Assessing Critical Thinking Using the CAT Instrument

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Importance of Critical Thinking

National polls indicate over 90% of the faculty in this country think critical thinking is the most important part of undergraduate education.

Derek Bok, 2005
President Emeritus of Harvard University
Information and the Internet

75% of College Students use the Internet as Primary Method of Searching for Information

31% of Population Use the Internet as Primary Source of Healthcare Information

Factual Error Found On Internet

LONGMONT, CO—The Information Age was dealt a stunning blow Monday, when a factual error was discovered on the Internet. The error was found on Ted’s Ultimate Brady Bunch.com, a Brady Bunch fan site that incorrectly listed the show’s debut year as 1968, not 1959.

Caryn Wisniewski, a Pueblo, CO, legal secretary and diehard Brady Bunch fan, came across the mistake while searching for information about the show’s first-season cast.

“When I first saw 1969 on the web page, I thought, ‘Wow, apparently, all those Brady Bunch books I’ve read listing 1969 as the show’s first year were wrong,’” Wisniewski told reporters at a press conference. “But even though I obviously trusted the Internet, I was still kind of puzzled. So I checked other Brady Bunch fan sites, and all of them said 1959. After a while, it slowly began to sink in that the World Wide Web might be tainted with unreliable information.”

Following up on her suspicion, Wisniewski phoned her public library, the

ABC television network, and the office of Brady Bunch producer Sherwood Schwartz—all of whom confirmed that “Ted’s Ultimate Brady Bunch Site” was in error.

Attempts to contact the webmaster of see INTERNET page 7
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 Ideas and Plans
  - Communication
- Evaluate One’s Own Understanding
  - Creativity
Bloom’s Taxonomy

Evaluation
Synthesis
Analysis
Application
Comprehension

Critical Thinking

Information (rote retention)
Agreement on what is **not** Critical Thinking

<table>
<thead>
<tr>
<th>*NSSE Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2a) Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form.</td>
</tr>
</tbody>
</table>

*National Survey of Student Engagement, Indiana University*
NSSE: Coursework emphasizes: Memorizing facts, ideas, or methods from your courses and readings

Student Responses Nationally

- Very little: 0%
- Some: 5%
- Quite a bit: 10% - 15%
- Very much: 20% - 25%
- Very much: 30% - 35%
- Very much: 40%
Why Assess Critical Thinking?

- Need to Measure Success for Accountability
- Assessment Drives Improvement Efforts
History of CAT Development

Evaluate Tests

Begin Test Development

Collaborate

Other Institutions

National Dissemination

NSF
Developing the CAT Instrument

- Faculty & Students
- Learning Sciences Experts
- External Evaluators
- Statistical Findings
Institutions Participating in Test Development

Howard University
Madisonville Community College
The University of Colorado
The University of Hawaii
The University of Southern Maine
The University of Texas
The University of Washington

Over 40 Institutions Now Collaborating
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.
Faculty Evaluations of Question Validity
## CAT Statistics

### General Measures of Academic Performance

<table>
<thead>
<tr>
<th></th>
<th>ACT</th>
<th>SAT</th>
<th>Academic Profile</th>
<th>Grade Point Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT</td>
<td>0.560*</td>
<td>0.528*</td>
<td>0.562*</td>
<td>0.295*</td>
</tr>
</tbody>
</table>

* correlations significant, $p < .01$

### Other Measures of Critical Thinking

<table>
<thead>
<tr>
<th></th>
<th>CCTST (California Critical Thinking Skills Tests)</th>
<th>CAAP Critical Thinking Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT</td>
<td>0.645*</td>
<td>0.691*</td>
</tr>
</tbody>
</table>

* correlations significant, $p < .01$
CAT Results with 2005 NSSE
(National Survey of Student Engagement)
Multiple R = .490
(explains 24% of variability in CAT)

<table>
<thead>
<tr>
<th>NSSE Question</th>
<th>Beta Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2a) Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form. <em>(negative relationship)</em></td>
<td>-.341 **</td>
</tr>
<tr>
<td>(3b) Number of books read on your own (not assigned) for personal enjoyment or academic enrichment.</td>
<td>.277 **</td>
</tr>
<tr>
<td>(11e) Thinking critically and analytically &amp; (11m) Solving complex real-world problems</td>
<td>.244 **</td>
</tr>
<tr>
<td>(7h) Culminating Senior Experience (thesis, capstone course, project, comprehensive exam, etc.)</td>
<td>.231 *</td>
</tr>
</tbody>
</table>

* Significant at .01 level
** Significant at .001 level
## CAT vs. CCTST with NSSE

<table>
<thead>
<tr>
<th>NSSE Question</th>
<th>CAT Coefficient</th>
<th>CCTST Coefficient</th>
</tr>
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<tbody>
<tr>
<td>(2a) Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form. <em>(negative relationship)</em></td>
<td>-.341 *</td>
<td>-.212 *</td>
</tr>
<tr>
<td>(3b) Number of books read on your own (not assigned) for personal enjoyment or academic enrichment.</td>
<td>.277 *</td>
<td>-.124</td>
</tr>
<tr>
<td>(11e) Thinking critically and analytically &amp; (11m) Solving complex real-world problems</td>
<td>.244 *</td>
<td>.144</td>
</tr>
<tr>
<td>(7h) Culminating Senior Experience (thesis, capstone course, project, comprehensive exam, etc.)</td>
<td>.231 *</td>
<td>.025</td>
</tr>
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</table>

* Significant at .01 level
CAT features

- One hour exam
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Reliable (0.82 - 0.85)
- Valid
Student Comments

• I thought the test wasn’t too difficult, but it was challenging. You have to look at things deeply to truly understand.

• I thought the assessment was interesting and made me use real life scenarios and data to decide my results.

• I thought the test was thought provoking, but not too difficult.

• It was an easy test that tests the mind. I enjoyed the stories and the questions on the test. I think I did very well on the test.
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?

________________________________________________________________________
Ensuring Reliability of Scoring

- Detailed Scoring Guide
- Integrated Training/Scoring
- Multiple Scorers Each Question
- Train-the-Trainer Workshops
- Scoring Calibration

CAT
Various CT Assessments

- CAT
  Portfolios & Other Tests
  (CLA, CCTST, CAAP CT module)

- IDEA Teaching Evaluations
  NSSE/CSSE & other surveys

- Alumni & Employer surveys

- Student Performance
- Student Perceptions
- Alumni/Employer Perceptions
Assessment Uses of CAT

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

- Assess Student Performance
- Improve Student Learning
- Increase Faculty Awareness of Student Weaknesses (Faculty Participate in Test Scoring)
- Increase Faculty Awareness of Effective Practices
Professional Development: Faculty Involvement in CAT Scoring

- Identify Student Weaknesses
- Recognize Faculty Strengths & Weaknesses

Developing a Teaching Community

Using Effective Practices
Design a task that resembles what we want students to do.

- Must Engage Students In Active Learning
- Learning Activity = Real-World Goal
- Create Numerous Opportunities to Practice In Diverse Contexts
- Use as Primary Course Assessment
Evaluate Faculty Interest
CAT Checklist
Upcoming Workshops

April 8 - 9 Boulder, CO
CAT National Dissemination Project

www.tntech.edu/CAT
or
www.CriticalThinkingTest.org

Center for Assessment and Improvement of Learning