Case Studies of Engaging Faculty in Assessing Critical Thinking Skills

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- The Development of the CAT Instrument and the National Dissemination of the CAT Instrument is supported by the National Science Foundation.
- 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.
History of CAT Development

Preliminary Work
At TTU  2000 - 2004

Refine Test with National Input
Expand National Dissemination
& Support Assessment in NSF Projects
Over 200 Institutions Collaborating

Guam

Hawaii
CAT features

- One hour exam
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Sensitive to course effects
- Reliable
- Valid
A government scientist believes that an ingredient commonly used in bread causes criminal behavior. To support the hypothesis the scientist notes the following evidence.

- 99.9 percent 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 described above strongly support the scientist’s hypothesis? Yes ___ No ___

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

_____________________________________________________________________________________

What kind of additional information or evidence would help evaluate the scientist’s hypothesis?

_____________________________________________________________________________________

Faculty Are Using the CAT To

- Identify Student Weaknesses
- Improve Course Assessments
- Identify Strategies for Improving Critical Thinking
| Q1: Summarize a pattern of information without making inappropriate inferences. |
| Q2: Evaluate how strongly correlational-type data supports a hypothesis. |
| Q3: Provide alternative explanations for observations. |
| Q4: Identify additional information needed to evaluate a hypothesis or particular explanation of an observation. |
| Q5: Evaluate whether spurious relationships strongly support a claim. |
| Q6: Provide alternative explanations for spurious relationships. |
| Q7: Identify additional information needed to evaluate a hypothesis/interpretation. |
| Q8: Determine whether an invited inference in an advertisement is supported by information. |
| Q9: Provide relevant alternative interpretations of information. |
| Q10: Separate relevant from irrelevant information when solving a real-world problem. |
| Q11: Analyze and integrate information from separate sources to solve a real-world problem. |
| Q12: Use basic mathematical skills to help solve a real-world problem. |
| Q13: Identify suitable solutions for a real-world problem using relevant information. |
| Q14: Identify and explain the best solution for a real-world problem using relevant information. |
| Q15: Explain how changes in a real-world problem situation might affect the solution. |
Using the CAT as a Model for Developing Better Discipline Specific Assessments

- Provide alternative interpretations for information or observations that have several possible interpretations.
- Identify additional information or evidence needed to evaluate the alternative interpretations.

Patterns of Data  Historical Events  Literature
Discipline Specific Analog

Read the following thesis from a student's analysis of Claude McKay's poem "If We Must Die":

"If We Must Die" is a poem about having valor on the battlefield. The speaker is a military commander rallying his troops before a big battle. This is evident by looking at the war-like language McKay uses throughout the poem, such as "let us nobly die," "we must meet the common foe," "our precious blood," and "dying, but fighting back."

1. To what extent do the quotations provided support the student's interpretation of the poem?
2. Provide an alternative interpretation of McKay's use of war-like language.
3. Identify 3 types of additional information that would help you investigate McKay's intent in writing the poem and explain why each source would be helpful.

J. Todd, Xavier University
Using Headlines to Develop Discipline

Analogs

Girls Who Play Soccer Have More Success in STEM Fields

Consuming High Fat Dairy Products Leads to Lower Obesity than Consuming Low Fat Dairy Products

Frequent Reliance on Social Services Yields Shorter Life Span

Eating Fast Food Leads to Depression
## Skill Set 2: Encouraging Effective Course Assessments

<table>
<thead>
<tr>
<th>Separate relevant from irrelevant information when searching for information to solve a real-world problem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify and explain the best solution for a real-world problem using relevant information.</td>
</tr>
<tr>
<td>Explain how changes to a real-world problem situation might alter the recommended solution.</td>
</tr>
</tbody>
</table>

- Selecting New Lab Equipment
- Solving a Community Problem – Feral Cats
- Designing a Set For a Play
Engaging Faculty in the Assessment and Improvement of Students’ Critical Thinking Using the CAT

New Challenges, New Strategies
Building Excellence in Undergraduate STEM Education

www.CriticalThinkingTest.org

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Using the CAT to Assess LMU’s Creative & Critical Thinking Undergraduate Learning Outcome

McKenzie Sweeney
Research Associate
Office of Assessment
• Why the CAT?

