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

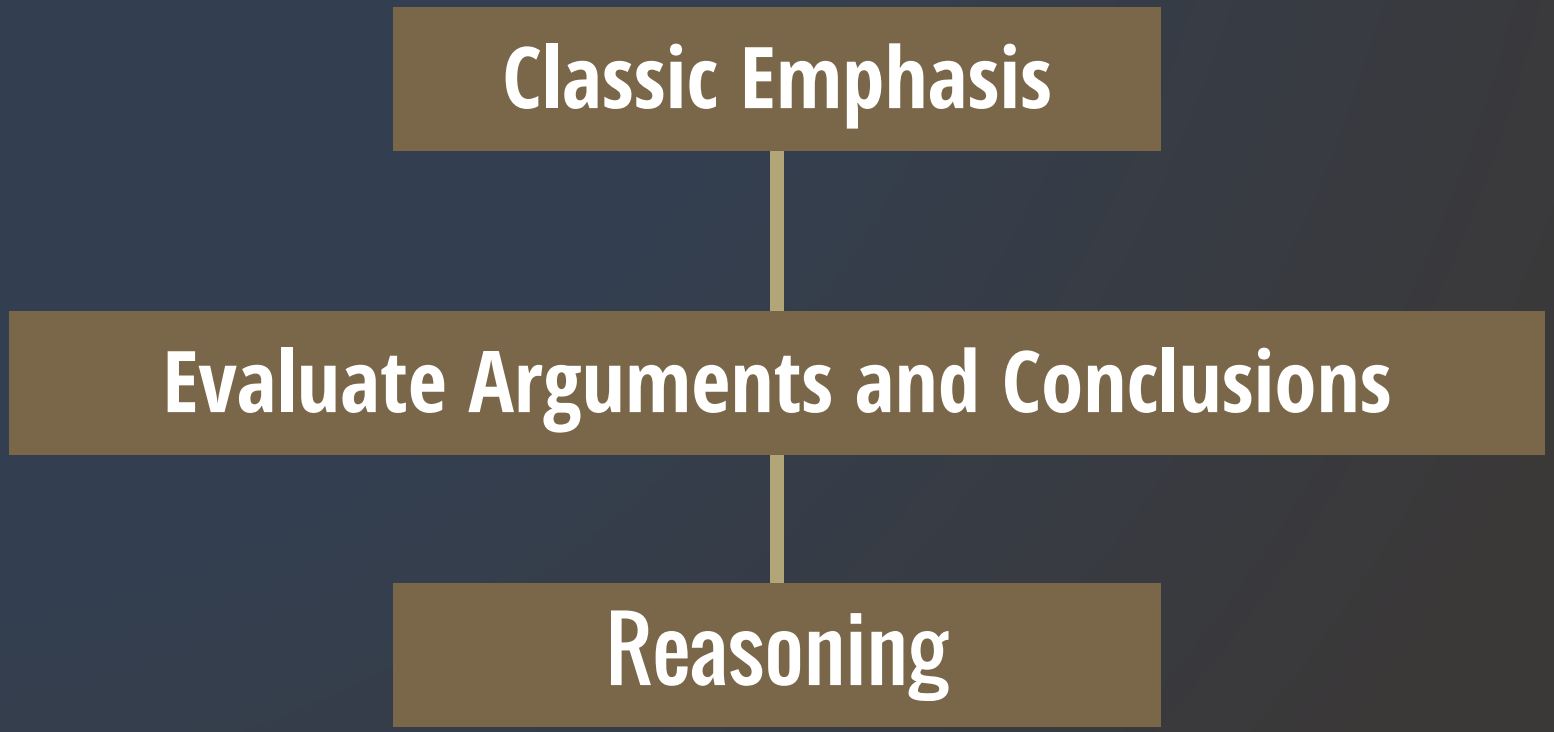
Remembering Information

Finding Relevant Information

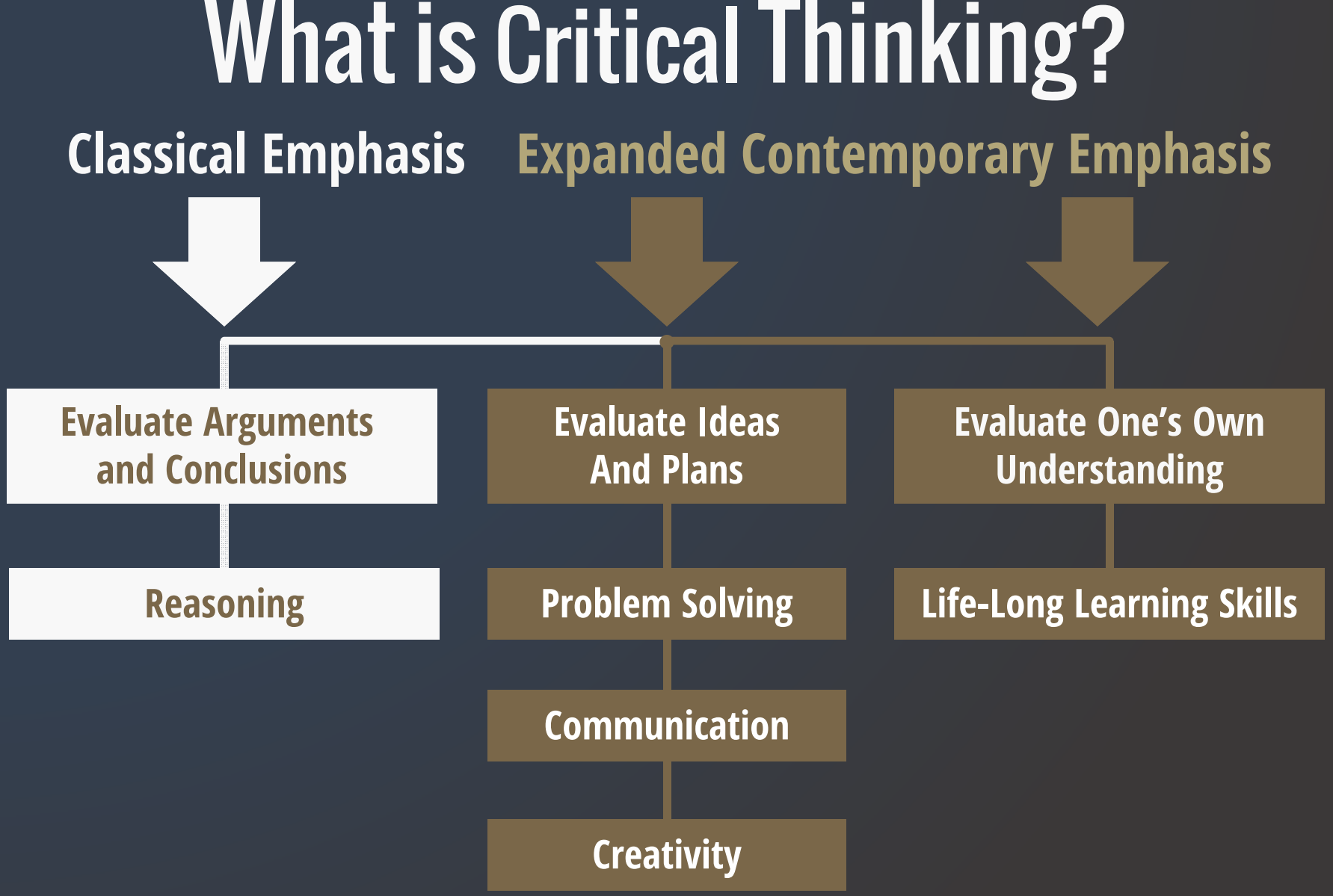
Understanding & Evaluating Information

Using Information Effectively

What is Critical Thinking?



What is Critical Thinking?



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

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

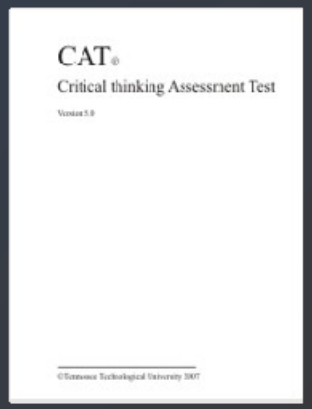
- Identify alternative interpretations for data or observations.
- Identify new information that might support or contradict a hypothesis.
- Explain how new information can change a problem.

Communication

- Communicate ideas effectively.

