Assessment of Critical Thinking Skills in Dental and Allied Dental Curricula

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20101 ADEA Annual Session: Faculty Development Workshop *SoTLfest*

Purpose

- The purpose of this workshop is to explore and offer suggestions to implement formative and summative evaluations supporting educators in assessing critical thinking in the classroom and clinic.

- Survey results of best practices from a variety of institutions will be provided.

- Included is an interactive component allowing participants to develop and/or refine assignments using described assessment techniques to measure critical thinking within individual programs.

Program Objectives:
After the session, the participant will be able to:

- Discuss the significance of assessment and assessing critical thinking skills in dental and allied dental education.

- Develop working definitions of assessment and critical thinking

- Discuss the various categories of assessment available to educators and specific types of assessments within each category.

- Explore both summative and formative categories of assessments that support educators in evaluating critical thinking skills in classroom, laboratory and clinical environments

- Establish networks for sharing ideas and collaborating on the development of critical thinking strategies and assessment.

- Summarize survey results of best practices from a variety of institutions.

- Develop or refine assignments using described assessment techniques to measure critical thinking within individual programs.
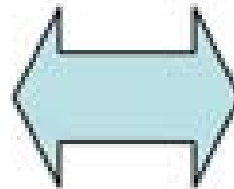
ASSESSMENT

Key Questions:

What should be learned?
What to learn?

ASSESSMENT ⟺ **Intended Learning Outcomes**

How to gauge learning?
How to show learning?

- 'Students can, with difficulty, escape from the effects of poor teaching, …..

- They cannot (by definition if they want to graduate) escape the effects of poor assessment'
 - (Boud, 1995).

- **...institutional assessment efforts should not be concerned about valuing what can be measured but, instead, about measuring that which is valued. --**

Banta, T. W., Lund, J. P., Black, K. E., & Oblander, F. W., Assessment in practice: Putting principles to work on college campuses. San Francisco: Jossey-Bass. p. 5, 1996

Assessment Definitions

- "Sustainable assessment" which *Boud* defines as
  - ...assessment that meets the needs of the present and prepares students to meet their own future learning needs...

- There is an equal level of importance to assessment:
  - as a tool for developing lifelong learning
  - alongside its function of measuring performance

Do your stakeholders understand the significance of your assessments?
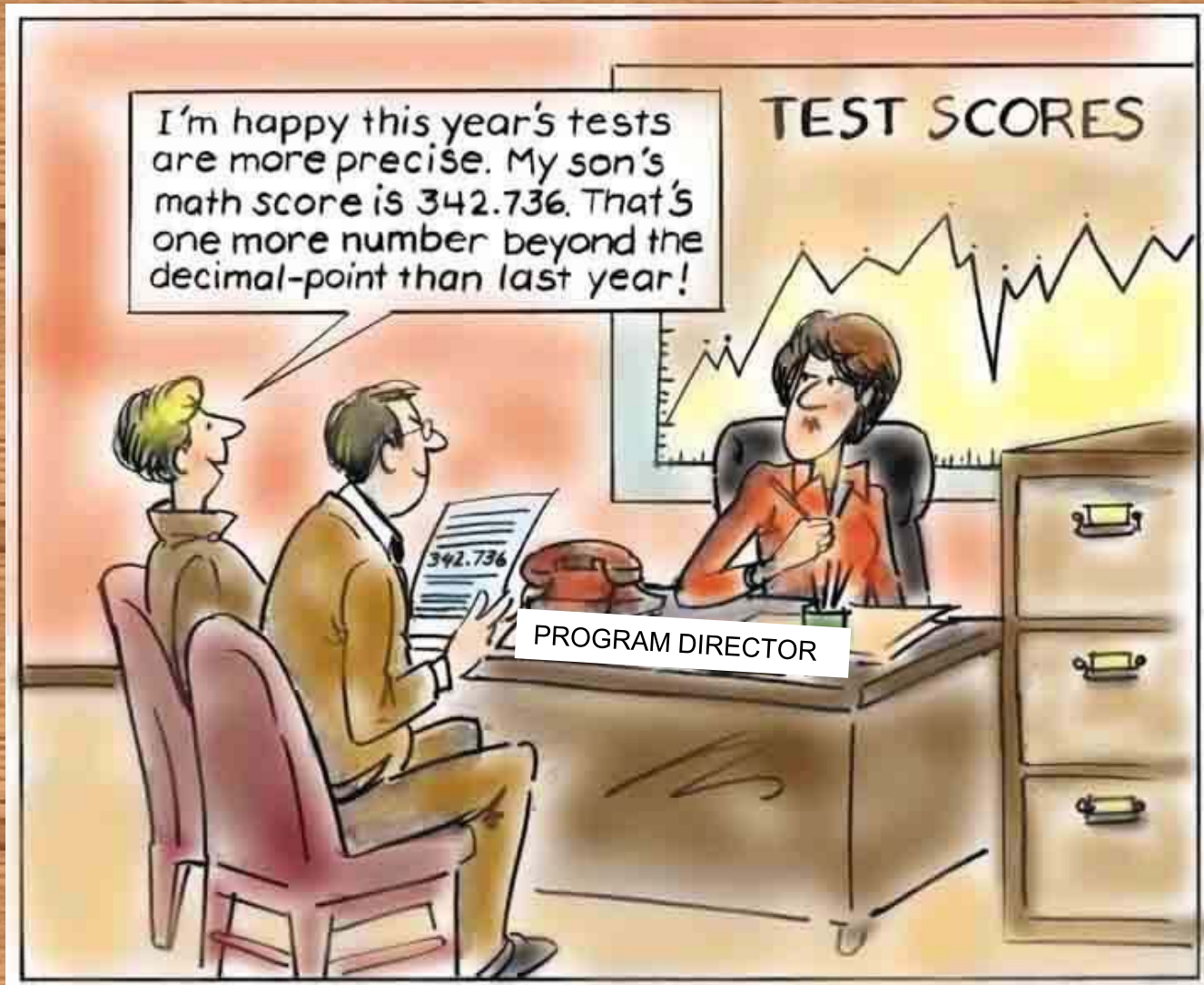
Group Activity 1

- What is assessment?

Instructions: In groups using the flipchart, complete the following task:

- Identify 5 characteristics of assessment for the purpose of developing a working definition of assessment.

Group Activity Responses: Assessment Characteristics

Working Definition of Assessment?

Summary Group Activity 1

- *Without school-wide/program-wide consensus on what assessment means*
  - ◦ *And what it will look like in your program*
- *The development of consistent linkages across the curriculum may become problematic*

- *Take home task1:*
  - ◦ *Gain consensus on meaningful assessment definitions and in assignments which represent alignment with those definitions*

FORMATIVE VS. SUMMATIVE ASSESSMENT

Assessment Purposes

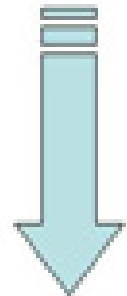There are two key purposes:

to certify/communicate
    (often to an external audience)
      - current standards
      - to aid decisions (promotion, etc.)

to aid learning & improvement

Summative

Formative

Formative assessment

- **Ongoing observations and methods of evaluation designed to measure student comprehension of a concept or task in order to identify areas that require enhanced or adapted instruction.**
- These adaptations can include
  - reviewing material, alternative approaches to instruction, and additional practice.
- Feedback is used to help students achieve learning goals and takes the form of specific suggestions and discussion of errors rather than merely providing the correct answer.
  - Examples of formative assessments include journals, learning logs, the minute paper, concept maps, directed summarization, anecdotal records, diagnostic tests, and quizzes, questioning techniques

Summative assessment

- **Evaluation administered at the conclusion of a unit of instruction to comprehensively assess student learning and the effectiveness of an instructional method or program.**
  - *LEARNNC, University of North Carolina*

  Examples: examinations, competencies

Don't forget to visit:

- Writing Evaluation Criteria for Summative and Formative Student Feedback, Faculty Calibration, and Criteria Validation
  - Charles Janus Virginia Commonwealth University; G. William Knight, University of Illinois at Chicago

Don't' forget to visit:

- Student Learning and Competency in a Clinical Environment Without Discipline-Driven Requirements
  - Vicky Evangelidis-Sakelison Columbia University

ADEA FDW: Other perspectives

- Term used when programs collect data on student learning for program or institutional level assessment.

- May involve the creation of new projects/assignments/exams that inform instructors about individual student performance

**Guidelines in creating and using embedded assessment:**

Faculty should:

- Understand the curriculum as a plan for learning
- Provide sequential and cumulative learning throughout the course
- Encourage transferable learning across the curriculum
- Design the curriculum as a matrix by integrating the development of specific skill sets
- Implement student-centered teaching strategies to encourage engagement with the material and active rather than passive learning
- Develop qualitative performance-based course-embedded strategies to assess and increase student learning
- Clearly define learning as the ability to apply prior learning to a new situation or context.

Embedded Assessment Practices

## Examples of Course Embedded Assignment

- Questions on examinations

- Pre-post tests

- Rubrics

- Samples of student work/projects or papers

- Elements of a portfolio

- Competencies

- Field assignment or other internship

- Service Learning arrangements
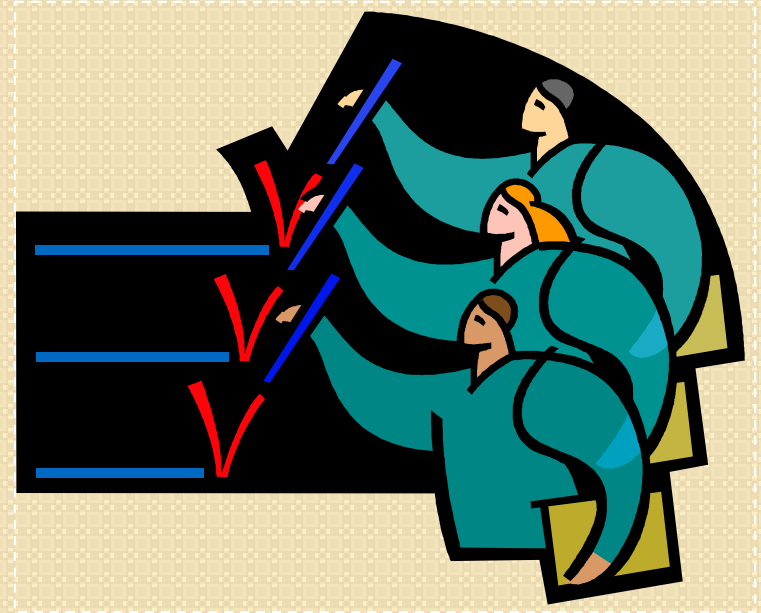
Data collected is only as good as the assignment

"Data collected is only as good as the assignment"

- What will you include in the assignment?

- If critical thinking skill sets are *valued* (Banta), how will they be <u>purposefully</u> measured?
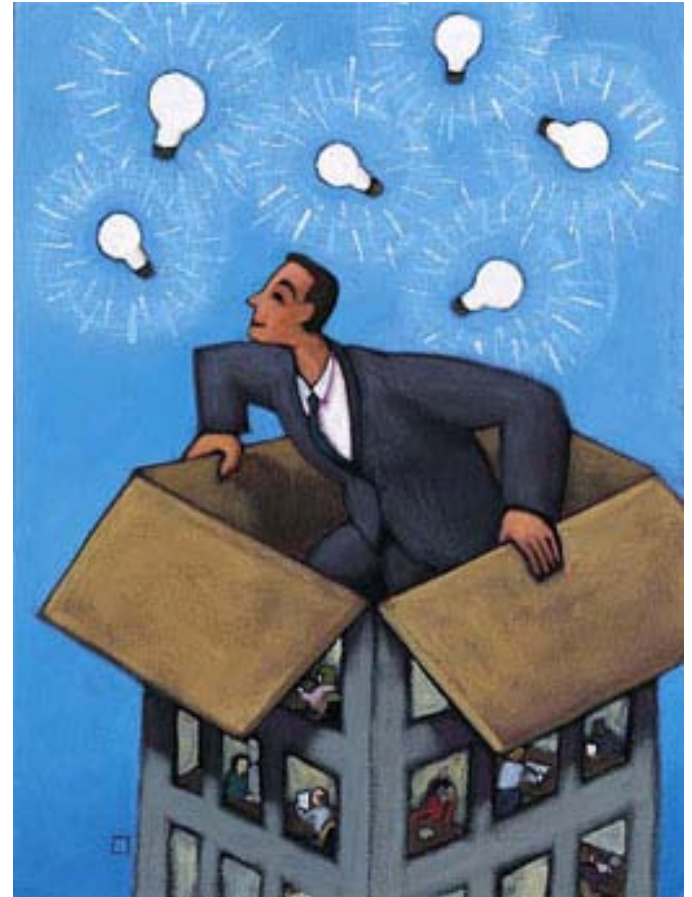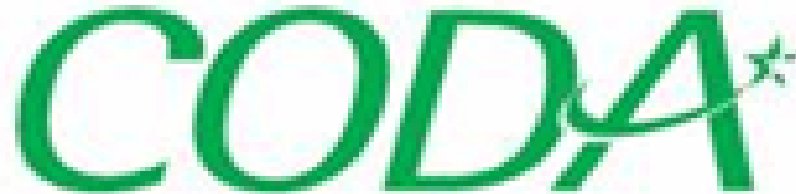
CRITICAL THINKING

Critical Thinking

- CODA supports the implementation of critical thinking as an essential component in both dental and allied dental curricula.

