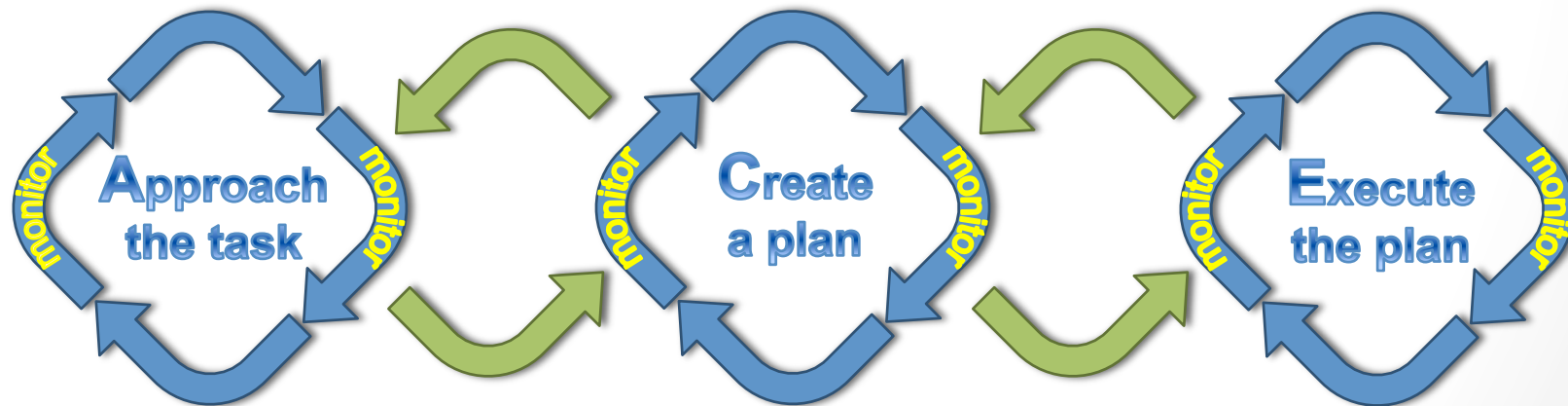
GPS devices monitor in each step:

1. They check the entered destination against a database to see if it exists. They also check the current location with multiple satellites.
2. They will consider many different routes and the pros and cons of each. (quickest, shortest, most scenic, etc.)
3. They are constantly determining the current location and compare it to the route. If there is any deviation... they *recalculate*.



ACE Problem Solving Process

- *Analyze the task: interpret and understand what is provided in the task.*
- *Create a plan: connect the given information and goal with models/concepts/relationships*
- *Execute the plan: follow the plan until the goal is attained*



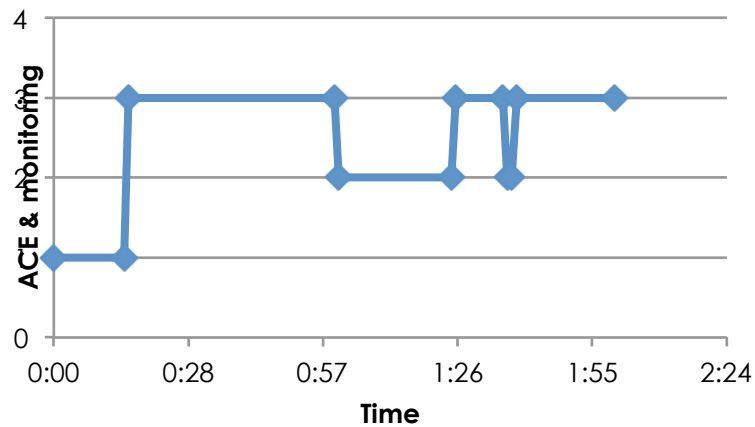
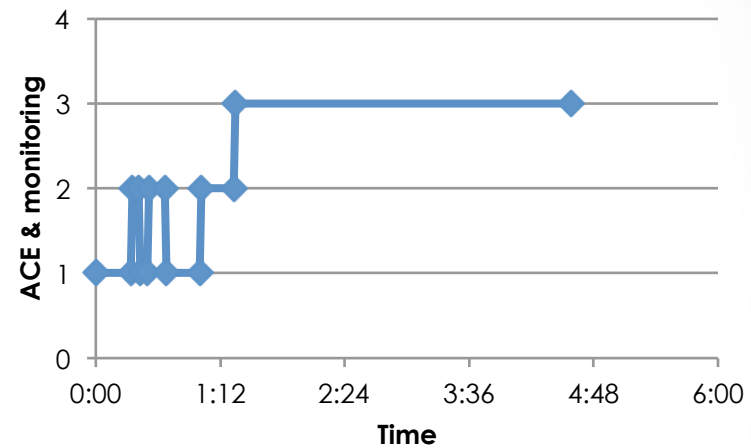
A sample pencast

- Listen to the pencast and decide the following as a team
 1. Identify time ranges when you hear analyzing, creating, and executing
 2. Identify time stamps when you hear monitoring

Come to consensus around one conclusion you reach about problem solving

School of Education: Clemmer

- What conclusions can you draw about each student's mathematical thinking?



Organic Chemistry: McCallum

- I: Students view expert created think-alouds (correct)
 - showcasing best practices in problem solving
 - 100 % of students agreed these were effective, useful, and improved problem solving
 - Allowed more time in class to focus on problem solving
- II: Students view authentic student think-alouds (correct and incorrect)
 - Students mixed on effectiveness
- III: Students create new pencasts
 - Individualized feedback tailored to their needs

Pre-Calculus & Linear Algebra: Zachariah

- In several of my classes students created think-alouds individually and pairwise during the past 1 1/2 years
- Encouraged colleagues to use the Livescribe pen in their classes
- Future plans: Will be collecting formal data during spring 2013 and fall 2013 from control groups and experimental groups
- Anecdotally, several students indicated that creating think-alouds helped them to understand the task better and it also helped them to monitor their progress.

General Physics: Phillips

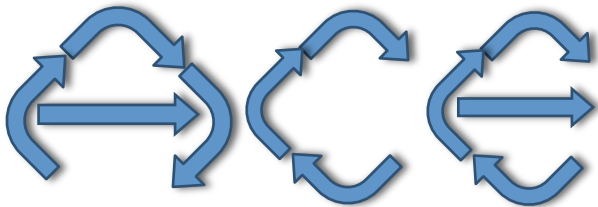
- On the first three in-class tests, Isaac's scores were 18-24% below the class average.

At the beginning of the semester I was quite skeptical of the livescribe pen and how following a few simple guidelines/ approaches to problem solving could change the way I think....I stubbornly have to admit that the whole process took much longer than I had anticipated due to my unwillingness to embrace the pen as well as the process of talking out my actions.... It took almost the whole semester but I have finally come to a point where I find myself automatically dictating my comprehension process to prove to myself that I truly understand what is happening and the best method to approach a problem while utilizing key concepts.

- The fourth test, where he reported that he was more aware of his thinking and would engage in metacognitive thinking, was only 6 points below the class average.
- On a post-instruction survey Isaac reported that his test anxiety was eliminated.

Thanks!!!

- For more information on our PENS Project:
 - Visit <<http://www.pensproject.com>>
 - Email any of us:
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PROBLEM-SOLVING
EXAMPLES WITH
NARRATION FOR
STUDENTS