• Assessment Process at LMU
  – Faculty-driven

• Impact & Insights
2010

- LMU adopted Undergraduate Learning Outcomes
  - **Creative and Critical Thinking**:
    - Students will be able to ask questions, solve problems and produce works through the innovation of ideas and concepts and by developing and justifying solutions through critical evaluation and analysis.
2012

• Began to focus on Creative & Critical Thinking ULO

• Selected the CAT
  – Short essay format
  – Faculty developed & scored
Faculty-driven Process:

• Assessment Advisory Committee recommended Faculty Leaders

• Faculty Leaders partnered with the Office of Assessment to lead CAT
Assessment Process

Summer 2012:
• CAT Training

Fall 2012:
• Freshman took CAT

Spring 2013:
• Seniors took CAT
Be a Lion

Take the CAT

The CAT (Critical thinking Assessment Test) is a test of your ability to evaluate information & creatively solve problems.

*Only 100 seniors will be invited to participate
*Current & future students will benefit from what is learned

$20 cash for one hour of your time
Thought-provoking questions

Watch for an exclusive invitation in your Lionmail

If you are one of the chosen few, take some time to give back to LMU

LMU|LA Loyola Marymount University
Assessment Process

Summer 2013:

• Faculty Leaders recruited 10 colleagues to score over 2 days

Fall 2013:

• Internal report generated
  – NSSE data
  – Alumni survey data
Assessment Process

Spring 2013:

• Presenting results to entire campus community

Spring 2015:

• Survey academic programs to learn about changes made
Impact & Insights

• Results will be interpreted and acted upon by faculty
  – Pedagogy
  – Courses
  – Resource allocation
  – Assessment methods

• Faculty spent time on the scoring days discussing:
  – Students’ weakest and strongest responses
  – Modifications to courses/assignments
  – Discipline-specific analogs

• Modeling rubric scoring this year on CAT scoring process
Questions?

For more on the use of the CAT at LMU:
Email: mckenzie.sweeney@lmu.edu

For more on assessment at LMU:
Website: www.lmu.edu/assessment

LMU|LA
Using the CAT to Assess Critical Thinking Skills in Pharmacy Students

David Hawkins, PharmD
Vice President for Academic Affairs
and Dean of Pharmacy
California Health Sciences University
Pharmacy Practice Skills that Require Good Critical Thinking Skills

1. Provide the best treatment for a given patient
2. Interpret relevant data to assess the patient’s clinical condition
3. Provide alternative explanations for a patient’s presenting problem
4. Decide when alternative treatments should be used to effectively manage a patient
5. Identify what information is needed to evaluate a patient’s clinical response to treatment
Critical Thinking Skills Assessed by the CAT that Are Important to the Practice of Pharmacy

1. Provide alternative explanations for a pattern of evidence that has many possible causes.
2. Identify additional information needed to evaluate a hypothesis/interpretation
3. Provide relevant alternative interpretations of information
4. Identify alternative solutions for a real-world problem.
5. Identify and explain the best solution for a real-world problem using relevant information.
Using the CAT to Assess and Sharpen Critical Thinking Skills

- Identify critical thinking skills in which students are most deficient at baseline
- Intentionally incorporate learning exercises throughout the curriculum that force students to further develop those skills
- Reassess critical thinking skills toward the end of the academic program
CAT Results Showing Critical Thinking Skills that Pharmacy Students Need to Sharpen

