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

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Importance of Critical Thinking

Explosion of Information

Internet

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

Email
MySpace
Wikipedia
Facebook
Phone Apps
Augmented Reality
Books
Magazines
Blogs
Television
Radio
Journals
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 100 Institutions Collaborating
Designing the CAT Instrument

Faculty Driven:
High Face Validity
Involved in Scoring

Construct Validity:
Learning Sciences

Engaging for Students

Reliable & Consistent Scoring
Essay Responses
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.

**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.

**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
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Reliable
- Valid

Cost

$6 Test, $200 Year Participation Fee
National Dissemination Model

Institution
8 – 14 Faculty Involved in Scoring

CAT Regional Training

2 - 3 Representatives
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

Value Added Enter vs. Exit

Tracking Outcomes Over Time

College Outcomes

Norm Referenced
Closing the Loop in Assessment and Quality Improvement

Assess Student Performance

Improve Student Learning

Increase Faculty Awareness of Effective Practices

Increase Faculty Awareness of Student Weaknesses
(Faculty Participate in Test Scoring)
SUCCESSFUL PROJECTS
Some Examples of Projects that have Improved CAT Scores

Clemson University
NSF TUES (CCLI) Project #0837540. Development of an Inquiry-Based Cell Biology Laboratory with Emphasis on Scientific Communication Skills. PI: Dr. Lesly Temesvari (TEMESVY@clemson.edu) or Dr. Terri Bruce (terri@clemson.edu).

This project involved the development of a new cell biology laboratory course that emphasized critical thinking, effective writing and communication, and ethical reasoning. The new course used an inquiry-based pedagogic strategy allowing students to design and perform experiments in the context of mini research projects. Students also gained experience in communicating their findings through poster/oral presentations and through the writing of manuscripts in standard journal format. As a part of the scientific inquiry and communication processes, students also engaged in the discussion of the ethics of scientific communication.

Duquesne University
NSF TUES (CCLI) Project #717685. A Model for Incorporating Application-Based Service Learning in the Undergraduate Science Curriculum. Dr. Nancy Trun (PI) trun@duq.edu, Dr. Lisa Ludvico & Dr. Becky Morrow (Co-PIs).

Application Based Service Learning (ABSL) is a pedagogy that we are developing to address the need for novel approaches to Science, Technology, Engineering and Math (STEM) education at the undergraduate level. ABSL combines traditional service learning with novel undergraduate research
Texas A&M University

Evaluate Undergraduate Learning Outcomes

Critical Thinking

Evaluate, analyze, and integrate information from a variety of sources

Use appropriate strategies and tools to represent, analyze, and integrate information

Develop critical, reasoned positions
Why CAT at Texas A&M

Chosen by faculty because

- Scored by real people
- Our faculty score the tests
- Inter-rater reliability
- Department-level reporting
- Direct measure of student learning achievement

CAT Used 4 Years
Sampling Strategy

- 500
- Upper-level students in their major
- 3-year cycle
  - 10 colleges, 2 satellite locations
  - 4 colleges/locations per year
  - Entire University after 3 years
  - Currently in 2\textsuperscript{nd} year of cycle
Using CAT Local Coding

4 Digits
Example:

1101

Location (College Station)
College (Agriculture)
Department (Wildlife)
Course Embedded

• Administered in the fall
• Participating colleges’ faculty contacted by college assessment liaisons
• Faculty asked to give up a class session
• Proctored by Office of Institutional Assessment staff
• Incentive to faculty = Department-level report (to be used in program assessment)
Institutional Review Board

• Faculty cannot be involved in recruiting students
• Faculty cannot be present during test
• Can give extra credit/participation grade
• Students sign consent form
• Initial next to name on class roster (roster sent to instructor)
Faculty Scoring

- One 8-hour scoring day (each year)
- 30 volunteers
- University-wide representation

Feed them, pay them, and they will come!
Utilization of Results

• General Education Assessment
  – SACSCOC 3.5.1
  – Texas Higher Education Coordinating Board (THECB) report – State mandated core objectives
  – Presidents’ Alliance for Excellence in Student Learning and Accountability

• Program Assessment
  – SACSCOC 3.3.1.1
  – For programs with critical thinking outcomes
  – Curricular Improvement
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.
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”
We use *extraordinary claims* to engage the students’ attention and increase motivation…
Students Work in Groups

Groups Share Ideas

Peer Review
Assessing CT Gains

Pre-Test  Post-Test Design
Using CAT Instrument

Treatment vs. Control
CAT Score

Fall '10 Intro Biol Control
Fall '09 FoS Treatment
Spr '10 FoS Treatment
Fall '10 FoS Treatment
Spr '11 FoS Treatment

Post Test
Pre Test

P < .001
ns

Fall '10
Fall '09
Spr '10
Fall '10
Spr '11
Intro Biol
FoS Treatment
FoS Treatment
FoS Treatment
FoS Treatment
FoS Treatment
Perspective

Gains in FoS Class => Typical Gains Over 4 Years
Thank You

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.