CODA
Commission on Dental Accreditation

Dental CODA Standards

"Old" CODA Standards:

- Information Management and Critical Thinking
  - 2-23: Graduates must be competent in the use of critical thinking and problem solving related to the comprehensive care of patients

Under Consideration: Competencies for the New General Dentist: The statements below define the entry-level competencies for the beginning general dentist:

- **1. Critical Thinking- Graduates must be competent to:**
  - 1.1 Evaluate and integrate emerging trends in health care as appropriate.
  - 1.2 Utilize critical thinking and problem-solving skills.
  - 1.3 Evaluate and integrate best research outcomes with clinical expertise and patient values for evidence-based practice.

Critical Thinking Competencies Under Consideration

Competency 1.2

- Utilize critical thinking and problem solving skills
  - ◦ Application of the scientific method in clinical problem-solving
  - ◦ Evidence-based delivery of oral healthcare
  - ◦ Critical thinking and problem-solving skills
  - ◦ Cultural competence
  - ◦ Communication skills, oral and written
  - ◦ Reading comprehension
  - ◦ Ethics
  - ◦ Computer literacy
  - ◦ Epidemiological methods

Dental Hygiene CODA Standards

- 2-25   Graduates must be competent in problem-solving strategies related to comprehensive patient care and management of patients

- ***Intent****: Critical thinking and decision making skills are necessary to provide effective and efficient dental hygiene services*

  ◦ Examples of evidence to demonstrate compliance may include:

    • Evaluation mechanisms to monitor knowledge and performance

    • Outcomes assessment mechanisms

DEFINING AND IDENTIFYING CRITICAL THINKING

But really… what IS it??

- **Definition:** the mental process of actively and skillfully **conceptualizing**, **applying**, **analyzing, synthesizing, and evaluating** information to reach an answer or conclusion

Source: Webster's New Millennium™ Dictionary of English, Preview Edition (v 0.9.7) Copyright © 2003-2008 Dictionary.com, LLC

Defining Critical Thinking in Dental Schools

- *…The conclusion that is offered is that critical thinking extends beyond the traditional cognitive and psychomotor skills taught in dental schools and thus requires a new, additional educational approach called tentatively the "third pedagogy."*

- Critical thinking means being able to give reasons for what one says and does…

- These reasons should be …, extending to almost all of one's activities and to the evaluation of novel practices….

- …as a member of a community of reflective practitioners…

Chambers DW. Lessons from Students in a Critical Thinking Course: A Case for the Third Pedagogy. *Jour Dent Educ.* 73(1): 65-82, 2009.

Attributes of a Critical Thinker:

Ferrett, S. Peak Performance (1997).

- asks pertinent questions
- assesses statements and arguments
- **is able to admit a lack of understanding or information**
- has a sense of curiosity
- is interested in finding new solutions
- is able to clearly define a set of criteria for analyzing ideas
- **is willing to examine beliefs, assumptions, and opinions and weigh them against facts**
- listens carefully to others and is able to give feedback

- sees that critical thinking is a lifelong process of self-assessment
- suspends judgment until all facts have been gathered and considered
- looks for evidence to support assumption and beliefs
- **is able to adjust opinions when new facts are found**
- looks for proof
- examines problems closely
- is able to reject information that is incorrect or irrelevant

Group Activity 2

- What is critical thinking?

Instructions:

In groups using the flip chart, identify the following:

- Identify 3 characteristics of critical thinking for the purpose of developing a working definition of critical thinking.

Responses of Group Activity 2: Critical Thinking Characteristics

Working Definition of Critical Thinking?

Summary of Group Activity 2

- If you don't know what you're measuring, you're likely to miss it even if it's right before you

- If you don't know what you're measuring, you'll miss opportunities to develop skill sets in students

- Take home task 2:
  - Gain consensus in a working definition of critical thinking and discuss how assignments may be modified to gain outcomes of critical thinking skill sets

IUPUI 's Definition of Critical Thinking

[Definition:] The ability of students to engage in a process of disciplined thinking that informs beliefs and actions. A student who demonstrates critical thinking applies the process of disciplined thinking by remaining open-minded, reconsidering previous beliefs and actions, and adjusting his or her thinking, beliefs and actions based on new information.

[Outcomes:]

The process of critical thinking begins with the ability of students to remember and understand, but it is truly realized when the student demonstrates the ability to:

apply, analyze, evaluate, and create knowledge, procedures, processes, or products to discern bias, challenge assumptions, identify consequences, arrive at reasoned conclusions, generate and explore new questions, solve challenging and complex problems, and make informed decisions.

Sou

The importance of …

The Lesson

- Then Jesus took his disciples up to the mountain and gathering them around he taught them saying…

- "Blessed are the poor in spirit for theirs is the kingdom of Heaven

- Blessed are the meek, for they shall inherit the earth

- Blessed are
  ◦ they who mourn; the merciful, who thirst for justice, who are persecuted, who suffer…
 ◦ Be glad and rejoice for your reward in Heaven is great"

- Then Simon Peter said
  - Do we have to write this down?
- And Andrew said
  - Do we have to turn it in?
- And James said
  - Does spelling count?
- And Phillip said
  - Will this be on the test?
- And Bartholomew said
  - What if we don't know this stuff?
- And John said
  - The other disciples didn't have to learn this stuff!
- And Matthew said
  - When can we get out of here?
- And Judas said
  - What does this have to do with "real life"?
- And *all* the other disciples likewise…

- Then the Pharoses who were present asked to see Jesus' lesson plan and they asked Jesus why he didn't have any goals or behavioral objectives …
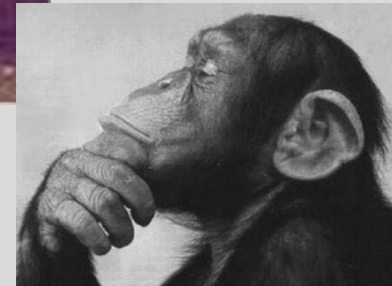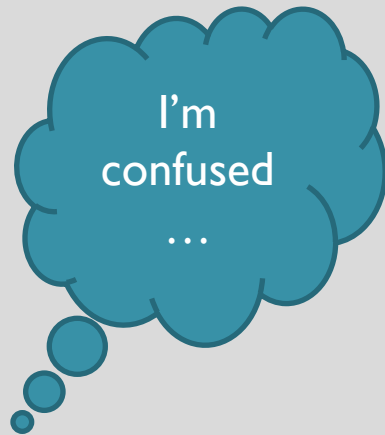
- *And Jesus wept*
John 11:35
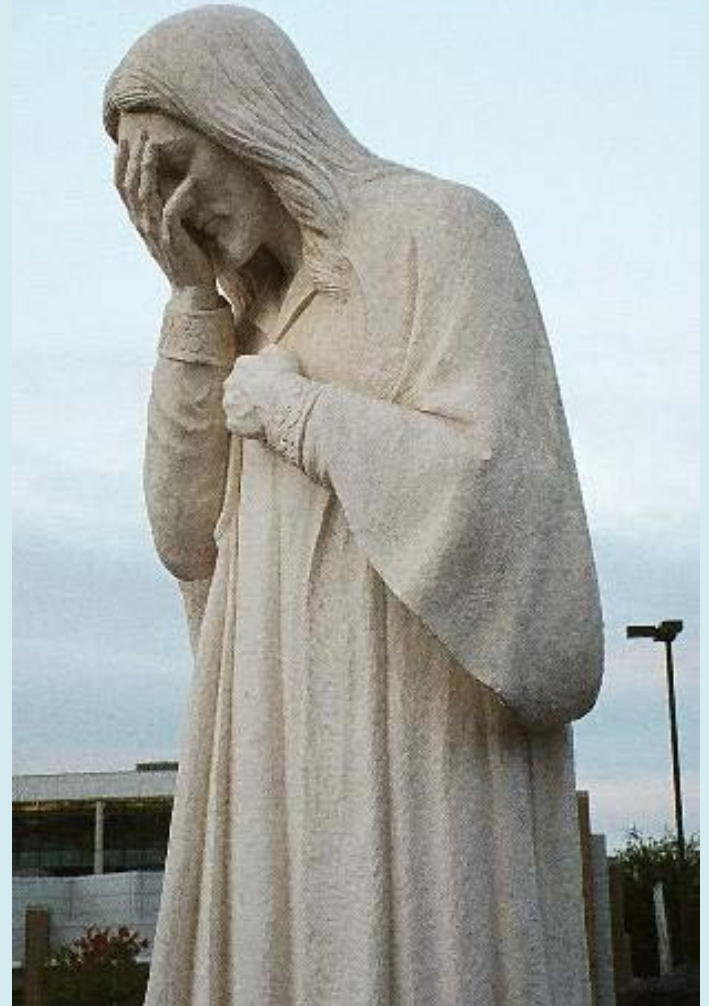
Purpose of Goals & Objectives

- Provides direction
- Aids communication
- Provides student motivation
- Facilitates and simplifies evaluation
- Aids instructional design to demonstrate the best possible end product

What has goals and objectives got to do with measuring critical thinking?

Robert Mager: Why G&O are important

"Instruction is effective to the degree that it succeeds in **changing** students in _desired_ directions and NOT in undesired directions."

Robert F. Mager, *Preparing Instructional Objectives*, 3d ed. (Atlanta, GA: Center for Effective Performance, 1997).

Robert Mager: Why G&O are important

"If you're not sure where you're going, you're liable to end up someplace else—and not even know it."

Robert F. Mager, *Preparing Instructional Objectives*, 3d ed. (Atlanta, GA: Center for Effective Performance, 1997).

Behavioral objectives require measuring changes in behavior

- Implies that behavior
  - CAN be measured objectively
  - ALL experiences are measurable
  - ALL learning is evident

- In order to measure, you must break "it" down into parts
  - Results in trivial / unimportant skills being evaluated
  - Focus transfers from "big picture" to the sum of individual parts

Mager's primary contribution

- Education is to focus on the STUDENT and what they ultimately will be able to do

- NOT on the TEACHER and what the teacher does during the lesson

CON:
Objectives fail to measure the unexpected

- Focus on pre-selected goals/objectives lead educators AND students to overlook learning that is occurring as a result of interactions with others that are not listed as an objective

Do behavioral objectives work?
Do they measure the learning?

- Not all objectives are written clearly
  - Vagueness
    - Usually comes from ambiguous verbs that do not describe observable behaviors
    - Specific behaviors must be selected that correspond to the teacher's goals for the session

Writing objectives

The *Magerian model* specifies three parts to an objective as follows:

- (1) It should have a measurable verb
  - (an action verb),
- (2) It should include a specification of what the learner is given to do, and
- (3) It should contain a specification of criteria for success or competency.