<table>
<thead>
<tr>
<th>Critical Thinking Skill</th>
<th>2008 Class Score</th>
<th>2009 Class Score</th>
<th>2010 Class Score</th>
<th>2011 Class Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing alternative explanations</td>
<td>1.0</td>
<td>0.89</td>
<td>1.29</td>
<td>1.09</td>
</tr>
<tr>
<td>Score Range: 0-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional information needed to evaluate a hypothesis</td>
<td>1.92</td>
<td>1.51</td>
<td>1.78</td>
<td>1.50</td>
</tr>
<tr>
<td>Score Range: 0-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify alternative solutions</td>
<td>1.08</td>
<td>0.92</td>
<td>1.45</td>
<td>1.16</td>
</tr>
<tr>
<td>Score Range: 0-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify best solution</td>
<td>2.16</td>
<td>2.17</td>
<td>2.69</td>
<td>2.74</td>
</tr>
<tr>
<td>Score Range: 0-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Teaching for Critical Thinking

- The lecture transmits information, not knowledge
- Knowledge must be constructed in the minds of students
- Knowledge construction requires critical thinking
- Active learning strategies promote critical thinking
- TBL is an efficient pedagogical frame for engaging students in critical thinking and active learning
Documented Benefits of TBL

- Enhancing clinical problem solving (Bick et al; Beatty et al)
- Having a positive impact on student engagement and learning satisfaction (Chung et al; Clark et al)
- Improving student performance (Zgheib et al; Vasan et al; Thomas et al; Tan N, et al)
- Sharpening critical thinking skills and long-term retention (McInerney and Fink).
Team-Based Learning

Preparation

Individual Study
Guided Learning

Evaluation

Individual Test
Team Test
Discussion

Application

Individual Application
Team Application
Wrap-up

Modified from: Michaelsen LK et al. Team-Based Learning for Health Professions Education
Backward Course Design

1. What do you want your students to be able to do when they finish this topic or course?

2. What will your students need to know in order to do those things?

3. How do you facilitate that learning?

4. How do you assess that learning?
We need to realize that we can improve student learning only by improving student thinking. We can improve student thinking only by creating opportunities and incentives for them to think.
A 62 y/o African American woman with newly diagnosed hypertension is being managed on diuretic therapy. The patient has a history of acute gouty arthritis. She read on WebMD that diuretics can precipitate an acute attack of gout.
Which blood pressure medication should replace the diuretic?

A. Tenormin (Atenolol)
B. Cozaar (Losartan)
C. Zestril (Lisinopril)
Provide alternative explanations for a pattern of results that has many possible causes.

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 seizure control in this patient?
A patient was admitted to a hospital for a heart infection. All admitting labs were normal. The patient was taking gentamicin 40 mg twice daily for his heart infection. Two days after being admitted the patient’s kidney function tests were found to be remarkably elevated. Since gentamicin may cause kidney dysfunction in some patients it was discontinued.

What additional information is needed to support the hypothesis that gentamicin may have caused acute kidney failure in this patient?
### Baseline – Post Test Scores

<table>
<thead>
<tr>
<th>Skill Assessed</th>
<th>Baseline Mean</th>
<th>Post Test Mean</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpreting Graphs</td>
<td>0.62</td>
<td>0.78</td>
<td>+0.34*</td>
</tr>
<tr>
<td>Provide Alternative Explanations</td>
<td>1.03</td>
<td>1.56</td>
<td>+0.54***</td>
</tr>
<tr>
<td>Spurious Information supports Hypothesis</td>
<td>0.82</td>
<td>0.92</td>
<td>+0.31*</td>
</tr>
<tr>
<td>Separate Relevant vs Irrelevant</td>
<td>2.92</td>
<td>3.23</td>
<td>+0.36*</td>
</tr>
<tr>
<td>Apply relevant information to evaluate problem</td>
<td>1.30</td>
<td>1.05</td>
<td>-0.40**</td>
</tr>
</tbody>
</table>

*p<.05, **p<.01, ***p<.001


McInerney MJ, Fink D. Team-based learning enhances long-term retention and critical thinking in an undergraduate microbial physiology course. Microbiology Educ 2003; 4:3-12.