

Promoting Metacognition In Geoscience Classrooms

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In the past . . .

- Job of the teacher was straightforward
- We present information
- Students learn it
- We test them and give grades
 - That reflect how well they learned



We present information

- But there are many ways to do this
- Different instructional strategies may be appropriate at different times, in different settings, with different students, etc.
- Many choices – never clear what is best



Students learn it

- Maybe
- Depends on definition of *learn*
- Surface learning vs deep learning



Surface and deep learning

Surface	Deep
Value of learning is unrecognized	Focus is on significance
Learning is a bunch of unrelated tasks	Relates previous to new knowledge
Information is memorized	Relates learning in one course to others
No reflection on facts/concepts	Relates material to every day life/experience
Principles not distinguished from examples	Distinguishes between evidence and argument
Learning is a chore imposed on the learner	Content is organized and structured into a coherent whole
Motivation is external	Motivation is internal

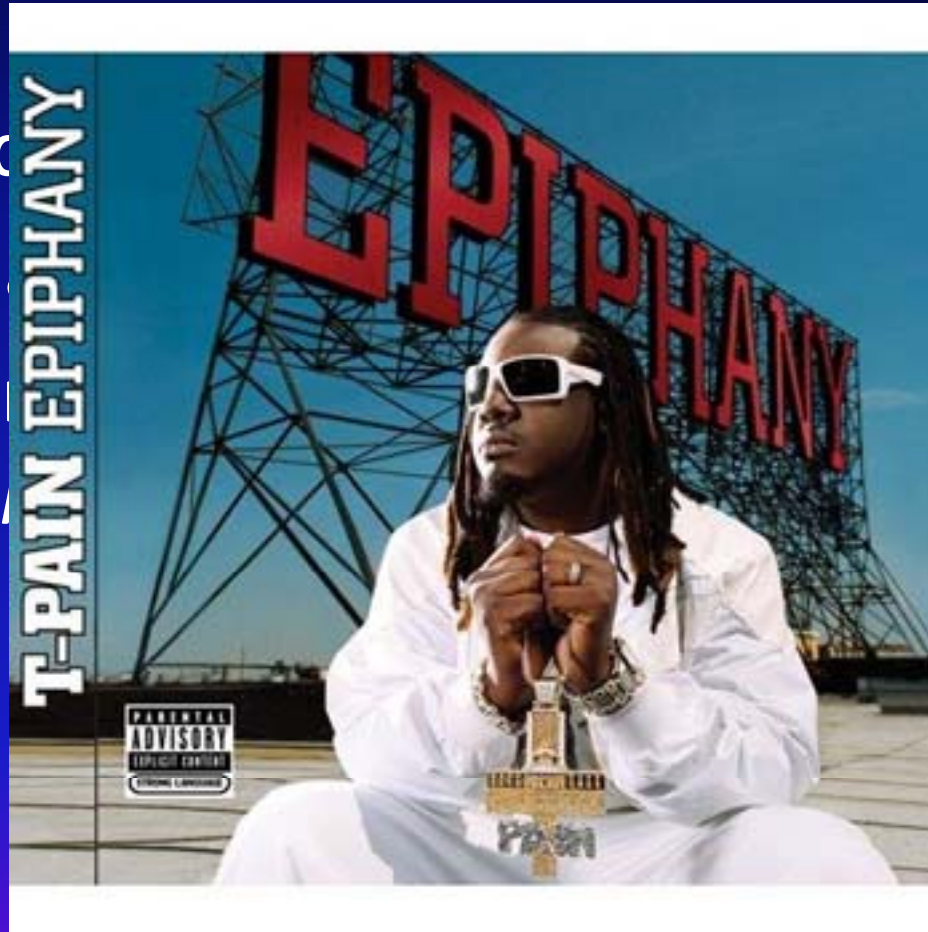
We test them and give grades

- But what actually are we measuring?
- Easy to find out if students have memorized things
- Unless we are very clever we have a very hard time evaluating *deep learning*



The most important things we can do . . .

- Help students
- Involves
- Perhaps develop



Metacognition

- *Metacognition* refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g., the learning-relevant properties of information or data. For example, I am engaging in metacognition if I notice that I am having more trouble learning A than B; if it strikes me that I should double check C before accepting it as fact.