Component Parts of an Objective: ABCD's

- **Audience:**
  - Who are you teaching?
- **Behavioral verb**
  - What do you want them to do?
- **Condition/Criterion**
  - How will they be ready to do it?
- **Degree**
  - How much to they have to do to demonstrate it to your satisfaction?
    - Degree is an addition to the initial Meager model but is commonly used today

Writing Instructional Objectives

Mager proposes writing specific statements about observable outcomes that can be built up to become a curriculum
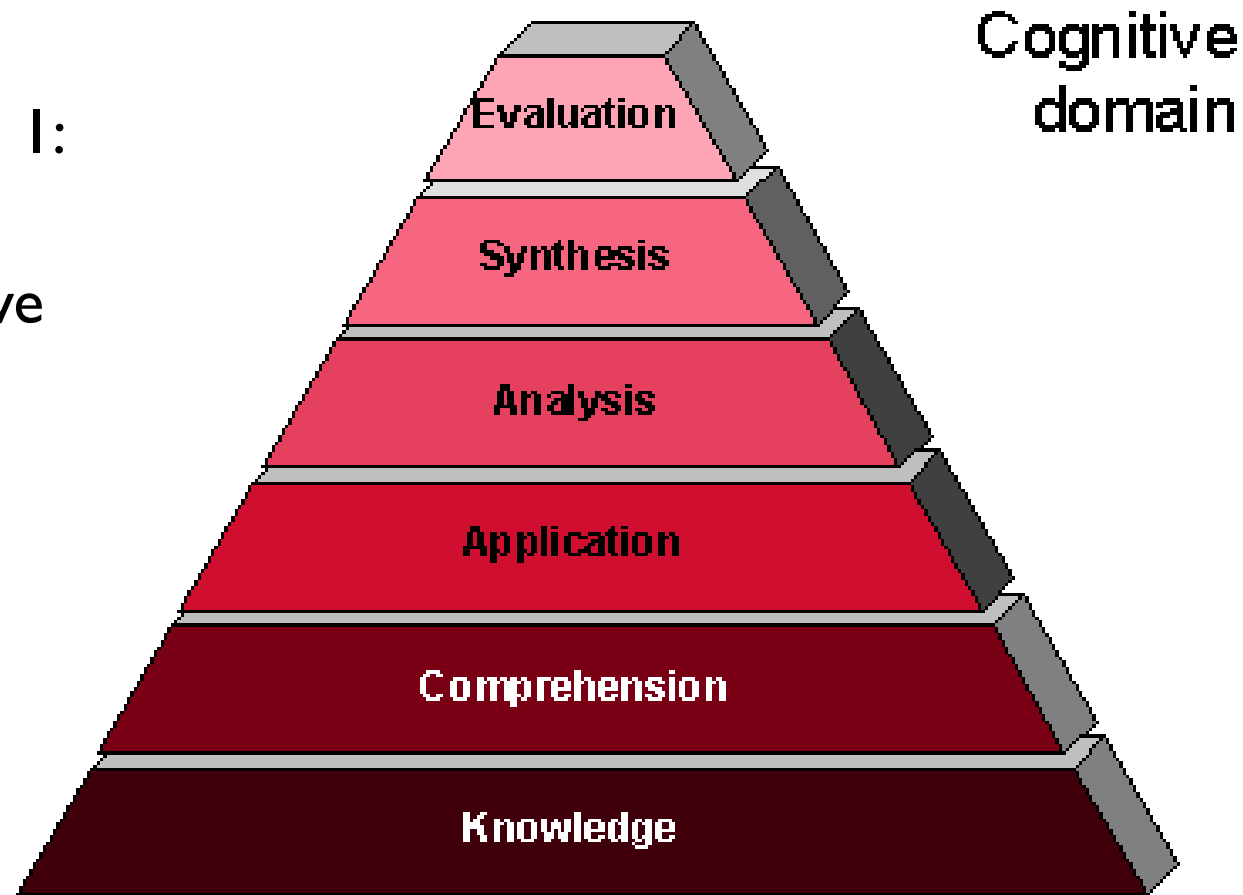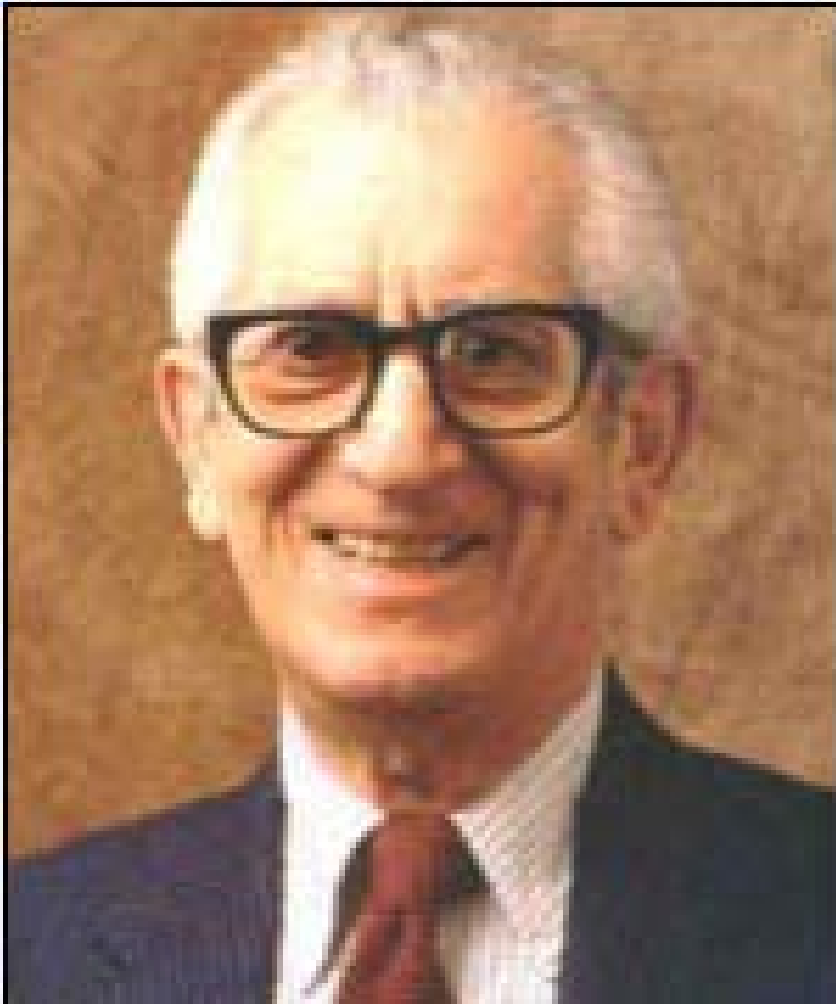
an inductive approach

- **An example of a behavioral objective:**

After the workshop, faculty members will be able to list 5 reasons for writing effective behavioral objectives that measure critical thinking.

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Where it all begins: The Domains

- Domain 1:
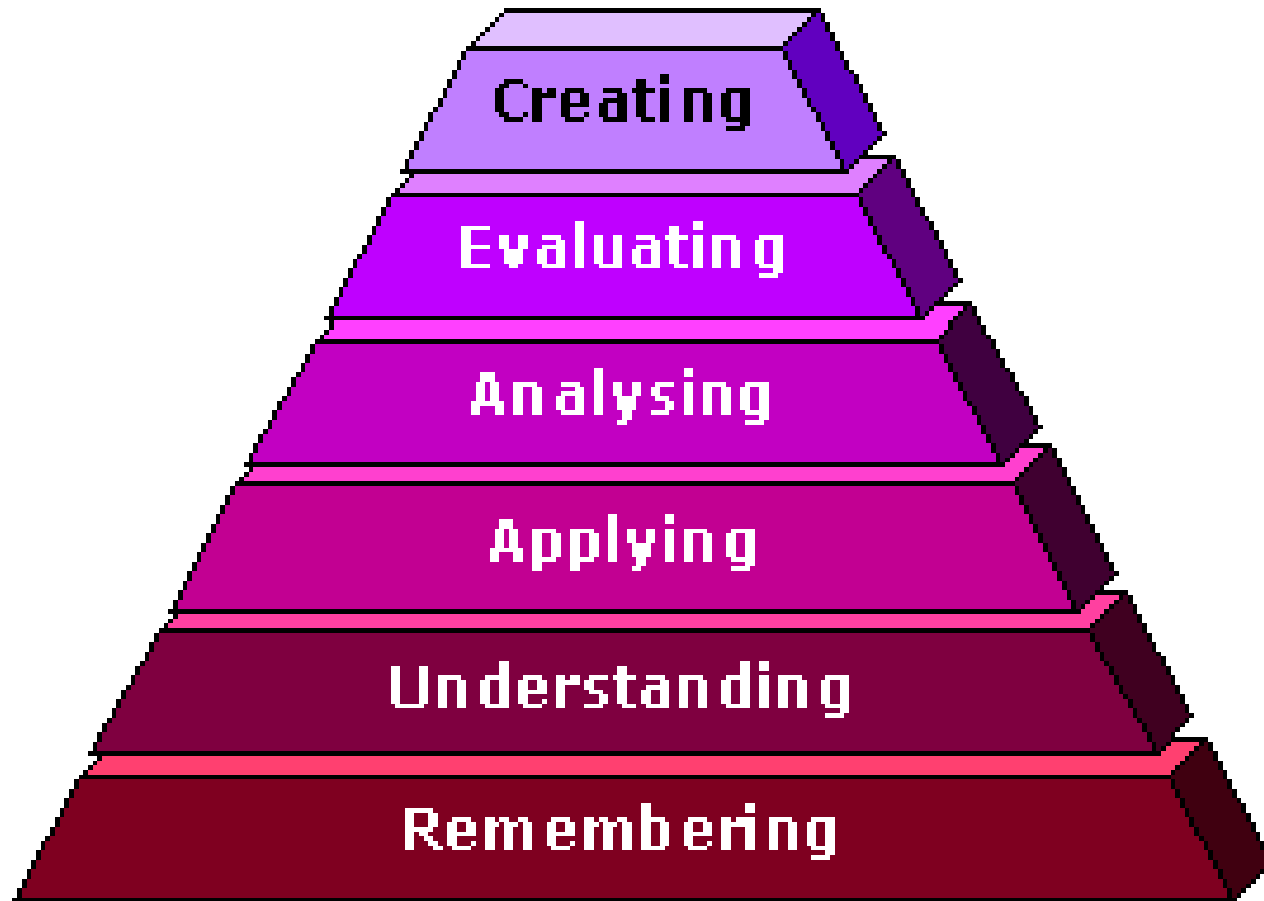- Bloom's Cognitive Domain

Cognitive domain

Evaluation
Synthesis
Analysis
Application
Comprehension
Knowledge

Benjamin Bloom

Image Source: http://redie.uabc.mx/contenido/vol6no2/art-104-spa/bloom.png

Anderson & Krathwohl's Cognitive Domain 2001

Bloom's Taxonomy 1956: Cognitive Domain	Anderson and Krathwohl's Taxonomy 2000
1. **Knowledge**: Remembering or retrieving previously learned material	I. **Remembering: Retrieving, recalling, or recognizing** knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material. **Examples:** define, recall, memorize repeat
2. **Comprehension**: The ability to grasp or construct meaning from material.	2. **Understanding:** Constructing meaning from different types of functions be they written or graphic messages activities like i**nterpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.**
3. **Application**: The ability to use learned material, or to implement material in new and concrete situations.	3. **Applying:** Carrying out or using a procedure through **executing, or implementing**. Applying related and refers to situations where learned material is used through products like models, presentations, interviews or simulations.
4. **Analysis:** The ability to break down or distinguish the parts of material into its components so that its organizational structure may be better understood.	4. **Analyzing:** Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose. Mental actions included in this function are **differentiating, organizing, and attributing**, as well as **being able to distinguish between** the components or parts. When one is analyzing he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.
5. **Synthesis:** The ability to put parts together to form a coherent or unique new whole.	5. **Evaluating:** Making judgments based on criteria and standards through **checking and critiquing**. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation. In the newer taxonomy evaluation comes before creating as it is often a necessary part of the precursory behavior before creating something. **Remember this one has now changed places with the last one on the other side.**
6. **Evaluation:** The ability to judge, check, and even critique the value of material for a given purpose.	6. **Creating:** Putting elements together to form a coherent or functional whole; **reorganizing** elements into a new pattern or structure through **generating, planning, or producing**. Creating requires users to put parts together in a new way or synthesize parts into something new and different a new form or product. This process is the most difficult mental function in the new taxonomy. **This one used to be #5 in Bloom's known as synthesis.**

Psychomotor Domain

Level	Definition	Example
1. Observing	Active mental attending of a physical event.	The learner watches a more experienced person. Other mental activity, such as reading may be a pert of the observation process.
2. Imitating	Attempted copying of a physical behavior.	The first steps in learning a skill. The learner is observed and given direction and feedback on performance. Movement is not automatic or smooth.
3. Practicing	Trying a specific physical activity over and over.	The skill is repeated over and over. The entire sequence is performed repeatedly. Movement is moving towards becoming automatic and smooth.
4. Adapting	Fine tuning. Making minor adjustments in the physical activity in order to perfect it.	The skill is perfected. A mentor or a coach is often needed to provide an outside perspective on how to improve or adjust as needed for the situation.

Harrow, A.J. (1972). *A taxonomy of the psychomotor domain.* New York: David McKay Co.

Domain 3: Affective

Krathwohl's Taxonomy of Affective Domain

Image Resource: **http://classweb.gmu.edu/ndabbagh/Resources/Resources2/krathstax.htm**

Affective Domain

Level	Definition	Example
Receiving	Being aware of or attending to something in the environment	Person would listen to a lecture or presentation about a structural model related to human behavior.
Responding	Showing some new behaviors as a result of experience	The individual would answer questions about the model or might rewrite lecture notes the next day.
Valuing	Showing some definite involvement or commitment	The individual might begin to think how education may be modified to take advantage of some of the concepts presented in the model and perhaps generate a set of lessons using some of the concepts presented.
Organization	Integrating a new value into one's general set of values, giving it some ranking among one's general priorities	This is the level at which a person would begin to make long-range commitments to arranging his or her instruction and assessment relative to the model.
Characterization by Value	Acting consistently with the new value	At this highest level, a person would be firmly committed to utilizing the model to develop, select, or arrange instruction and would become known for that action.

