Engaging Faculty in the Assessment and Improvement of Critical Thinking using the CAT Instrument

SACS/COC 2014 ANNUAL MEETING

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Importance of Critical Thinking

Information Overload
The Changing Nature of Education

Remembering Information

Finding Relevant Information

Understanding & Evaluating Information

Using Information Effectively
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
- Communication
- Creativity
- Evaluate One’s Own Understanding
- Life-Long Learning Skills
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

Collaborate With Other Institutions To Refine CAT 2004 - 2007

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

Expand National Dissemination & Support Assessment in NSF Projects 2010 - 2014
Over 200 Institutions Collaborating
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.
- Evaluate evidence and identify inappropriate conclusions.

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.

Creative Thinking
- Identify alternative interpretations for data or observations.
- Identify new information that might support or contradict a hypothesis.
- Explain how new information can change a problem.

Communication
- Communicate ideas effectively.
CAT Features

One hour exam
Mostly short answer essay
Faculty scored in workshops
Detailed scoring guide
Reliable
Valid
National Dissemination Model

2 - 3 Representatives

Institution
Faculty Scoring Session (8-14 Faculty)

CAT
Regional Training
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?

____________________________________________________________________________________
Assessment Uses of CAT

- Informal Learning Experiences
- Classroom Learning Experiences
- Program Outcomes
- College Outcomes
Closing the Loop in Assessment and Quality Improvement

Assess Student Performance

Increase Faculty Awareness of Student Weaknesses
(Faculty Participate in Test Scoring)

Improve Student Learning
(Faculty Implement Effective Practices)

Increase Faculty Awareness of Effective Practices

Increase Faculty Awareness of Effective Practices
Some Successful Projects

- Clemson University
- Duquesne University
- Purdue University
- Sam Houston State University

See Others @ CriticalThinkingTest.org
Sam Houston State University’s QEP to Improve Critical Thinking

Critical-thinking Assessment Test

Scientific reasoning
General Goals

- Improve critical thinking skills
- The importance of evidence and logic
- Engender scientific habits of mind
Why Did We Choose this QEP Topic?

Carnegie Institution Report

✓ > 93% of American adults are scientifically illiterate.
✓ > 78% of college graduates are scientifically illiterate.

A Twenty-Year Survey of Science Literacy Among College Undergraduates

By Chris Impey, Sonny Lanci, Jesse Aronowitz, Elizabeth Johnson, and Geert Boyer King

A person who teaches undergraduate science plays an important role in our society. If their teaching improves, they will be helping to prepare students for the fast-paced society that we live in today. The results from the twenty-year survey of science literacy among college undergraduates can help teach science. The survey was conducted in the fall of 1991 and again in the fall of 2011. The results show that there has been a significant increase in the number of students who are able to answer questions correctly. This is important because it means that students are better prepared for the challenges that they will face in the future.
Specific Course Goals

- Distinguish Science from Pseudoscience
- Scientific Content & Terminology from Several Disciplines
- Enhance Critical Thinking
- Science as a Way of Knowing
- Distinguish Science from Pseudoscience
Pedagogies:

Case Studies & Team-based Learning
Ex: “Tragic Choices: Autism, Measles, and the MMR Vaccine”
In addition to standard science topics, we use extraordinary claims to engage the students’ attention and increase motivation...
Students Work in Groups
Groups Share Ideas
Peer Evaluation
Why did we choose the CAT?

CAT specifically addresses scientific reasoning and it is not discipline-specific.

Students are given information in the form of scenarios and asked:

• To what degree does the evidence support the conclusion?
• Are there alternative interpretations/hypotheses? (MWH)
• How would you test the idea? What additional evidence would you need to evaluate the claim?
Rico wanted to find out if the majority of people in Texas do not support gun control laws. So, he surveyed 25 of his friends at the local shooting range. He found that 90% of them are strongly opposed to gun control laws. Rico concluded that “Texans strongly oppose gun control laws”. Which of the following is true?

a. Based on his survey results, Rico’s conclusion must be correct.
b. The sample size of Rico’s survey is appropriate.
c. The group Rico surveyed is appropriate for the purposes of determining how most Texans feel about gun control laws.
★ d. The survey Rico conducted is not adequate to support his conclusion.
e. A, B, and C are correct
Megan believes that eating corn silk from a corn plant (like that shown below) will improve the strength and luster of her hair because the corn silk looks like hair.

**What logical fallacy has Meagan committed?**

a. appeal to ignorance  
b. post hoc ergo propter hoc (false cause)  
c. faulty analogy  
★ d. argument from ignorance  
e. none of the above – her logic is correct
Assessing CT Gains

Pre-Test  Post-Test Design
Using CAT Instrument

Treatment vs. Control
Perspective

Gains in FoS Class $\Rightarrow$ Typical Gains Over 4 Years
Benefits of use of CAT to SHSU

Graders, from multiple disciplines, have incorporated CAT-like questions into their assignments

Grading sessions foster communication among faculty; Enjoy the sessions

Test reveals reading comprehension and writing deficiencies

**CAT results Validated the effectiveness of the course:**
- Led to presentations on campus focused on CT and alternative pedagogies, as well as 2 seminars
- Course now required of EC-6 Education majors at SHSU
Benefits beyond SHSU

- Info on CT has been presented at Correctional Management Institute of Texas seminars; Juvenile Justice and other law enforcement personnel; CT isn’t discipline specific

- Presentations to many universities and contacts with others

Validity of CAT made these things possible
Suggestions and Lessons Learned

Give background information in PPT presentation to graders about the test and the rationale for its use at your institution.
Suggestions and Lessons Learned

Keep sample size appropriate...

Limit number of graders to about 12

Repeat graders can become lax...

Try to select graders that are focused and ‘analytical’ – details matter
Assistance

CAT Center spot checks representative sample of the tests for accuracy

Can statistically correct results if the score on a question falls outside the range of acceptable variation

CAT Center VERY HELPFUL with any questions we’ve had
Thank You

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.