Engaging Faculty in Assessing and Improving Students’ Critical Thinking

Barry Stein, Professor, Co-Director
Tennessee Tech University

Ada Haynes, Professor, Co-Director

Gregory Light, Director
Northwestern University

Denise Drane, Associate Director
Northwestern University

Meg Skinner, ECTL Director
University of Wyoming

Erika Prager, Assessment Specialist
University of Wyoming

ISSOTL Panel, 2013

Partial support for this work was provided by the National Science Foundation’s TUES Program under grants 1022789 and 942404.

© 2013
Importance of Critical Thinking

Explosion of Information

Internet

E=MC^2
Email
MySpace
Wikipedia
Facebook
Phone Apps
Augmented Reality
Magazines
Blogs
Television
Radio
Journals
Books

Phone Apps
Augmented Reality
The Changing Nature of Education

- Remembering Information
- Understanding & Evaluating Information
- Finding Relevant Information
- Using Information Effectively
Disconnect Between What is Considered Important and What We Assess

Critical Thinking

Factual Knowledge
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
  - Communication
    - Creativity
Why Assess Critical Thinking?

Need to Measure Success for Accountability

Assessment Drives Improvement Efforts

How We Assess - Determines What Students Learn
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.
Designing the CAT Instrument

Faculty Driven: High Face Validity Involved in Scoring

Construct Validity: Learning Sciences

Engaging for Students

Reliable & Consistent Scoring Essay Responses
CAT Features

- One hour exam
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Sensitive to course effects
- Reliable
- Valid
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?

________________________________________________________________________
National Dissemination Model

Institution
8 – 14 Faculty Involved in Scoring

CAT Regional Training

2 - 3 Representatives
Over 180 Institutions Collaborating
Closing the Loop in Assessment and Quality Improvement

Ability to Transfer CT Skills Beyond Discipline

Assess Student Performance

Improve Student Learning

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

Increase Faculty Awareness of Effective Practices

and How to Design Better Discipline Specific Assessments
How the CAT is Used

- Program Evaluation
- Evaluate Courses and Informal Learning

Faculty Development
Professional Development: Faculty Involvement in CAT Scoring

Develop a Teaching Community

- Identify Student Weaknesses
- Recognize Faculty Strengths & Weaknesses

Use Effective Practices

Use Appropriate Assessments
Using the CAT as a Model for Developing Better Discipline Specific Assessments

Provide alternative interpretations and identify additional information or evidence needed to evaluate those interpretations.

Patterns of Data  Historical Events  Literature
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.
Using the CAT for Professional Development at

Meg Skinner, Director of Ellbogen Center for Teaching and Learning

&

Erika Prager, University Assessment Specialist
Engaging Faculty in Assessment

- Teaching and Learning Symposia
- Group grants

- Assessment Forum
- Individual grants

- Assessment
- Individual grants
Engaging Faculty in Assessment

- Annual assessment reports: Crossed out
- One-off projects: Crossed out
- Discussions of what matters: Checkmark
- Faculty Learning Community/Assessment Academy: Checkmark

Successful, but still somewhat fractured around campus
History of CAT

- School of Pharmacy discovered CAT in 2010
  - Assessment Academy
  - Accreditation need
- Train-the-trainer workshop
  - Utility and usefulness for other programs
- Pharmacy, Social Work, Veterinary Sciences began using in 2011
- Spring Colloquium on Critical Thinking – Spring 2012
- Expanded further in 2012 and 2013
  - College of Business, Geology/SMTC, and Zoology/Physiology
  - Kinesiology/Health and Nursing
How CAT Project is Organized

• Every project has unique administration
  • Longitudinal vs. cross-sectional studies
  • Different research questions

• Centrally coordinated through Academic Affairs and ECTL

• Cross-program discussions and projects through scoring, Assessment Academies, and new Faculty Learning Community

• Principal goal is faculty development
Plans for 2013-14

• **Analyze/discuss results and scoring**
  - Compare/contrast results by program and for UW overall
  - Examine accuracy of faculty scoring

• **Develop analog questions**
  - Create year-long faculty learning community
  - Finish developing first two UW specific example questions (Social Work and Pharmacy)
  - Work with Tennessee Tech as part of “test group” for creation of national database for analog questions

• **Resolve administration issues**
  - Overlap in administrations between programs
Faculty Reactions From Scoring the CAT

- Validates some suspicions regarding specific skills
- Challenges the way some faculty currently structure test questions (e.g. recall vs. critical thinking)
- Provides insight on how to deal with ambiguous student responses in class
- Rethinking their own grading rubrics
Faculty Reactions From Scoring the CAT

- Increases validity of open book tests
- Willingness to develop analog questions
- Brings faculty together to discuss curriculum

Assessment can actually be fun!
From Scoring Tests to Faculty Development

- Invite them to share results at faculty development
- Faculty are credible to other faculty
- Sign up sheets – target interest immediately

Overall suggestion - Start small and try it
Questions?