Adapted from: Krathwohl, D., Bloom, B., & Masia, B. (1956). *Taxonomy of educational objectives. Handbook II: Affective domain*. New York: David McKay. Available at: http://www.aps.edu/aps/gifted/krathwahl.html

What's the point?

- Memorizing, while a necessary element for critical thinking, is a lower level mental activity

- Making judgments, which requires analysis, synthesis and evaluation, is a higher level mental activity
  - Critical Thinking requires higher levels of mental activity

Measuring critical thinking…

- Should include activities that will be assessed which can promote its development
- Plan for measurement by writing explicit goals and objectives for each lesson, assignment, project, clinical competency

- Make the expectations VISIBLE and CONSISTENT across the entire curriculum

How is *Critical Thinking* Observable?
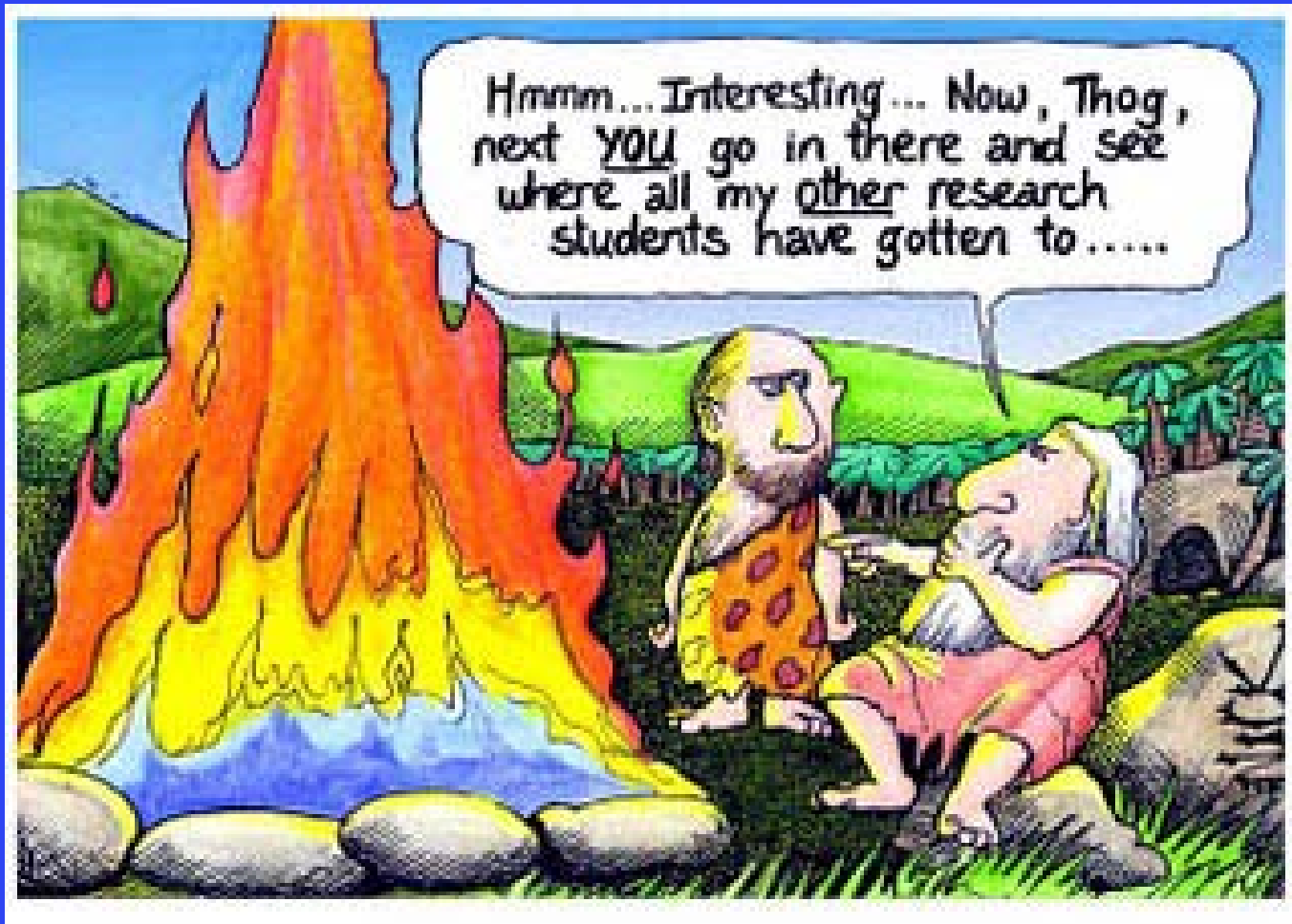
PROTO-PROFESSOR ZOG: PIONEER IN FIRE RESEARCH

FORMATIVE ASSESSMENT: *QUESTIONING TECHNIQUES FOR DEVELOPMENT OF CRITICAL THINKING SKILL SETS*

What we usually do…

- Our students learn from being told and shown by expert faculty members how to use the best science and how to think about the role of science in practice
- This assumes that critical thinking is basically a cognitive skill
  - Free from application

- This philosophy is built on the "transfer of information" metaphor

- It also assumes that in the "skill learning" portion of dental/allied dental education, critical thinking is also being "taught" in the same fashion
  - Role modeling

Chambers *JDE* 2009

Traditionally

- Information transfer

- Practice of skills

- Neither didactic nor structured practice are sufficient to develop effective habits of critical thinking

- Learning happens best when it is organized around purposeful intended use of knowledge, skills and values in practice

- Reflection on these practices should be required and purposeful

- "Novices do not understand the relationship between scientific concepts and their clinical applications the same way researchers or clinical experts do…

- even when they can perform relevant tasks under controlled circumstances"
  - *[i.e., competencies]*

- "Knowing the rules of science and …having the skill to apply them in *controlled circumstances* may not be a strong indicator of critical thinking performance…

- …(Students) have the [critical thinking] tools but are not yet skilled in using them…"

Chambers DW. Lessons from Students in a Critical Thinking Course: A Case for the Third Pedagogy. *JDE* 2009 71(1):65-82.

- Consequently, evaluation of critical thinking must extend beyond traditional approaches in didactic and skill acquisition
  - More than Cognitive/Psychomotor Domains

- "Applied critical thinking"
  - Present information that will bring all students to a uniform level of knowledge
  - Must consider the range of factors that account for students' habits of reflection on practice
  - and emphasize reflection as a component that will improve the consistency of using CT in dental practice

Consistent reflection is key in developing critical thinking skills

Reflection as a means to enhance critical thinking

- Reflection allows one to make judgments in complex and ambiguous situations

- Is the "integration of all learning in practice"
  - Suggests that without reflection, students are merely participating without *meaningful* learning occurring
    - Must have meaningful learning for long term behavior changes to take place

© Dennis Brack

Resource: Boyd LD. Reflections on Clinical Practice by First Year Dental Students: A qualitative study. *JDE*. 2002; 66(6): 710-720.

Dentistry requires 2 reflective processes

- **Reflection-on-action** = thinking about a situation *after* it has happened
    - Reevaluating the experience
    - Deciding what to do differently
    - Planning for trying out a new approach next time
  - Drives improvement
  - Is a mindful, purpose-driven and honest openness to what one is doing
  - Should have an element of accountability
    - Who's going to see what a student reflects on?
    - Who's going to help with "stinking thinking" issues or offer positive reinforcement?

- **Reflection-in-action**: Reshapes what is being done *while* it is happening
    - Requires the creation of new ways of thinking and acting about the problems of dental practice
  - Educators need to be cognizant that reflective practice is a result of a *cycle of action and reflection*
    - Student need to be encouraged and have time to reflect on clinical experience purposefully in the curriculum and while on the clinic floor
      - All clinical faculty must participate

Boyd JDE 2002

You can't (*in the long run*) behave differently than how you feel about a situation

- Reflective experiences must also assess the individual's *feelings* in order for comprehensive critical thinking to occur

- Exploring emotions linked to an experience is of great importance in moving towards new learning and permanent changes in behaviors
  - In this study, 120 reflective papers were written
    - 93 times students referred to connections they were making between the clinical experience and some aspect of their didactic coursework

Boyd JDE 2002

Sample reflection questions:

- Instructions: Think back to clinic today and replay the experience.
  - Describe the process from meeting the patient, recording assessment data, interacting with the patient in conversations, as you provided treatment, and after the patient left.

- What went well and what would you have done differently?

- What feelings did you experience during this process?

- In reflecting on what you learned today, what are some concrete examples of processes or procedures you will use with a patient with similar conditions next time?

Summary on reflection as a means to critical thinking

- Reflection is underutilized in dental educational circles

- Reflection can lead to deeper learning

- Reflection is a component part of the critical thinking process

- Dental students benefit from a reflective process

- Changes in the curriculum and in application in clinic should be considered as a means to enhance the transition of critical thinking skills from the classroom to the clinical environment

A difference in questions

HIGHER ORDERED vs LOWER ORDERED

Lower-order / Higher-order Questions

Lower-order questions require students to recall information from memory or directly from the text (Barden, 1995).

◦ Helps teachers check for knowledge and retention of facts and can focus students on previously learned content.

◦ Knowledge level questions fall into the lowest level of Bloom's / Anderson's levels of cognitive knowledge

Higher-order questions require students to use higher-order thinking or reasoning skills (Barden, 1995; Brualdi, 1998).

◦ Reveals whether student has grasped and can apply a concept.

◦ Higher-order questions go into levels of comprehension, application, analysis, synthesis, evaluation or judgment
   • (Bloom, 1956).

Resource: Center for Teaching and Learning: Leaders in Learning: Available at:
http://www.ctlt.org/documents/leaders_in_learning/Section_4.pdf

Convergent vs Divergent

Another way to look at questions

Another way to assess level of questions: *Convergent* vs. *Divergent*

- Convergent
- Q: Who is the 16th president of the United States?

- Single or generally agreed upon single BEST answer
- Usually lower-level questions

- Divergent
- Q: Who is the greatest president in US history?

- Multiple "right" answers
- Frequently higher-level questions

Differentiation

Convergent

- Closed questions
  ◦ Narrow range of responses
  ◦ Answers are predictable
  ◦ Limited amount of thought
- Memory
- Can be used as a measurement of understanding

Divergent

◦ Open questions
  - Wide range of responses
  - Answers less precise
  - Represents higher-level thinking
◦ 2 main types:
  - Process: focusing on how students are thinking (thought processes)
  - Evaluation: defense of a position on a rational basis

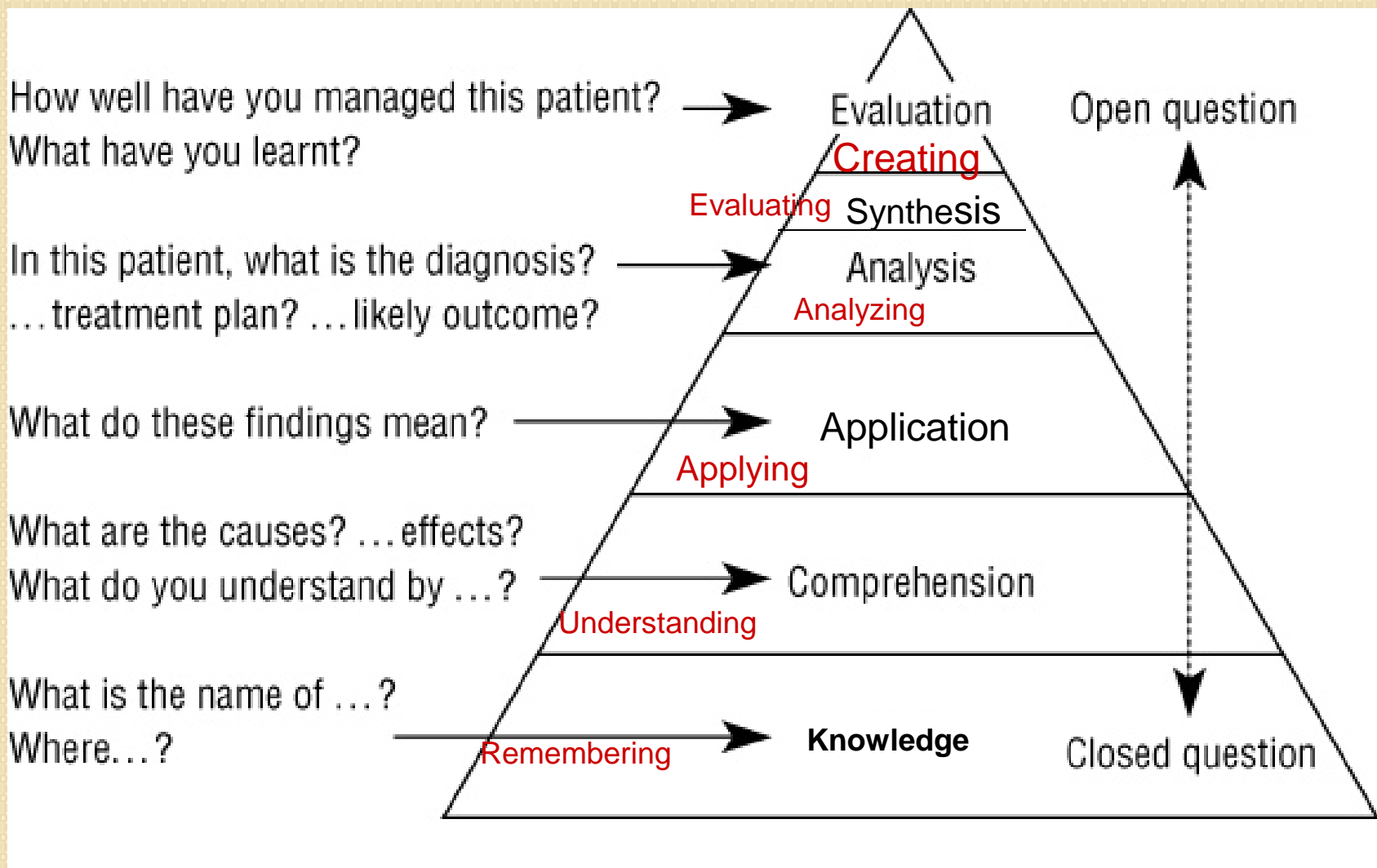# Group Brainstorming Activity:

In your discussion group, given a didactic course and/or clinical/laboratory settings, develop and differentiate between-

- Lower-ordered questions

- Higher ordered questions

Are they "convergent" or "divergent"?