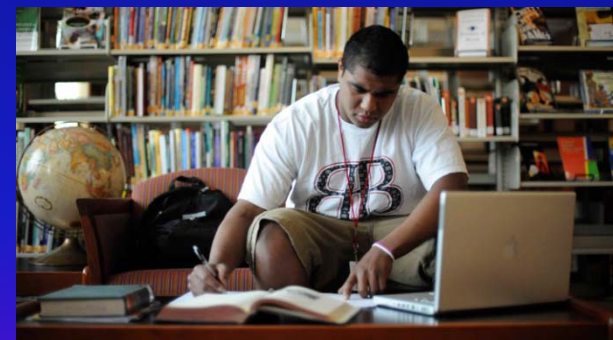
Seminal work of J.H. Flavell (1976)



METACOGNITION consists of three basic elements that guide learning:

- *Developing* a plan of action
- *Maintaining/monitoring* the plan
- *Evaluating* the plan

This is an iterative process!



Strategic Teaching and Reading Project Guidebook. (1995, NCREL, rev. ed.).

Students should ask themselves:

- What in my prior knowledge will help me with this particular task?
- In what direction do I want my thinking to take me?
- What should I do first?
- Why am I reading this selection?
- How much time do I have to complete the task?



They need to monitor how they are doing:

- Am I on the right track?
- How should I proceed?
- What information is important to remember?
- Should I move in a different direction?
- Should I adjust the pace depending on the difficulty?
- What do I need to do if I do not understand?



- *And afterwards:*

- How well did I do?
- Did my particular course of thinking produce more or less than I had expected?
- What could I have done differently?
- How might I apply this line of thinking to other problems?
- Do I need to go back through the task to fill in any "blanks" in my understanding?



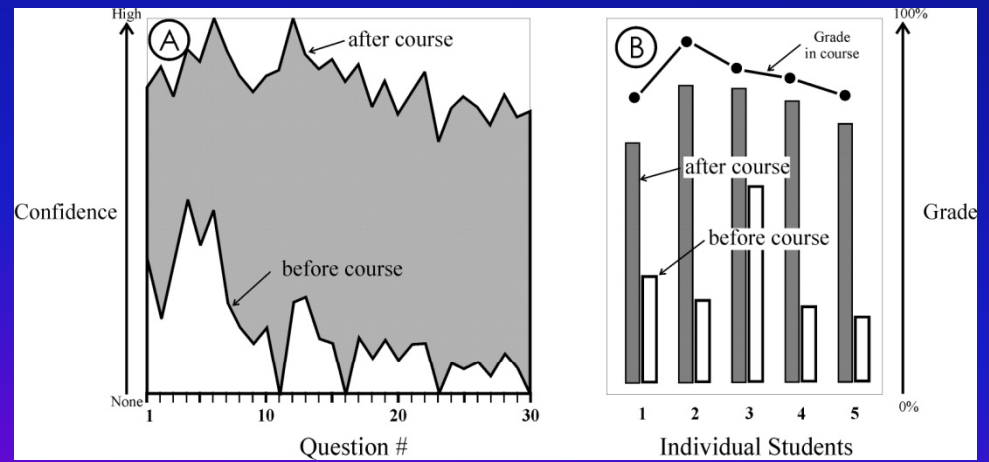
So, what does it all mean?

- Developing metacognitive skills is very important
- Many college students lack metacognitive knowledge and skills

But:

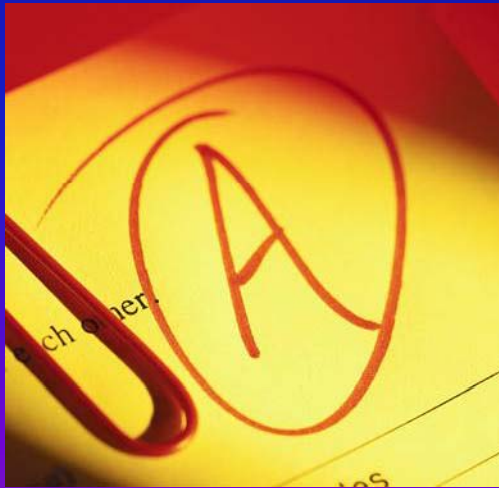
- Instruction must be explicit
- Instruction should be embedded within content lessons in different subject areas

- Knowledge Surveys
 - 80-200 questions
 - Students say whether they could answer the question and with what confidence
 - At beginning and end of semester
 - And/or before each new part of a class
 - At UND we use Knowledge Surveys for program assessment



