Getting Faculty Involved in Assessing and Improving Students’ Critical Thinking

Dr. Michael Grant, Associate Vice-Chancellor
University of Colorado – Boulder

Dr. David Hawkins, Dean
California Northstate Pharmacy

Dr. Ada Haynes, Professor & Co-Director
Tennessee Tech University

Dr. Barry Stein, Professor & Co-Director
Tennessee Tech University

Western Association of Schools and Colleges ARC, 2011
Partial support for this work was provided by the National Science Foundation’s TUES Program under grants 0717654, 1022789.

© Tennessee Tech University 2011
Importance of Critical Thinking

Explosion of Information

Internet

E=MC²
Email
MySpace
Wikipedia
Facebook
Phone Apps
Augmented Reality
Magazines
Blogs
Television
Radio
Journals
Books

Email
MySpace
Wikipedia
Facebook
Phone Apps
Augmented Reality
Magazines
Blogs
Television
Radio
Journals
Books
What is Critical Thinking?

Classic Emphasis

Evaluate Arguments and Conclusions

Reasoning
What is Critical Thinking?

Classical Emphasis

- Evaluate Arguments and Conclusions
- Reasoning

Expanded Contemporary Emphasis

- Evaluate Ideas and Plans
- Problem Solving

- Evaluate One’s Own Understanding
- Life-Long Learning Skills

- Evaluate One’s Own Understanding
- Life-Long Learning Skills

- Communication
- Creativity
Why Assess Critical Thinking?

Need to Measure Success for Accountability

Assessment Drives Improvement Efforts

How We Assess - Determines What Students Learn
History of CAT Development

- **Preliminary Work At TTU**
  - 2000 - 2004

- **NSF**

- **Collaborate With Other Institutions To Refine CAT**
  - 2004 - 2007

- **NSF**

- **Develop Training Methods for National Dissemination & Collect Norms**
  - 2007 - 2010

- **NSF**

- **Expand National Dissemination & Support Assessment in NSF Projects**
  - 2010 - 2014
Designing the CAT Instrument

Faculty Driven:
High Face Validity
Involved in Scoring

Construct Validity:
Learning Sciences

Reliable & Consistent Scoring
Essay Responses

Engaging for Students
Skills Evaluated by CAT Instrument

**Evaluating Information**
- Separate factual information from inferences.
- Interpret numerical relationships in graphs.
- Understand the limitations of correlational data.
- Identify inappropriate conclusions.

**Creative Thinking**
- Identify & evaluate evidence for a theory.
- Identify new information that might support or contradict a hypothesis.
- Explain how new information can change a problem.

**Learning & Problem Solving**
- Separate relevant from irrelevant information.
- Integrate information to solve problems.
- Learn & apply new information.
- Use mathematical skills to solve real-world problems.

**Communication**
- Communicate ideas effectively.
CAT features

- One hour exam
- Simulates real-world problems
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Reliable
- Valid
Assessment Uses of CAT

- Informal Learning Experiences
- Classroom Learning Experiences
- Program Outcomes
- College Outcomes
- Tracking Outcomes Over Time
- Value Added Enter vs. Exit
- Norm Referenced
Closing the Loop in Assessment and Quality Improvement

1. Assess Student Performance
2. Improve Student Learning
3. Increase Faculty Awareness of Student Weaknesses (Faculty Participate in Test Scoring)
4. Increase Faculty Awareness of Effective Practices
Sample Disclosed Question

A scientist working at a government agency believes that an ingredient commonly used in bread causes criminal behavior. To support his theory the scientist notes the following evidence.

- 99.9% of the people who committed crimes consumed bread prior to committing crimes.
- Crime rates are extremely low in areas where bread is not consumed.

Do the data presented by the scientist strongly support their theory? Yes ___  No ___

Are there other explanations for the data besides the scientist's theory? If so, describe.

________________________________________________________________________

What kind of additional information or evidence would support the scientist’s theory?