CAT Features

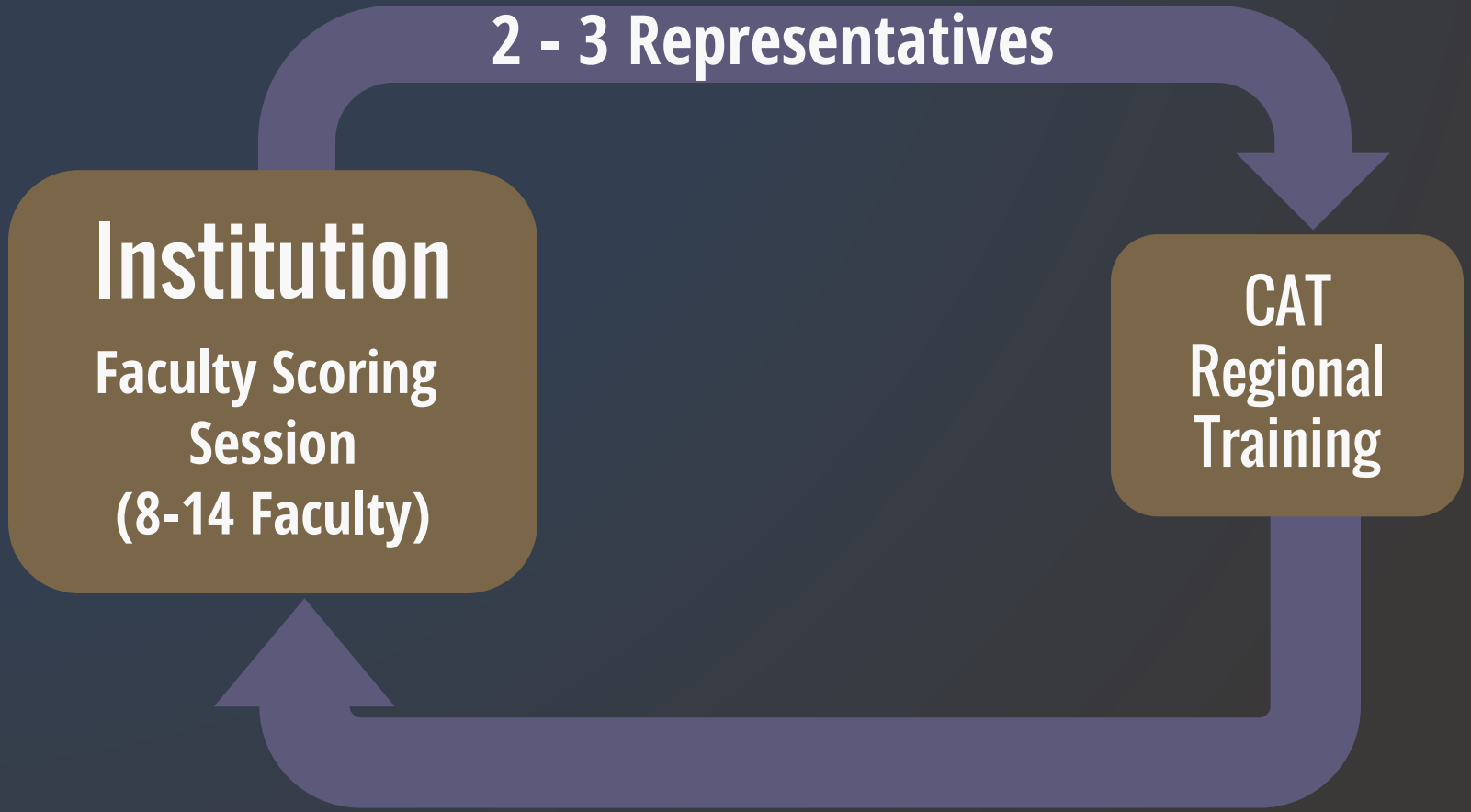
One hour exam
Mostly short answer essay
Faculty scored in workshops
Detailed scoring guide
Reliable
Valid



Test Booklet

Additional Information Packets

National Dissemination Model



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____

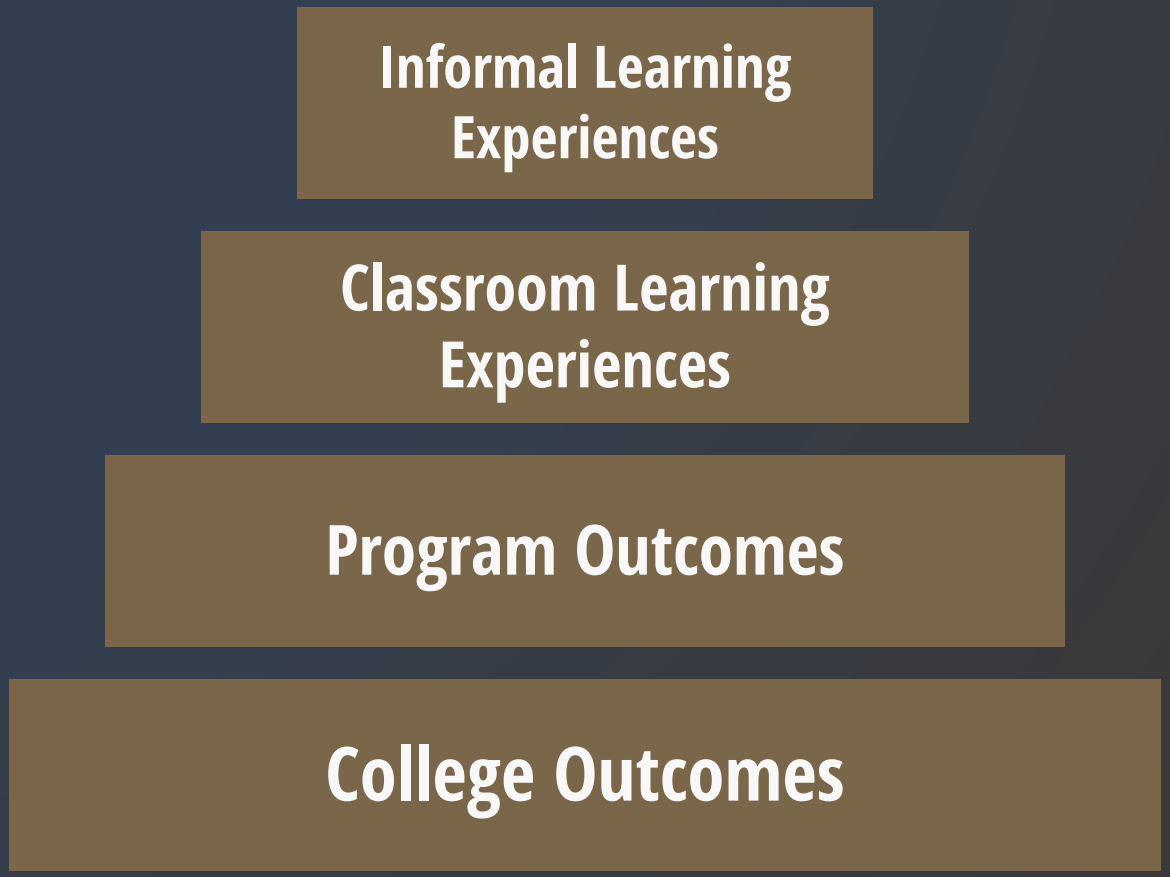
Are there other explanations for the data besides the scientist's theory? If so, describe.