How well have you managed this patient?
What have you learnt?
→ Evaluation

Creating

Evaluating Synthesis

In this patient, what is the diagnosis?
…treatment plan? …likely outcome?
→ Analysis

Analyzing

What do these findings mean?
→ Application

Applying

What are the causes? …effects?
What do you understand by …?
→ Comprehension

Understanding

What is the name of …?
Where…?
→ Knowledge

Remembering

Open question

Closed question

Resource: Adapted from Peyton JWR, Allery L. Setting objectives. In: Peyton JWR, editor. *Teaching and learning in medical practice*. Rickmansworth, UK: Manticore Europe Limited, 1998: 57-67. Modified by L. Coan 2007

Summary

- Lower-level (convergent) questions help students to…
  - reconnect with previously learned content,
  - help stimulate their making connections by thinking through what they may already know, and
  - check for understanding of relevant facts before exploring new concepts

- Higher-order (divergent) questions ask students to…
  - *do* something with what they know,
  - apply their knowledge to new situations,
  - use their knowledge in analyzing information or events,
  - put together ideas to form new concepts or ideas, and
  - evaluate situations or scenarios based upon a set of criteria or expectations.

For your own purposes, you may assess questions related to each domain

- Affective Domain
- Psychomotor Domain
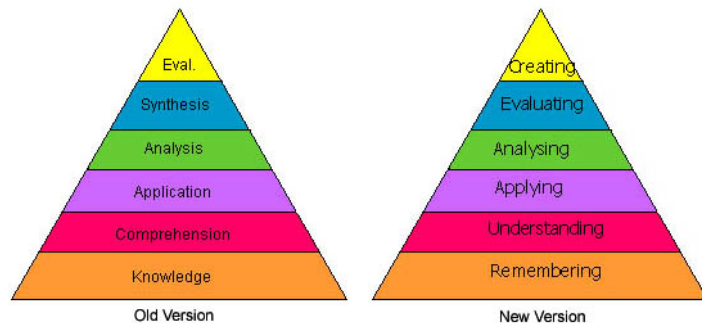
Cognitive Domains

Activity 3: Group Discussion-Mapping Critical Thinking Outcomes

How are WE doing?

- Using your handout, assess the level of the cognitive domain of each question given thus far during this workshop.

- Identify each question as being "convergent" or "divergent"

ACTIVITY 3: Hierarchy of Questions

| List of all questions asked so far:	Knowledge Remembering	Comprehension Understanding	Application Applying	Analysis Analyzing	Synthesis Evaluating	Evaluation Creating
Is your primary teaching responsibility / interest: didactic, clinical, research/mentor?						
What is assessment?						
What is critical thnkinkins?						

Strategic Strikes

Your assignment is to place your questions purposefully

Summary of Activity 3

- One option for collecting and reporting outcomes in critical thinking is to map specific activities/assignments/questions to levels of hierarchy in all domains

- Use a variety of convergent or divergent questions (depending on outcome desires) from all domains

- Take home task 3:

  ◦ Given a lesson, course, clinical or laboratory experience: map **purposeful strategic** questions to Domain hierarchy

Scaffolding:
Another way to use Questioning
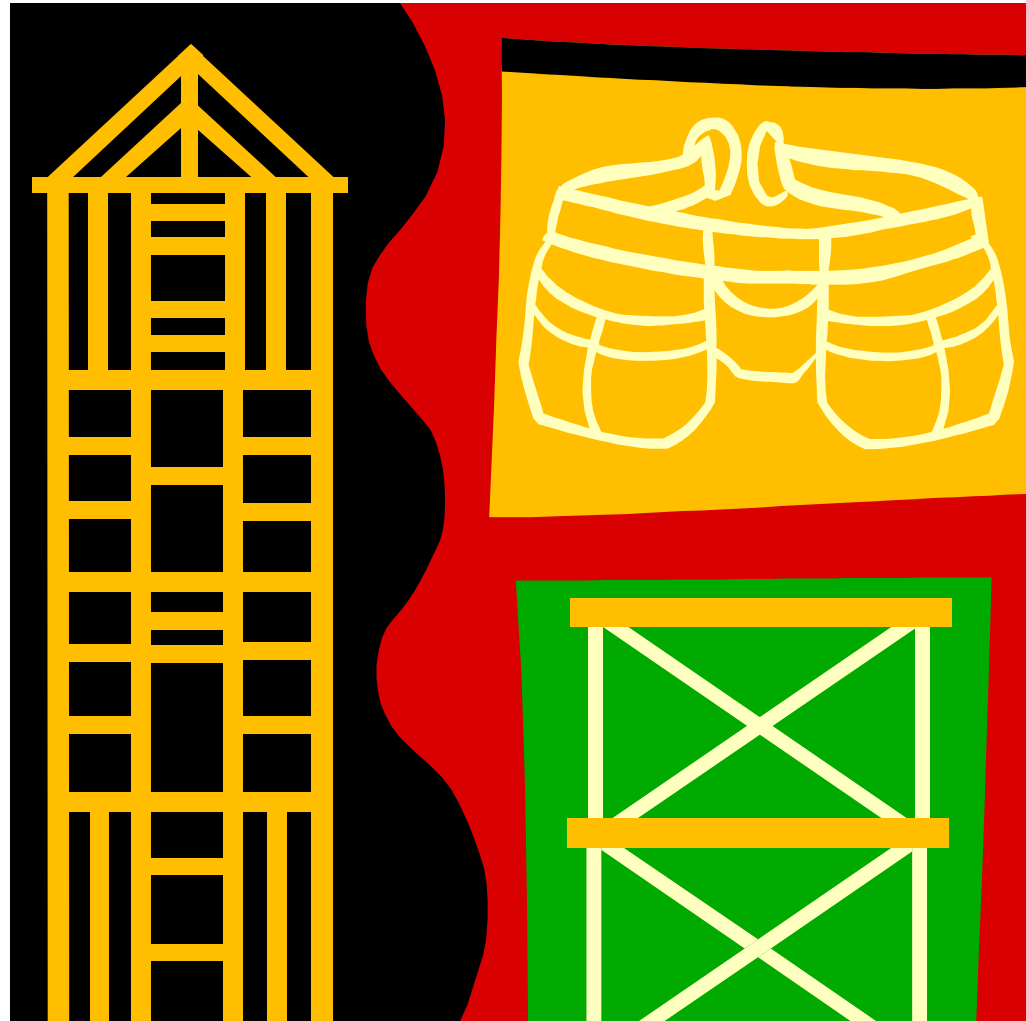
Cognitive Apprenticeship Model

- Situated cognition is a theory of instruction that suggests learning is naturally tied to authentic activity, context, and culture
  - (Brown, Collins, & Duguid, 1989).
  - It is more difficult to learn from un-natural activities.
- Cognitive apprenticeship is a model of learning based on the situated cognition theory.
  - It provides practical steps for applying situated cognition theory.

Scaffolding

- Traditional classroom uses IRE model of instruction
  - Initiation
  - Student Response
  - Evaluation

  Teaching is a "prescript" for transmission of knowledge

- Scaffolding
  - Emphasizes social nature of learning and teaching
  - Considers the dynamic interaction and changing roles of teacher and student
  - General aim is to build support for students interactively
  - It was developed in conjunction with *Constructivist* view

Resource: Wu X. Scaffolding in Action Michigan State University   Available at:
http://www.eliteracy.org/courses/912-Fall2000/papers/htms/XWu2.htm

- Scaffolding is a type of instructional assistance that enables the student to solve a problem, carry out a task, or achieve a goal that they **cannot** accomplish alone.
  - Wood, Bruner, and Ross (1976)

- Scaffolding involves a gradual release of responsibility by the teacher and increasing responsibility of the students through collaborative construction of curriculum on a moment-to-moment basis.
  - Gallimore and Tharp (1990)
  - Stone (1998)

- In the joint involvement of a *scaffolded* learning process, the teacher or *the typical more capable other* draws on various means of assistance in a meaningful dialogue
  - modeling,
  - feedback (allows performance to be compared to a standard, allowing self-correction),
  - contingency management,
  - instruction requiring specific action,
  - questioning,
  - cognitive structuring,
  - task structuring
    - Tharp 1993

Teacher & Student Roles

- The teacher first assumes the role of the expert and provides assistance through "scaffolds" or tools where needed by the student in a particular task *(psychomotor)* or learning exercise *(cognitive, affective)*

- As the individual students gain greater control of the learning, they become more independent and responsible.

  - Salomon, 1997; Wood, Bruner, and Ross, 1976; Vygotsky, 1978

- The role of the *more capable other* in scaffolding is to pull support away as the student becomes more independent in their performance on a task.

- Assistance in scaffolding is temporary and responsive to individual students' needs.

  - Kaye 1982

4 Stages of Scaffolding

- **Orientation**
  - Exposed to new information
  - Related to prior knowledge
  - Demonstration/role modeling
- **Coaching**
  - Teacher and student "think conjointly"
  - Scaffolding questions as needed for learner to absorb new information and transform into knowledge
  - Student performs on request, teacher provides encouragement, correction as needed

- **Tuning**
  - Refines knowledge
  - Application to "authentic" situations
  - Teacher prompts the next step
  - Continued practice
    - Supervision "fades"
- **Autonomy**
  - Behavior "routine-ized"
  - Learner knows how and when to use knowledge
  - Does it effectively without external prompting
  - Does it whether supervised or not

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. American Educator, 6-46.

Embedded Questions

- Definition: *Questions found randomly throughout the lesson plan (or in clinical/lab experience)*
  - rather than grouped in one area
  - Promote learning
  - Maintain interest
- Should be purposefully selected and inserted precisely
  - Generally "correct" responses should be "written out" *before* the presentation/interaction
    - What will you think is the "correct" response?

Goal of Scaffolding:
Fading Away

Dental Educator

Strategic Strikes

Your assignment is to place your questions purposefully

What are we ACTUALLY doing?

- *Behar- Horenstein et al.* in a dental school environment and *Taylor et al.* in medical education found that instructors in their respective settings **were** aware of teaching best practices
  - such as guiding learners with open-ended questions to stimulate critical thinking,
- But *rarely used these* techniques when working with students.

Behar-Horenstein LS, Dolan TA, Courts FJ, Mitchell GS. Cultivating critical thinking in the clinical learning environment.*J Dent Educ* 2000;64:610-5.

Taylor CA, Dunn TG, Lipsky MS. Extent to which guided discovery teaching strategies were used by 20 preceptors in family medicine. *Acad Med* 1993;68(5):385-7.