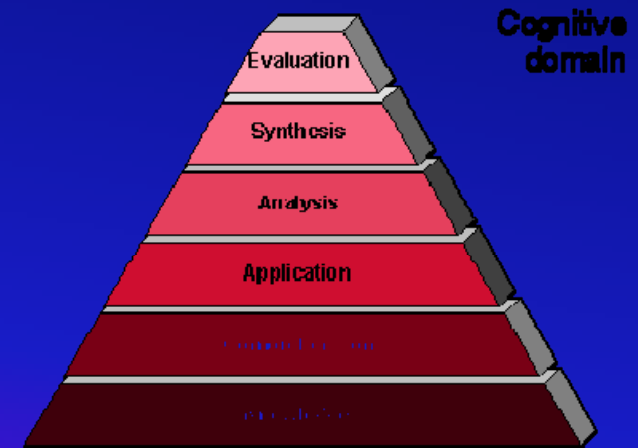
Self-assessment and monitoring learning

- I deserve an A because . . .
 - Write a letter describing what you accomplished in this course. The letter should be dated for the end of the semester and written in the past tense. Tell me what you did, how you did it, and how your thinking and understanding changed.



Goal setting and planning

- Learning to Learn
 - 30 page document
 - Discusses
 - How well college education is working
 - What the experts say is needed
 - Blooms Taxonomy and different levels of thinking and learning
 - Role of the affective domain
 - Fink's taxonomy of significant learning
 - Learning cycles
 - How learning affects the brain
 - Intellectual development
 - Critical thinking
 - Metacognition
 - Learning styles
 - Significance of grades



Metacognitive knowledge

- Learning Portfolios
 - Contain all work that students have done
 - Handed in every four weeks
 - But (we learned the hard way)
 - We must give them a TOC



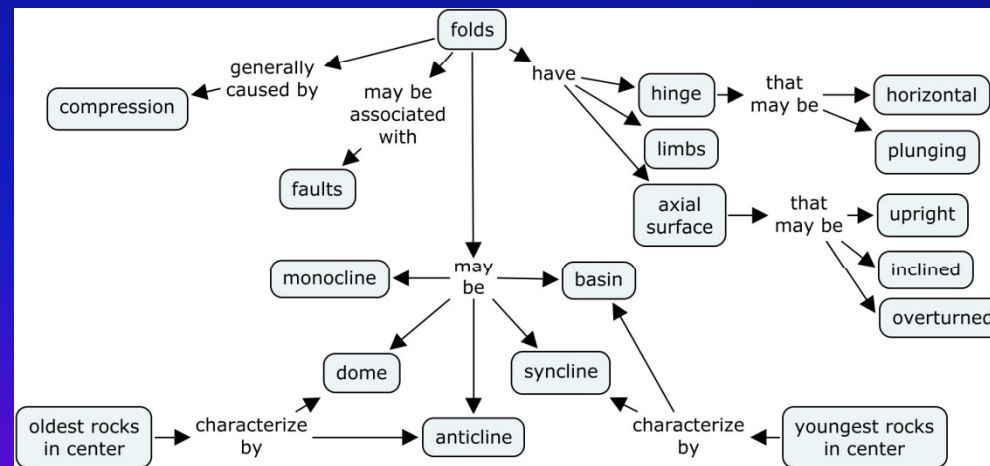
Evaluation and reflection

- Self-reflections

- Essays that go in portfolios

- Why are you here? What do you expect? How hard will you work? Etc.
 - What has or has not been working in this class to promote your learning? Why?
 - What are the most important/significant things that you have learned so far?
 - How hard are you working for this class and do the results so far reflect what you are doing?
 - What could you do to be more successful in this class?
 - What things have challenged you the most in this class; what can you do to overcome those challenges?
 - Is the material in your portfolio a good reflection of what you have learned this semester?

- Concept Maps
 - On every major topic in the course
 - Sometimes we hand out a list of terms or a map with blanks
 - Sometimes students create them from scratch



Connecting knowledge

- Reading reflections
 - Short questionnaire
 - In response to homework assignment



Evaluation and reflection

- Exam Wrappers
 - Short questionnaire
 - Completed before, just after taking, and after seeing grade on an exam

Did I prepare adequately?

How well will I do?

Now that I have taken the exam, how well do I think I did?

Did I get the grade I expected?

What will I do differently next time?

Monitoring and reflection

- Does all this work?
 - Students say it does
 - Surprisingly there have been NO complaints about the “extra” work
 - My department has created a special sophomore level seminar that will focus in part on metacognition
 - Our provost has just appointed a task force to examine ways that we can work with all students on campus to improve metacognitive skills