_____

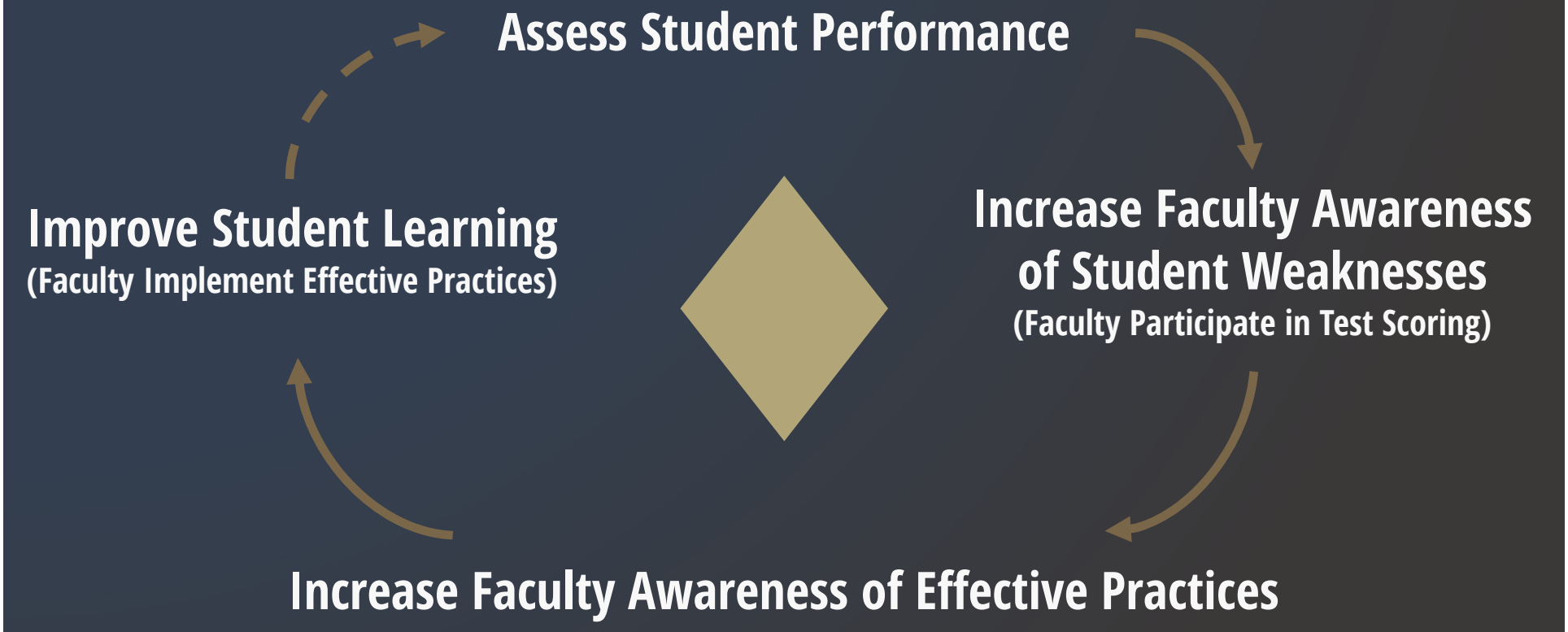
What kind of additional information or evidence would support the scientist's theory?