Further…

- Faculty development workshops don't necessarily lead to instructional changes

- However, development opportunities that are based on sound pedagogy & encourage reasoning, reflection and discussion can result in a higher chance of application post-seminar


Changemaker
There is nothing good unless you do it

Behar-Horenstein L, Schneider-Mitchell G, Graff R. Promoting the Teaching of Critical Thinking Skills through Faculty Development *JDE* 2009 73(6): 665-675.
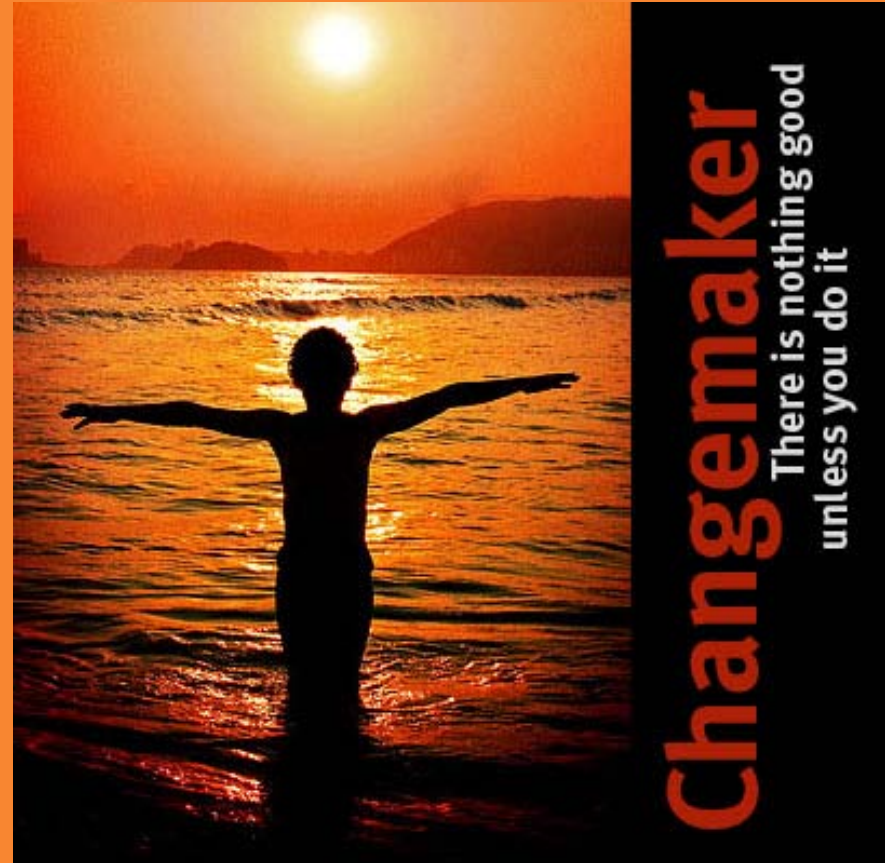
Activity 4: *(See activity sheet)*
Individually develop own set of strategic questions

- Reflect on concept of scaffolding and embedded questions
- Imagine a scenario in which you would like to employ these strategies

- Write out strategic questions for your scenario considering:
  ◦ Working definitions of assessment or critical thinking
  ◦ 4 stages of scaffolding
  ◦ Importance of purposeful reflection in development of critical thinking skills

Take Home Task 4: Evaluate courses, clinical or laboratory experiences for opportunities in applying strategic questioning

Giving Feedback:
Developing Skills in Reflection
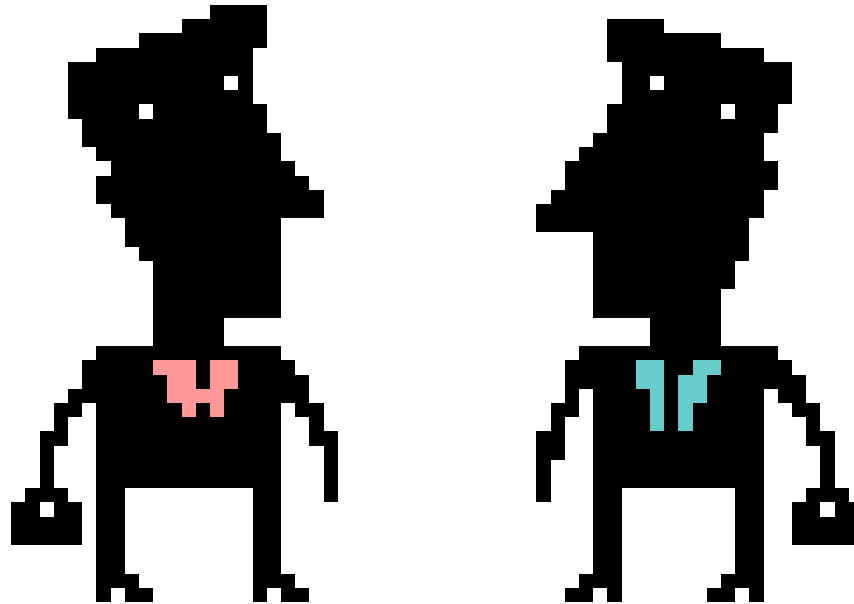
Faculty complaints of student performance

- Fail to meet specifications
- Don't ask good questions
- Fail to use technical terminology correctly
- Questions are poorly organized, lack specificity, do not lead to constructive problem-solving
- Unable to recall and apply basic and clinical science information that forms the rationale for the performance of all clinical tasks

- Who's fault is this?

Further…

- Students are often unsure about the outcomes of the procedures they complete
- Large lectures isolate students by discouraging "risk-taking" by asking questions
- Competencies don't typically assess the ability to develop and use appropriate learning strategies

Learning is a discriminative process

- Definition: Discrimination learning is learning what something IS by comparing what it is to what it is NOT
  - Learning has occurred when a learner can recognize the differences between the thing to be learned from other similar things OR its error form
- Feedback plays a substantial role in discerning similarities and differences

Feedback as a *reflection* skill development process

- Following completion of a task, the learner needs to compare what was intended to be the result of treatment compared to the actual end result of treatment

- It is essential for the learner to generate this feedback and be able to tell if his/her interpretation is accurate

- To do this the learner must have a clear picture of the preferred "movement" (knowledge of performance: *instrumentation for example*) and finished product (knowledge of results: *removal of all deposits without trauma for example*)

  ◦ All criteria should be clearly defined
    - Student handbooks, clinic manuals, competency sheets, daily grade sheets

How to make sure self-generated feedback occurs

- The learning environment ought to be structured to assure that:
  - Feedback is generated and used routinely
  - Students are **<u>required</u>** to to become self-evaluators

  - Valid and reliable criteria is in place to help students develop relevant feedback
    - A part of daily assessment

New perspectives in the role of faculty feedback

- Instructor generated feedback may impede learning

  ◦ Performance is still facilitated on the day of the practice session with frequent feedback

  ◦ However, on the day of the *testing*, students receiving frequent daily feedback did less well than those who had feedback less frequently

HUH???

- When feedback is provided by instructors only *some* of the time, students are forced to generate *their own feedback*
  - They are forced to assess their own progress and learn not to use the instructor as a crutch

- Researchers suggest we wean students from the perceived need to constantly defer to the instructors for feedback

So what does it mean?

- It does **not** mean instructors are unnecessary

- It DOES mean that the instructor should not automatically proffer feedback without requiring the students to construct their own first
  - "How do you think you did?"
  - "What did you perceive to be a problem during this assessment?"
  - After the student identifies what was wrong, ask the student: "How might you correct this error?"

How are you going to "*get 'er dun*"?

MEASURING CRITICAL THINKING

The Art and Craft of Assessment

Or what I had to do to "prove it"

Description of a grade:

An inadequate report
of an inaccurate judgment
by a biased and variable judge
of the extent to which a
student has attained an
undefined level of mastery of an
unknown proportion
of an indefinite material.

P. Dressel, p. 12 "Grades: One more tilt at the windmill." in A. W. Chickering (Ed.), Bulletin. Memphis: Memphis State U. Center for the Study of Higher Education, Dec. 1983

What is a rubric?

- A rubric is a guideline for rating student performance.

- The guidelines specify what a performance is like at various levels (superior, excellent, good, poor) and, usually, on various attributes

- The key elements of a rubric are the descriptors for what a performance is like within the full range of possible performance levels

Benefits:

◦ The rubric provides those doing the assessment with exactly the characteristics for each level of performance on which they should base their judgment.

◦ The rubric provides those who have been assessed with clear information about how well they performed.

◦ The rubric also provides those who have been assessed with a clear indication of what they need to accomplish in the future to better their performance.

Quality Continuum

- A rubric must define the range of possible performance levels.
  - Within this range are different levels of performance which are organized from the lowest level to the highest level of performance.
- Usually, a scale of possible points is associated with the continuum where the highest level receives the greatest number of points and the lowest level of performance receives the fewest points.

Descriptors

- Each level of performance should have descriptors which clearly indicate what is necessary to achieve that level of performance.

Analytic vs. Holistic Rubrics

- Analytic rubrics identify and assess components of a finished product.

- Holistic rubrics assess student work as a whole.

Which one is better?

- Neither rubric is better than the other. Both have a place in authentic assessment, depending on the following:
  - *Who is being taught?*
    - Because there is less detail to analyze in the holistic rubric, novice students may be able to integrate it into their schema better than the analytic rubric.
  - *How many teachers are scoring/items are scored with the product?*
    - Different teachers have different ideas about what constitutes acceptable criteria.
    - The extra detail in the analytic rubric will help multiple grades emphasize the same criteria.

Steps to Creating a Rubric

1. Identify exactly what is to be scored.
2. Define the scale (point range) of the rubric.
3. Develop descriptors for each performance level that

   a. describe unique characteristics, and
   b. use unbiased language

4. Assure that the rubric

   a. defines a continuum of quality,
   b. focuses on the same criteria,
   c. validly discriminates performance levels,
   d. can be reliably rated.

Activity 5

- Divide into groups:
  - Didactic
  - Clinical
  - Lab

- Develop a rubric to measure critical thinking

Activity 5 Summary:

- In order to measure critical thinking consistently, one has to define the quality continuum which describes the levels of student performance

- All criteria must be VISIBLE

Take Home Task #5: Devise rubrics for all activities that require measurement related to critical thinking

RUBRIC Resources

- Rubistar for Teachers
  - http://rubistar.4teachers.org/
- TeacherVision
  - http://www.teachervision.fen.com/teac hing-methods-and-management/rubrics/4523.html?detour ed=1
- Teachnology
  - http://www.teach-nology.com/web_tools/rubrics/

Program/institutional level

OUTCOME MEASURES

When accreditation comes to town, what will I have to show them?

Tips for implementing & documenting critical thinking in courses/assignments/clinical and laboratory rotations

- Define critical thinking for your program/course
- Develop specific assignment/clinical/lab objectives in addition to course and class objectives
- Develop criteria for assessing each (i.e. grading rubric)
- Evaluate the assignment to determine the level of critical thinking that is occurring by comparing assignment objectives to the defined critical thinking hierarchies.
- Measure student perceptions of critical thinking.
- Continue an on-going assessment of assignment effectiveness

Critical Thinking at Indiana University Purdue University at Indianapolis (IUPUI)

Example of Indirect Measures of Critical Thinking

- The NSSE Survey of "Mental Activities"

National Survey of Student Engagement Example of an Indirect Measure

- The National Survey of Student Engagement (NSSE) documents dimensions of quality in undergraduate education and provides information and assistance to colleges, universities, and other organizations to improve student learning.

  Its primary activity is annually surveying college students to assess the extent to which they engage in educational practices *[including critical thinking]* associated with high levels of learning and development.

Implementation of Critical Thinking Across the Curriculum

Led by the Critical Thinking COP:

- Developed beginning and intermediate levels of expectations for demonstrating critical thinking

- Developed examples of assignments and rubrics focused on critical thinking across the disciplines

- Surveyed student and faculty perceptions
  - Approved by the IUPUI IRB EX0702-33B

Disciplines Represented in the Perceptions Survey

Disciplines Represented		Disciplines Not Represented
School Unit	Department	School/Unit
IUPUI Community Learning Network	Adult Education/General Studies	IU Herron School of Art and Design
IU Kelly School of Business	Management	Purdue School of Engineering & Technology
IU School of Dentistry	Allied Health and Periodontics	IU School of Health and Rehabilitation Sciences
IU School of Library and Information Science		IU Division of Labor Studies
IU School of Nursing		IU School of Music
IU School of Physical Education and Tourism Management	Tourism, Conventions, & Event Management	IU School of Social Work
IU School of Public and Environmental Affairs	Environmental Health Science; Public Affairs	IUPUI University College
Purdue School of Science	Biology	IU School of Medicine

NSSE Survey of Mental Activities

| Sample survey items may be found at: http://nsse.iub.edu/pdf/NSSE2008_US_English_Paper.pdf	Very much	Quite a bit	Some	Very Little
Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form				
Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components				
Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships				
Making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions				
Applying theories or concepts to practical problems or in new situations				

Look familiar???!!

NSSE Mental Activities Survey Items

Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form

Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components

Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships

Making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions

Applying theories or concepts to practical problems or in new situations
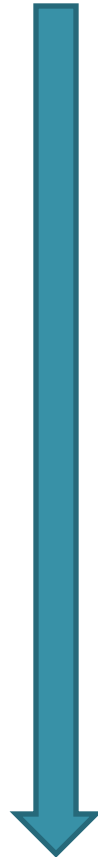
Higher Order Thinking Skills

- Evaluation
- Synthesis
- Analysis
- Application
- Comprehension
- Knowledge

Lower Order Thinking Skills

Best Practices Sample

ASSESSING ASSIGNMENTS AND STUDENT PARTICIPATION

Example:

Joyce Hudson, RDH, MS

Critical Thinking Assignment: Determining the amount of fluoride removed by various water filtration systems

IUSD : Periodontics and Allied Health

H217 Preventive Dentistry

Assignment Objectives**:** This assignment will allow students to:

1. Use research skills to learn the amount of fluoride removed by various water filtration systems.

2. For a specific water filtration system, determine if an adequate amount of fluoride remains in the water following filtration.