Meg Skinner
mjf@uwyo.edu

Or

Erika Prager
ekprager@uwyo.edu
Overview

1. Goals & Hypotheses of study
2. Theoretical Rationale
3. Study Design
   • Participants
   • Design
   • Measures
4. Some very early findings
Goals

1. To use critical thinking as a higher-order learning skill to promote change in faculty conceptions of teaching and learning.

2. To motivate faculty to make changes to their teaching of critical thinking by providing them with data about their students’ critical thinking.

3. To see if the changes that faculty make in their teaching lead to changes in how students perform on critical thinking tests.
Study Participants

Faculty
11 City Colleges of Chicago
&
9 Northwestern University

Anatomy
Astronomy
Biology
Calculus
Chemistry
Chemical Engineering
Electrical Engineering
Linguistics
Physics
Quantum Mechanics
Study Design

Year 1: Preparation
- 10 CCC & 9 NU faculty recruited
- Faculty learn about the CAT test
- Faculty develop course specific assessments of critical thinking (analogues) modeled on the CAT test

Year 1: Baseline
- Data collected on faculty approaches to teaching and conceptions of critical thinking and assessment
- CAT test & course specific assessments administered pre & post course
- Faculty teach as usual

Year 1: Intervention
- Faculty review CAT & course specific assessment data
- Faculty participate in interactive workshops on critical thinking pedagogy
- Faculty develop plans to enhance students’ critical thinking

Year 1: Post
- Faculty make changes to their teaching
- CAT test & course specific assessments administered pre & post course

Year 2: Compare:
- Student learning gains; faculty teaching practices; faculty approaches to teaching; faculty conceptions of critical thinking & assessment
Faculty Commitment

**Faculty Participation:**
- One Northwestern faculty left program due to time commitments; and two City Colleges faculty left program in 2nd year: one became chair; one left the college.

**Faculty Engagement with Program:**
- All faculty were highly engaged in the process: all engaged the CAT data; attended the workshops; constructed analogues.
- All faculty developed and implemented activities to enhance critical thinking in their courses.
Activities that Faculty Developed to Promote Critical Thinking

CAT skills focus of activities

• generating alternative explanations
• identifying additional information required to evaluate a hypothesis
• solving real world problems

Variation in Activities

Intensity
• single activity vs. series of linked activities

Nature
• in class vs. homework assignment
• hands on inquiry-based activities vs. worksheet data
• group activity/discussion vs. individual work
Case Study: Critical Thinking Quiz

Northwestern Engineering Course

- Students: 15 Juniors, seniors, grad students
- Time: twice a week – Tue. & Thur. - for 1.5 hours
- Format: Presentation/discussion

CTQ Learning Outcomes

1. Develop dynamic group thinking skills.
2. Develop awareness of multiple perspectives to each problem.
3. Learn to present, defend, evaluate critical responses.
4. Develop critical skills with different team partners.
Case Study (cont.)

**Description of Activity**

- 20 minutes once a week (sometimes bi-weekly)
- Students break into 4-5 Quiz-Teams – of 3 students
- Each group discusses 3 problems for 5-7 min.
- Students use hole-punch to commit to multiple choice answers
- Each Quiz-Team shares their answers and reasoning for 3 minutes with the class
- Quiz-Team partners change every two quizzes
The students were engaged by the activity and were clearly invested in discussions. Spirited discussions would persist for several of the groups. Group dynamics clearly affected the collective decision -- sometimes the loudest voices in a group would talk more timid ones away from the correct answer.

Even when students all got a problem wrong, they seemed quite satisfied to have had the chance to talk through their best answer with their group, and they all seemed to recognize the missing piece which kept them from getting the correct answer when it was shown to them.
Learning Outcomes & CAT Question
(as Identified by Faculty)

Discussing problems with peers
#2 Evaluate how strongly correlation type data support a hypothesis.
#4: Identify additional (or more precisely what information is needed) information needed to evaluate a hypothesis/interpretation.
#5 Evaluate whether spurious relationships strongly support a claim.
#7: Identify additional information needed to evaluate a hypothesis/interpretation.

Develop critical skills with different team partners
#3: Provide alternative explanations for a pattern of results that has many possible causes.
#6: Provide alternative explanations for spurious relationships.

Learn to present, defend, and evaluate critical responses
#9 Provide relevant alternative interpretations of information.
## Case Study: Learning Outcomes in terms of CAT Skill Areas and CAT Question

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>CAT Skill Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluate/interpret info</td>
</tr>
<tr>
<td>Dynamic group thinking skills</td>
<td>2, 5</td>
</tr>
<tr>
<td>Develop awareness of multiple perspectives</td>
<td></td>
</tr>
<tr>
<td>Present, defend, evaluate critical responses</td>
<td>9</td>
</tr>
<tr>
<td>Critical skills with different team partners</td>
<td>3,6</td>
</tr>
</tbody>
</table>
Results: Student Gains in Critical Thinking
Results: Student Gains in Critical Thinking
Thank You


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.