_____

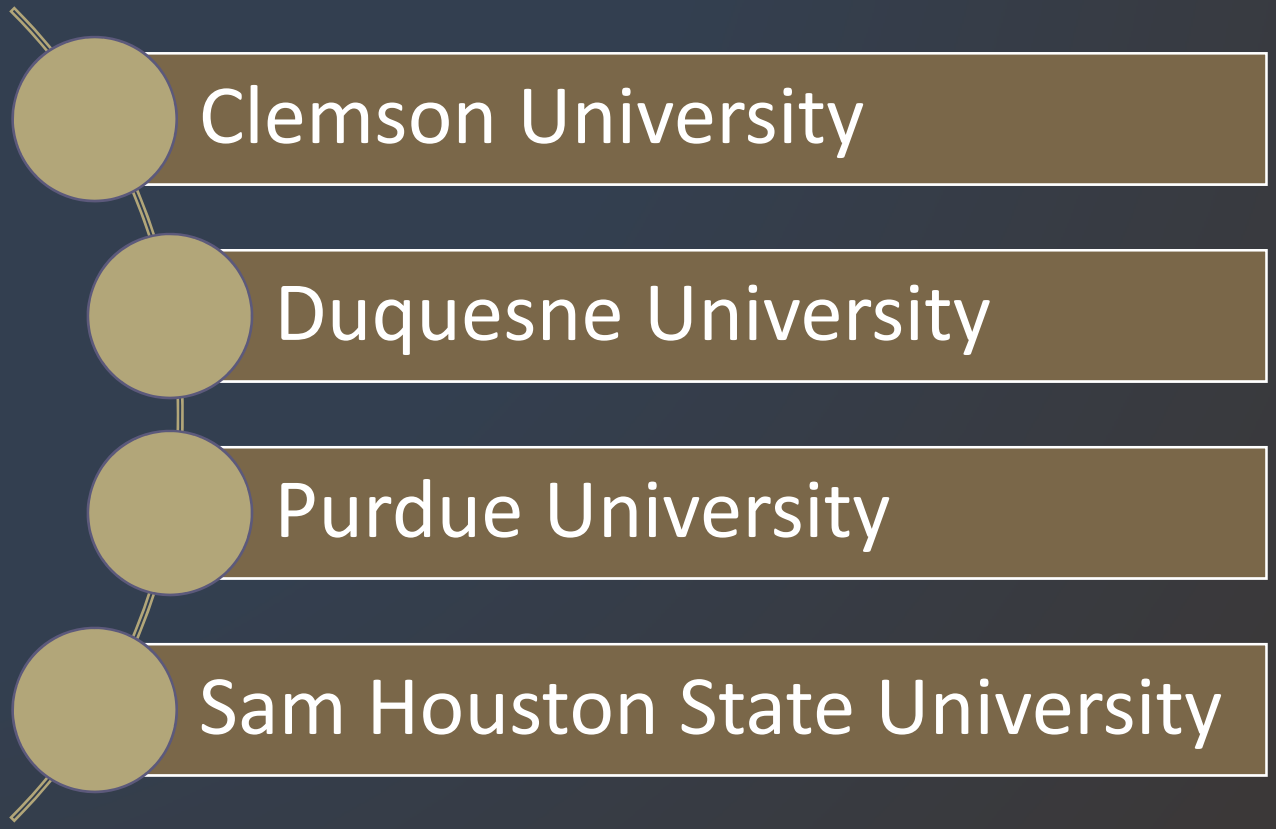
Assessment Uses of CAT



Closing the Loop in Assessment and Quality Improvement

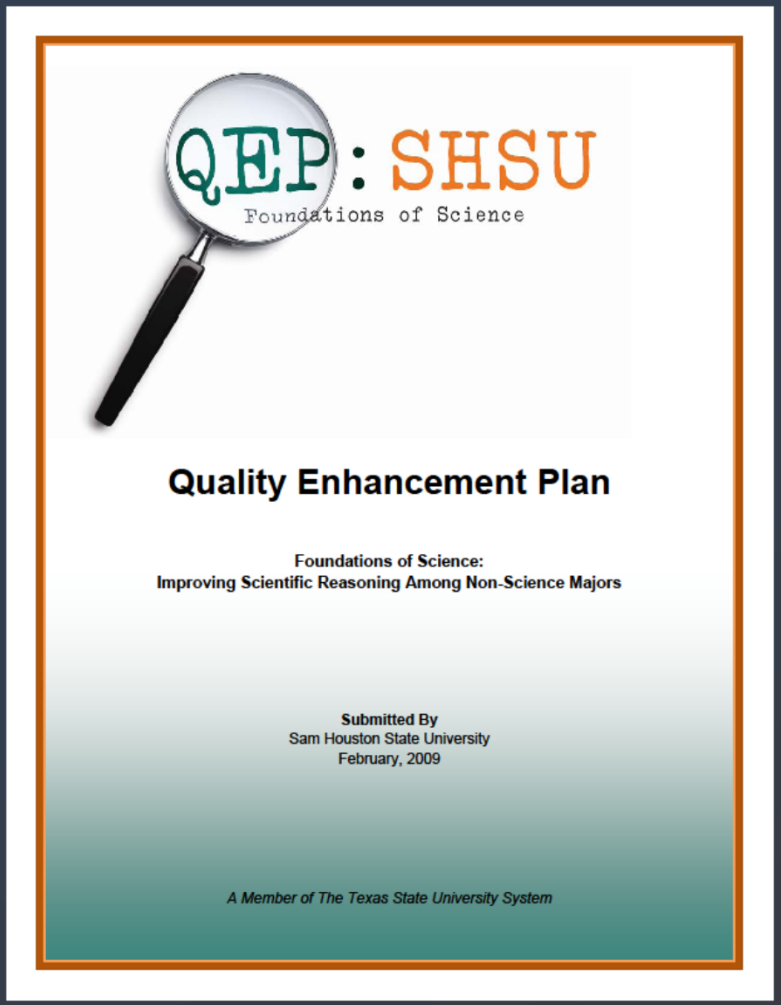


Some Successful Projects



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

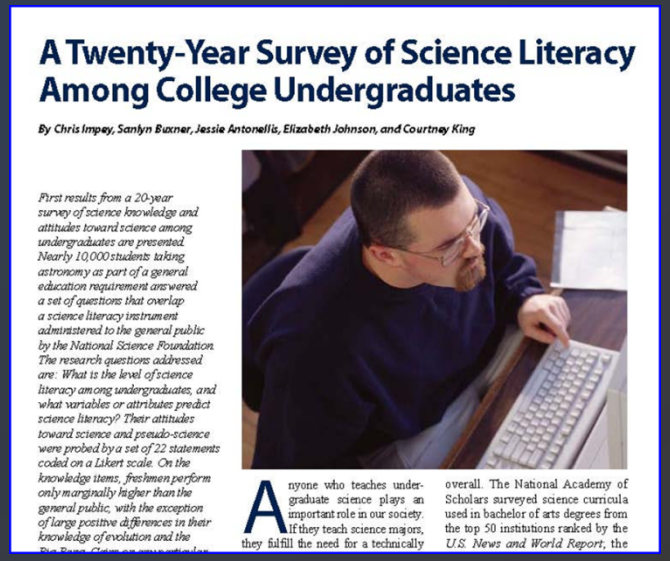
✓engender scientific habits of mind

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

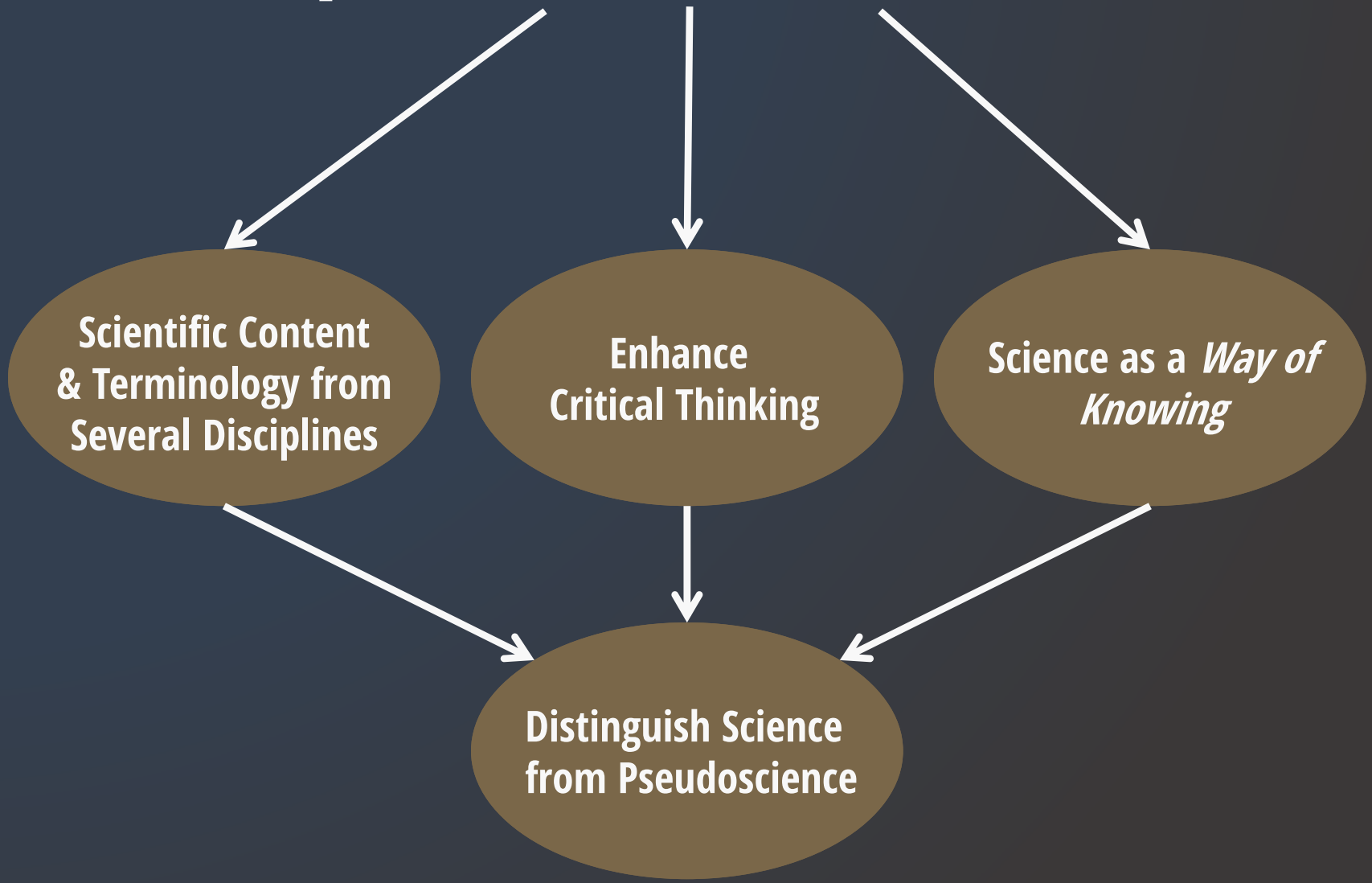
By Chris Impey, Sanlyn Buxner, Jessie Antonellis, Elizabeth Johnson, and Courtney King

First results from a 20-year survey of science knowledge and attitudes toward science among undergraduates are presented. Nearly 10,000 students taking astronomy as part of a general education requirement answered a set of questions that overlap a science literacy instrument administered to the general public by the National Science Foundation. The research questions addressed are: What is the level of science literacy among undergraduates, and what variables or attributes predict science literacy? Their attitudes toward science and pseudo-science were probed by a set of 22 statements coded on a Likert scale. On the knowledge items, freshmen perform only marginally higher than the general public, with the exception of large positive differences in their knowledge of evolution and the