3. Compare and contrast the amount of fluoride removed by various water filtration systems.

4. Discuss possible explanations for variations in research findings within specific brands of water filtration systems.

5. Discuss the importance of utilizing this information in patient education.

6. Select a patient you've previously treated, review the caries risk assessment and determine the following:

   a. Accuracy is assessing the patient's fluoride intake based upon what you have learned regarding water filtration systems.

   b. Modifications you will make in assessment of fluoride intake for future patients based upon what you have learned regarding water filtration systems.

Mapping Critical Thinking Hierarchy

	Levels	Of	Critical	Thinking	Required
Objectives of critical thinking assignment	**Memorizing** facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form.	**Analyzing** the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components.	**Synthesizing** and organizing ideas, information, or experiences into new, more complex interpretations and relationships.	**Making judgments** about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	**Applying** theories or concepts to practical problems or in new situations.
Use research skills to learn the amount of fluoride removed by various water filtration systems.				X	
For a specific water filtration system, determine if an adequate amount of fluoride remains in the water following filtration.		X			
Compare and contrast the amount of fluoride removed by various water filtration systems**.**		X			
Discuss possible explanations for variations in research findings within specific brands of water filtration systems.				X	
Discuss the importance of utilizing this information in patient education.					X

OTHER BEST PRACTICES

Steps in Performing Critical Thinking in Clinic

**Treatment Planning Process for Patient Care**
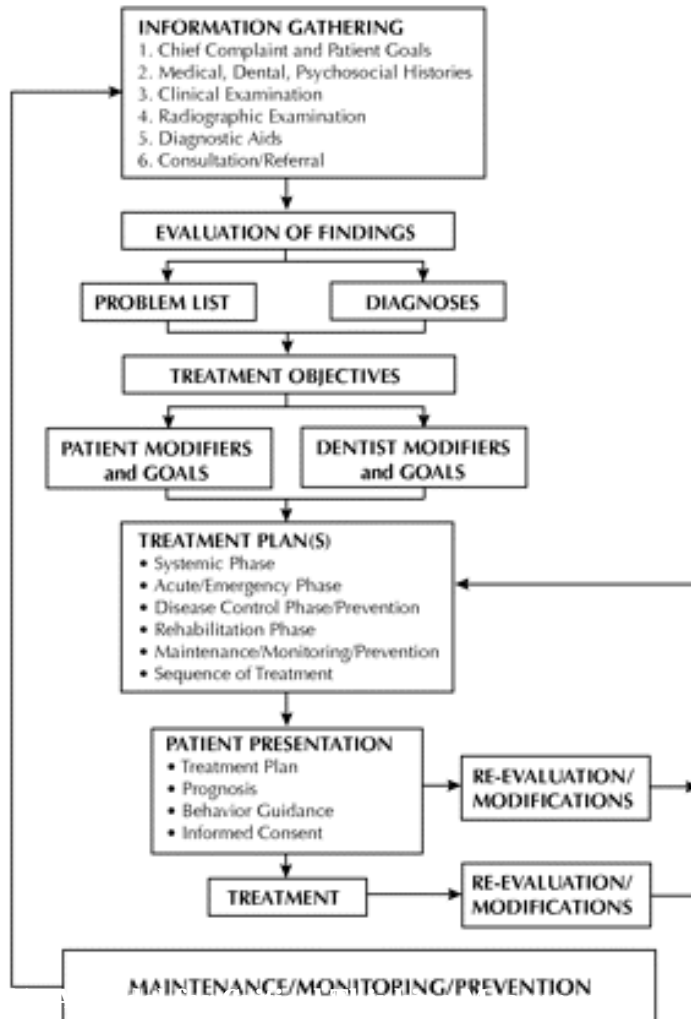
- The purpose of this article is to present a model now being used to measure dental student critical thinking abilities in patient assessment and treatment planning
- The schematic diagrams an agreed upon set of minimally essential steps in the critical thinking process applied to patient assessment and treatment planning

Johnsen DC et. al. A Model for Critical Thinking Measurement of Dental Student Performance *JDE* 2009. 73(2):177-183.

Practical Application of CT :

Schematic for Critical Thinking Measurement
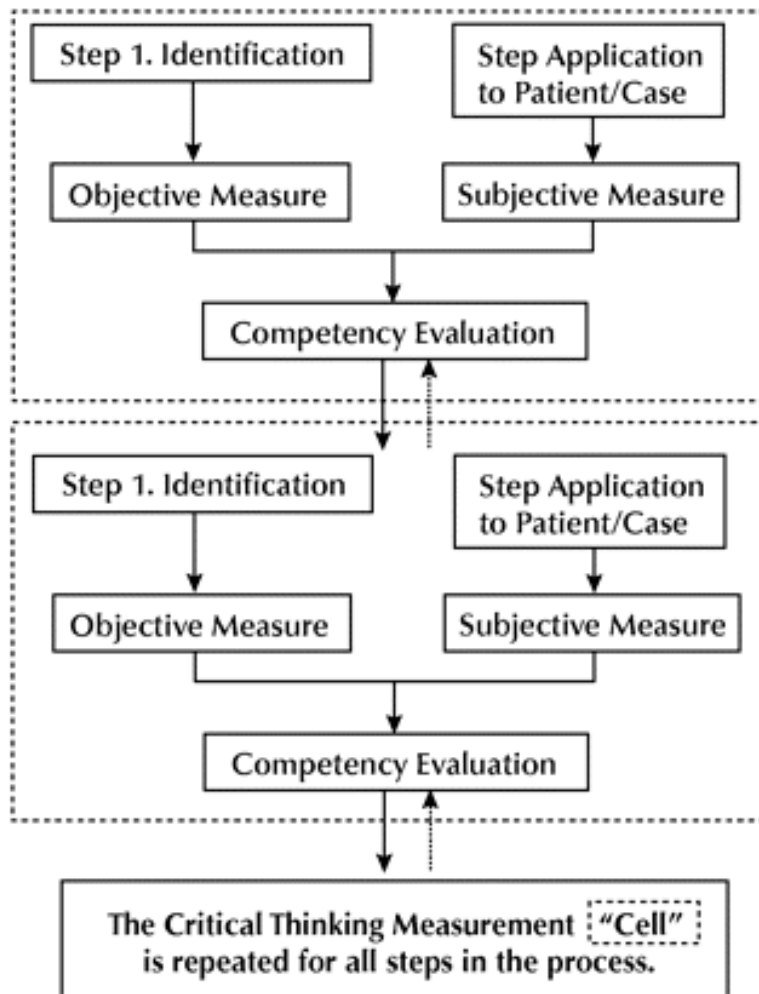
- "…we define critical thinking as the art of analyzing and evaluating thinking with a view to improving it…

- The critical thinking measurement cell reflects the smallest set of interdependent actions from which some assessment of critical thinking can be made…

- The cell is repeated, creating a framework for more general assessments of student thinking abilities. The cell has only five components, making it practical for widespread use…"

- The model includes both objective and subjective faculty assessment

- The model recognizes differences between novice to competent student clinicians and the role of the faculty expert

Preceptor vs. Checker Approach

- the "One-minute preceptor approach"
  - communication framework that helps the medical student learn problem-solving skills while presenting cases to the medical preceptor.
    - introduced by Neher et al. in 1992

- ICARE System
  - Revised by Sakaguchi (Oregon Health and Science University)
    - Facilitates a professional exchange of information between the clinical instructor and the dental student while educating the student and providing the best possible care for the patient

Sakaguchi RL. Facilitating Preceptor and Student Communication in a Dental School Teaching Clinic *JDE* 2010;74(1):36-37.

Practical Application: iCare System

Preceptor Perspective

- I: Inquire about the patient's dental history and current condition and about student's tentative diagnostic conclusion and possible treatment plan

- Ask :
  - What is medical and dental history
  - What did the evaluation reveal?
  - What is your diagnosis?
  - What is your treatment plan?

Student Perspective

- I: Identify key facts in the patient's current and dental history & initiate a discussion of a possible tentative diagnosis and treatment plan

- Example student presentation:
  - My patient's chief complaint is pain when drinking cold beverages. After the reviewing the history and completing the assessment, I believe the pain is from gingival recession in the lower right quadrant. Possible treatment may include desensitizing agents such as found in toothpastes.

iCare

Preceptor Perspective

- **C**ultivate the student's use of scientific evidence to support the tentative diagnosis and treatment plan

- **A**dvise the student on the general oral health principles relevant to this and other cases

- **R**einforce what was done well and make suggestions for improvement

- **E**mpower the student to evaluate the diagnosis and treatment plan by using evidence & modify as necessary. Ask student to make a timeline for next actions

Student Perspective

- **C**ontribute evidence to support the tentative diagnosis and treatment plan

- **A**pply relevant oral health principles to this and other cases

- **R**eflect on what was done well and what can be improved integrating evidence-based decision-making

- **E**xecute and modify treatment plan if necessary. Educate the patient

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What happens now?

REFLECTION

Survey Results of ADEA 2009

- *Integration of Curricular Elements to Demonstrate Outcomes of Critical Thinking in Evidence-Based Practice*
  - *L. Coan & J. Hudson*