________________________________________________________________________
Teagle Foundation Grant

University Colorado

CAT

Colorado College

Assessment & Faculty Development
Target Groups

- Critical Thinking Classes
- Civic Engagement/Service Learning Classes
- Other Classes
Goals

- Exploring Effects of Different Classes
- Faculty Development
- Curriculum Strengthening
General Experimental Layout

• Three Factor Design
• Two Schools: CC and CU
• Two Testing Periods
• Three Class Types
Preliminary Findings

Mean Score Relative to Exam Time for Control Group

- **Question 7**
  - Exam Time: 0.00, 0.5, 1.0, 1.5, 2.0
  - Mean Score: 1.0, 0.5, 0.5, 0.5, 0.5

- **Question 8**
  - Exam Time: 0.00, 0.2, 0.4, 0.6, 0.8, 1.0
  - Mean Score: 0.8, 0.8, 0.8, 0.8, 0.8

- **Question 9**
  - Exam Time: 0.00, 0.5, 1.0, 1.5, 2.0
  - Mean Score: 1.0, 1.0, 1.0, 1.0, 1.0
Preliminary Findings

Mean Score Relative to Exam Time for Civic Engagement Group

Question 7

Question 8

Question 9
Preliminary Findings

U. of Colorado Exam Scores by Treatment and Exam Time

- Civic Engagement
- Critical Thinking
- Control

Legend:
- Beginning of Semester
- End of Semester
Using the CAT as a Diagnostic Tool
California Northstate Pharmacy

Skills Needed in Pharmacy

Student Performance on CAT

Implications for Training
Pharmacy Practice Responsibilities that Require Good Critical Thinking Skills

1. Differentiate the best treatment for the patient based on age, race, organ function, and concomitant conditions.

2. Define the desired therapeutic outcomes given the patient’s underlying disease state and prognosis.

3. Determine the patient’s clinical response to treatment and decide whether to maintain the same course of therapy or make appropriate adjustments.

4. Delineate the possible causes of a patient’s signs, symptoms, abnormal lab results, or failure to achieve expected treatment results.
Critical Thinking Skills Assessed by the CAT

- Provide alternative explanations for a pattern of evidence that has many possible causes.
- Identify additional information needed to evaluate a hypothesis/interpretation
- Provide relevant alternative interpretations of information
- Separate relevant from irrelevant information when searching for information to solve a problem.
- Identify suitable solutions for a real-world problem.
- Identify and explain the best solution for a real-world problem using relevant information.
Alternative Explanations (0-3pts)

- 0: 39.33%
- 1: 30.34%
- 2: 22.47%
- 3: 7.87%
Diagnosis

- 92.2% of our students have difficulty generating alternative explanations for a pattern of results that has many possible causes.
- 89.9% of our students have difficulty identifying suitable solutions for real-world problems using relevant information.
Treatment

- Design application exercises that challenge students to come up with alternative explanations for a patient’s clinical response to pharmacotherapy.
- Design application exercises that challenge students to come up with rational alternative treatment strategies.
A 52 y/o male patient with a seizure disorder has been placed on 300mg of Dilantin daily. Despite this usual daily dose, the patient continues to have 1-2 seizures every 3-4 days.

What are three possible explanations for the lack of anticonvulsant effectiveness in this patient’s Dilantin therapy?
Linda and Lance enter a tavern and are served identical vodka tonics. Lance gulped his drink down, walked out of the bar, and lived.

Linda nursed her drink and then died.

What was the cause of Linda’s death?
A 62 y/o African American woman with newly diagnosed hypertension is being managed on 25 mg of Hydrochlorothiazide (HCTZ) daily. The patient has a history of acute gouty arthritis. She read on WebMD that HCTZ can precipitate an acute attack of gout.

What alternative medication can be used to manage her hypertension?
CAT National Dissemination Project

www.CriticalThinkingTest.org

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.