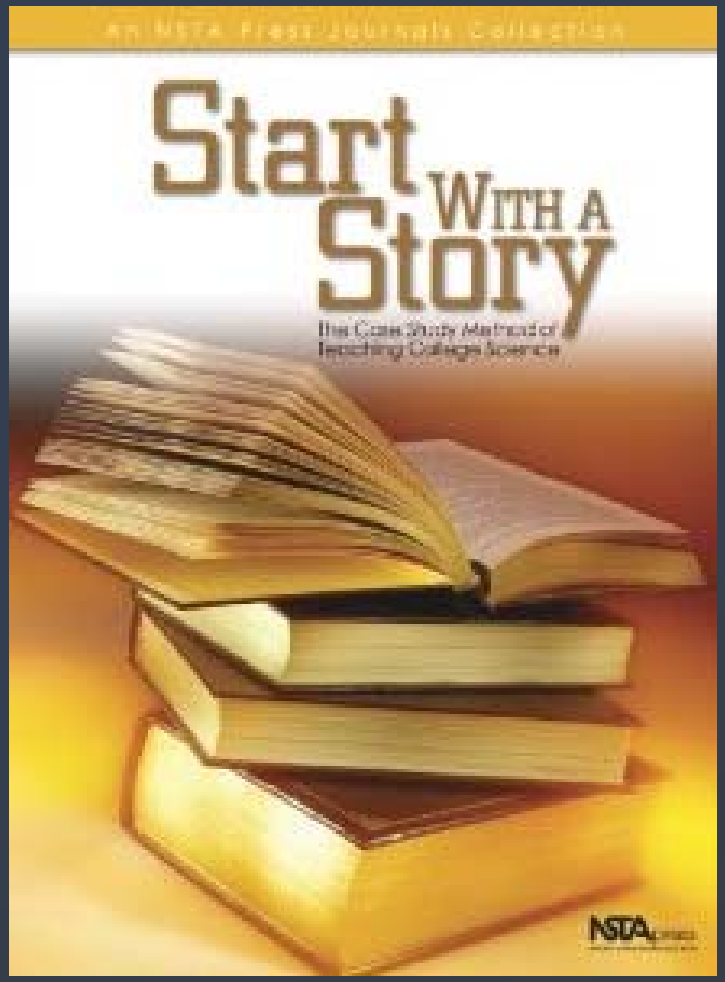
Anyone who teaches undergraduate science plays an important role in our society. If they teach science majors, they fulfill the need for a technically

overall. The National Academy of Scholars surveyed science curricula used in bachelor of arts degrees from the top 50 institutions ranked by the *U.S. News and World Report*, the

Specific Course Goals

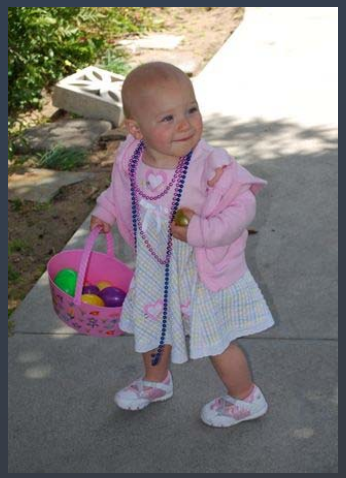


Pedagogies:



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?

Examples of FoS Questions

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.