ADEA 2009 Survey Results

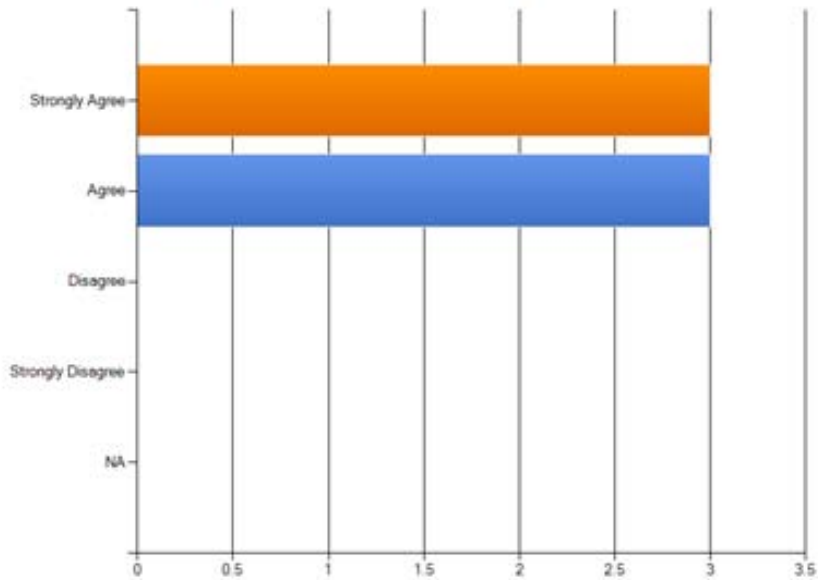The workshop provided me with useful information regarding critical thinking
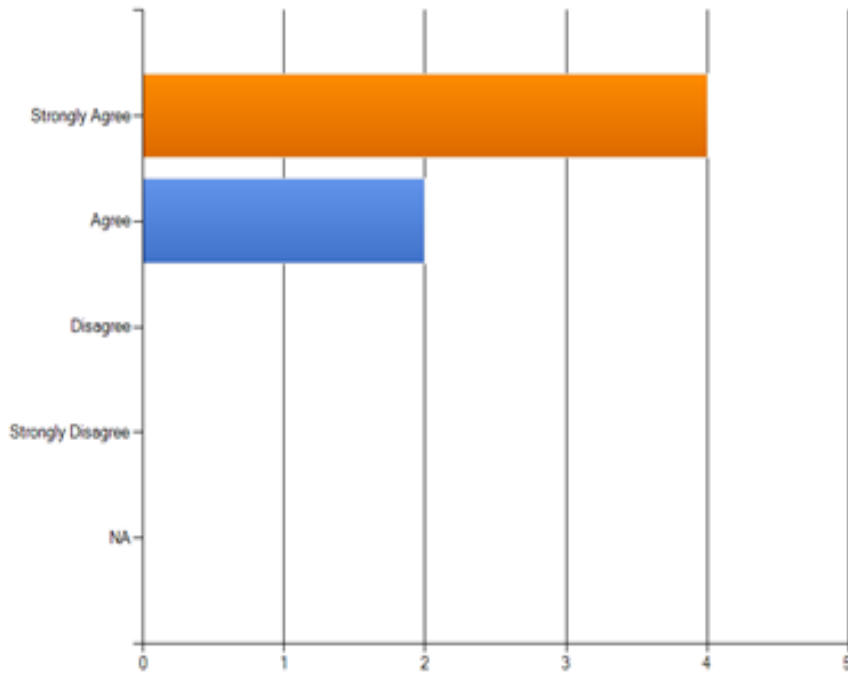
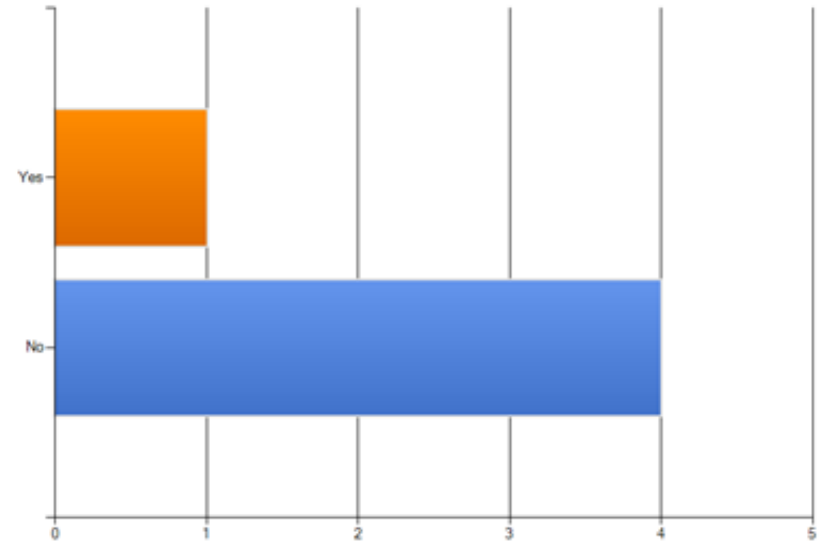The workshop provided ideas that I could take back to my institution for use in my course or program
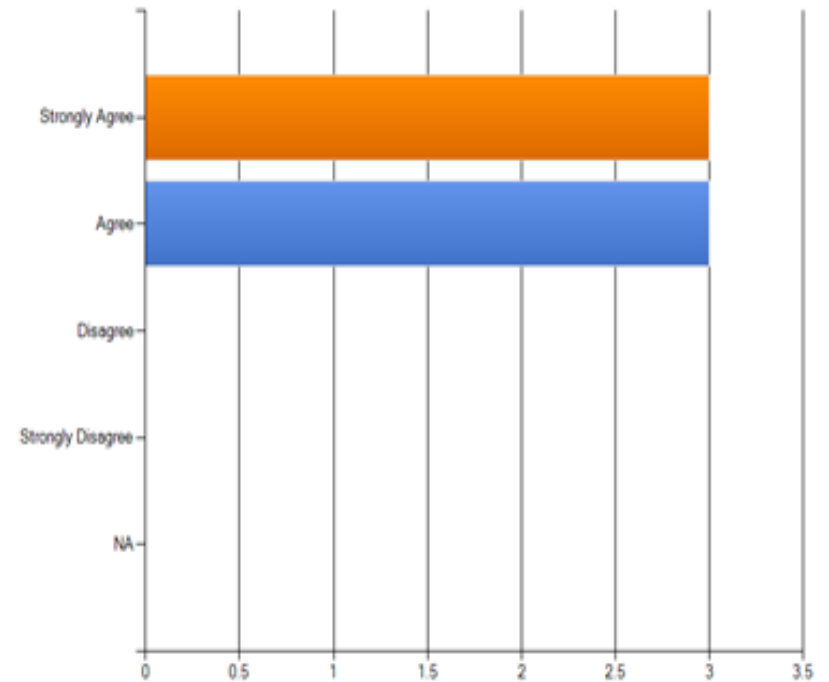
ADEA 2009 Survey Results

The workshop helped me identify critical thinking in my assignments

Our program has since formed a new definition of critical thinking since attending the FDW
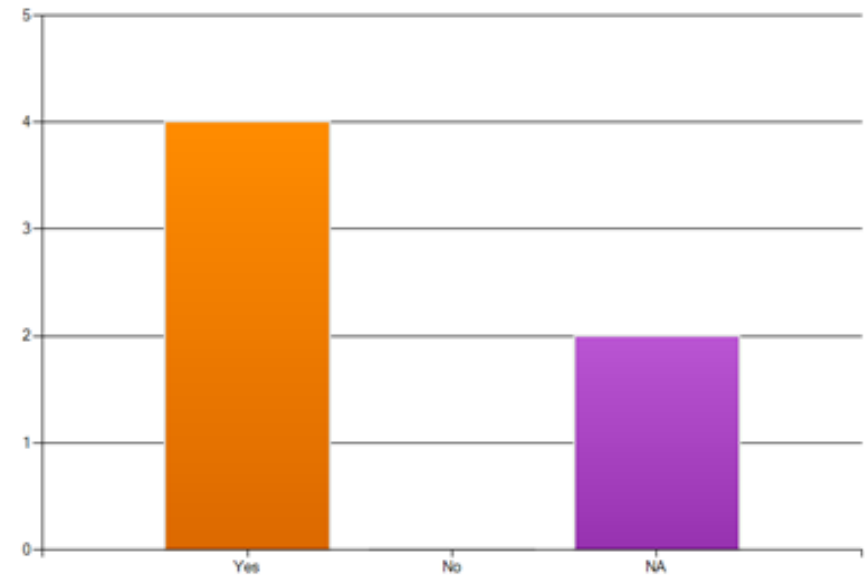
ADEA 2009 Survey Results

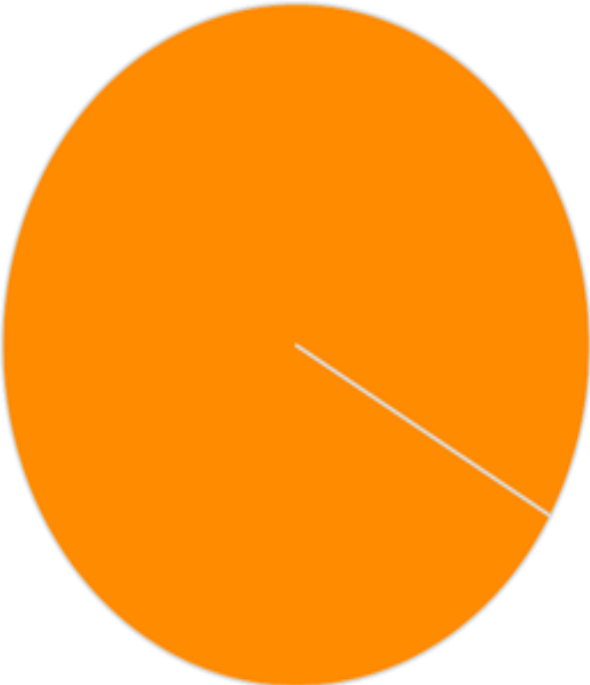I have defined critical thinking for the purposes of my course(s) since attending the FDW
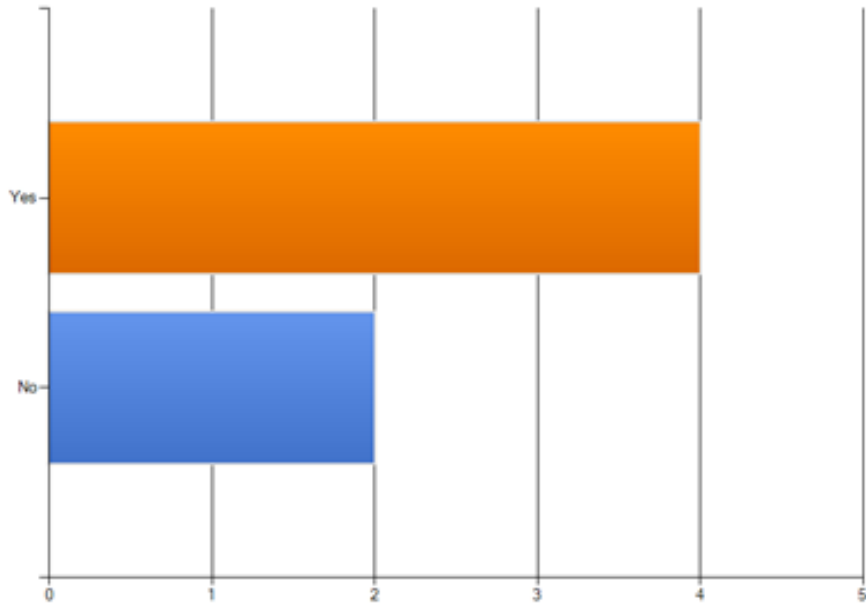
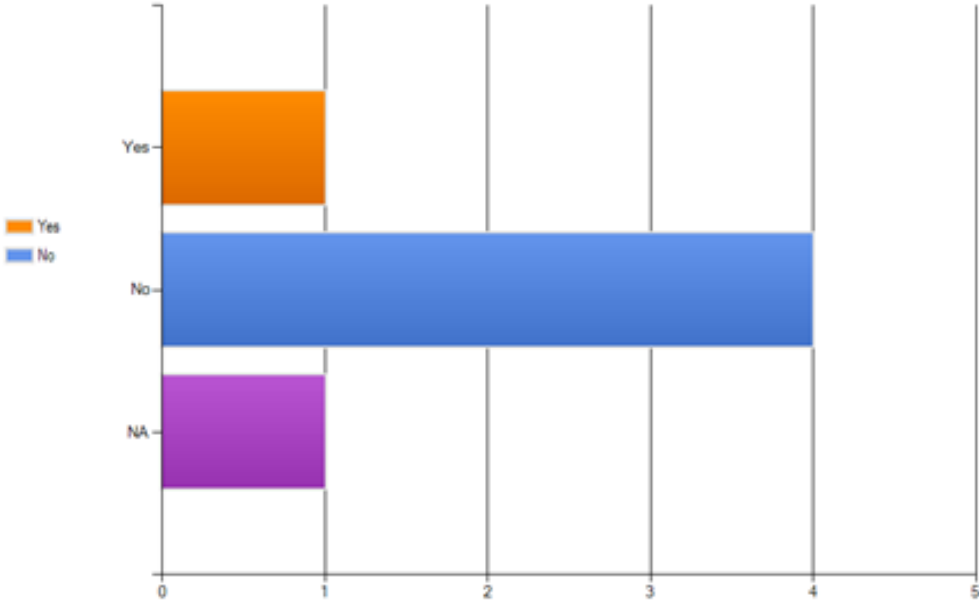I have assessed the level of critical thinking within the assignments I have developed since the FDW

ADEA 2009 Survey Results

I have shared information from the workshop with other members of my school/department or program

Information I have shared with colleagues has resulted in changes in our curriculum

ADEA 2009 Qualitative Data: How have you used information from the course?

- Created assignments that require the students to problem solve and research on their own rather than using lecture

- Faculty in many courses throughout the school are identifying critical thinking exercises in their courses and posing it to the students as such. Thanks for a good/useful course

- I already had implemented CT within my courses. Attendance at the workshop was affirming that I was indeed strongly incorporating CT within the course I teach. Hence the survey response of 'no' to some of the questions. I don't know if anyone has changed

- Provided CE for faculty professional development

What will you do?

- Karl Malden

Assessing Critical Thinking
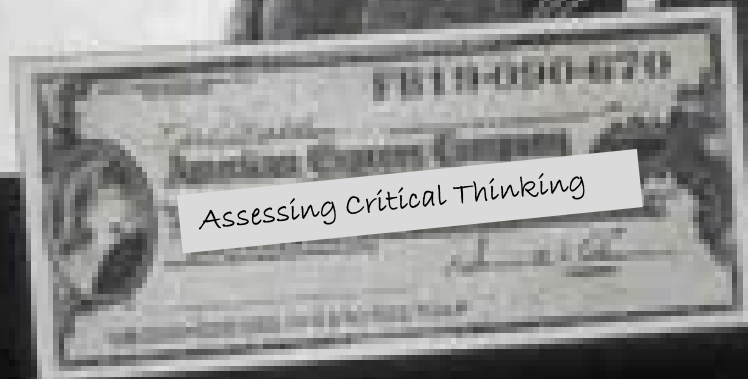
Activity 6: Action Plan

- In your groups and on the tabletop pads, compile a list of plans stating what you will be doing when you get home

   ◦ Make copies for yourself and identify those to which you are committing

- EX:

   ◦ 1. Complete Tasks 1-5

   ◦ 2. Take a nap!

Where do we go from here.........

- Establish networks for sharing ideas and collaborating on development of teaching methods that promote critical thinking for evidence-based practice.
  - ◦ A distribution list has been established for all participants
  - ◦ Recommendation: A sharing of developed assignments
  - ◦ Survey item to come to assess impact of workshop

- Remember: Above all…
  - ◦ Practice practice practice…..

Questions?

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