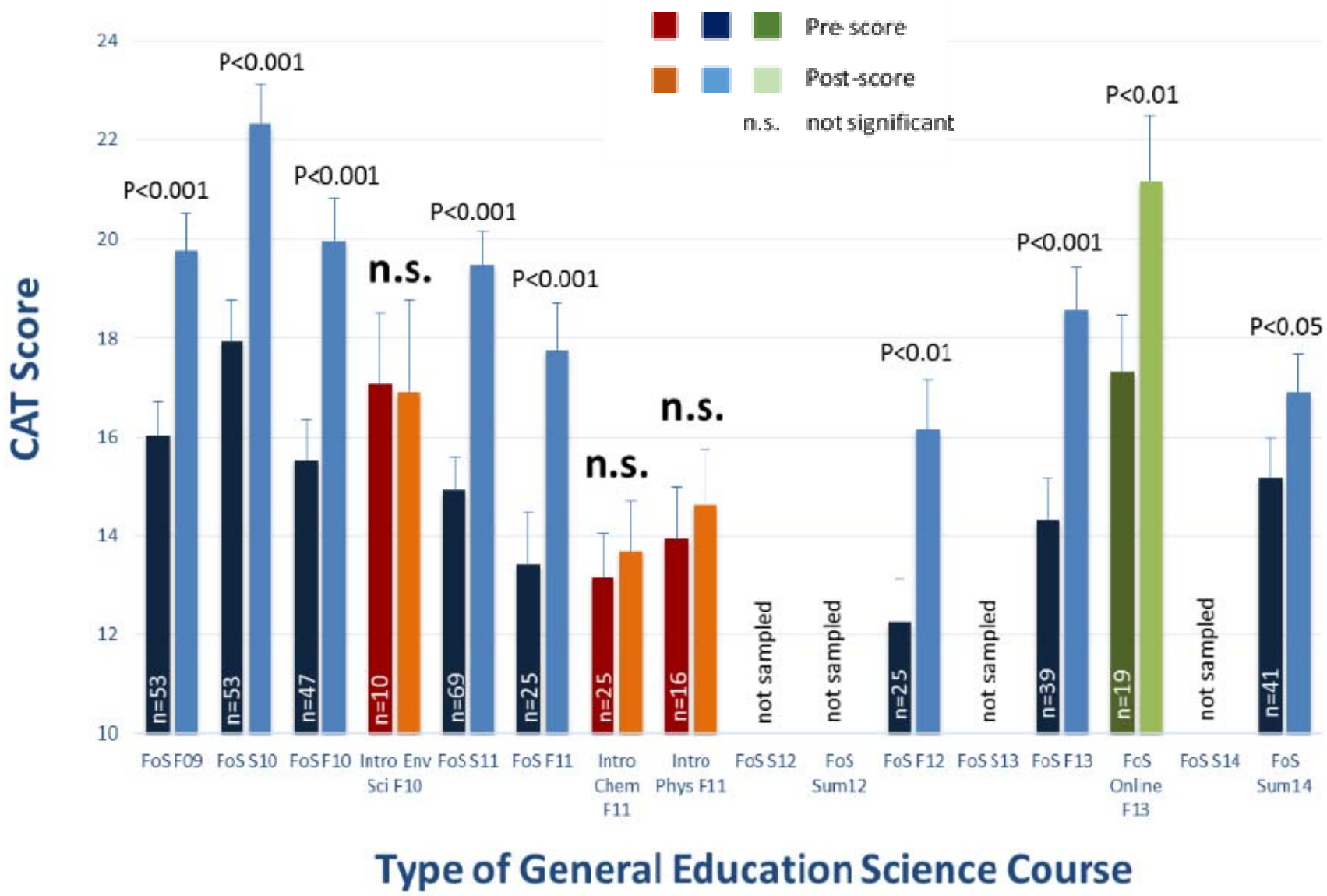
What logical fallacy has Meagan committed?

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

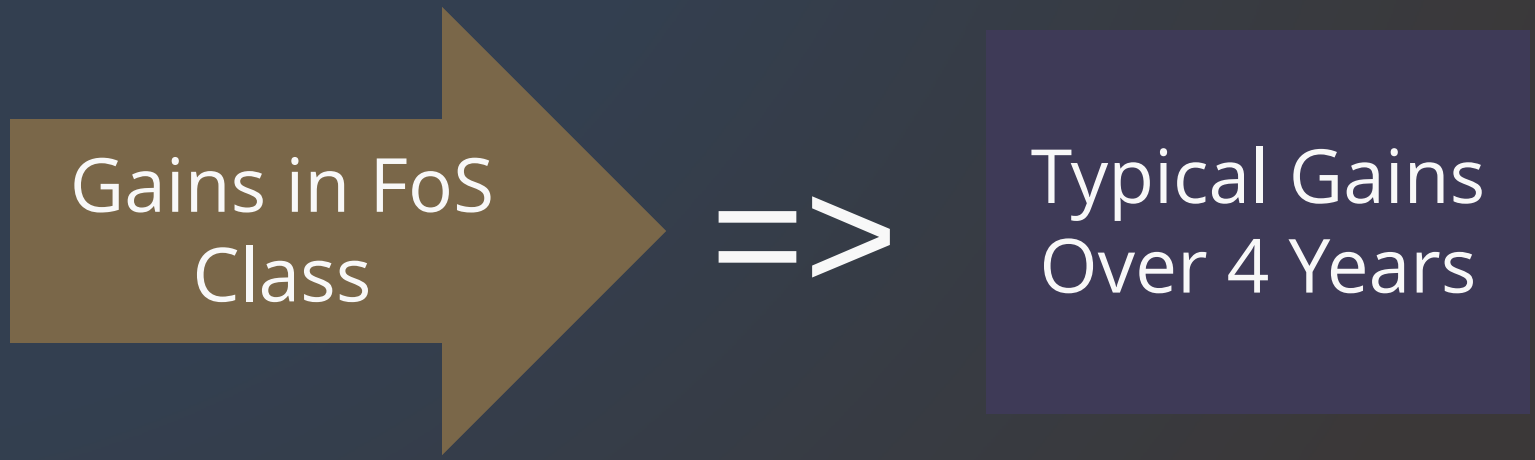
Assessing CT Gains

Pre-Test Post-Test Design
Using CAT Instrument

Treatment vs. Control


Pre-score
Post-score
n.s. not significant
CAT Score
24
22
20
18
16
14
12
10
P<0.001
P<0.001
P<0.001
n.s.
P<0.001
n.s.
n.s.
P<0.01
P<0.001
P<0.01
P<0.05
n=53
n=53
n=47
n=10
n=69
n=25
n=25
n=16
not sampled
not sampled
n=25
not sampled
n=39
n=19
not sampled
n=41
FoS F09
FoS S10
FoS F10
Intro Env Sci F10
FoS S11
FoS F11
Intro Chem F11
Intro Phys F11
FoS S12
FoS Sum12
FoS F12
FoS S13
FoS F13
FcS Online F13
FoS S14
FoS Sum14
Type of General Education Science Course

Perspective



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

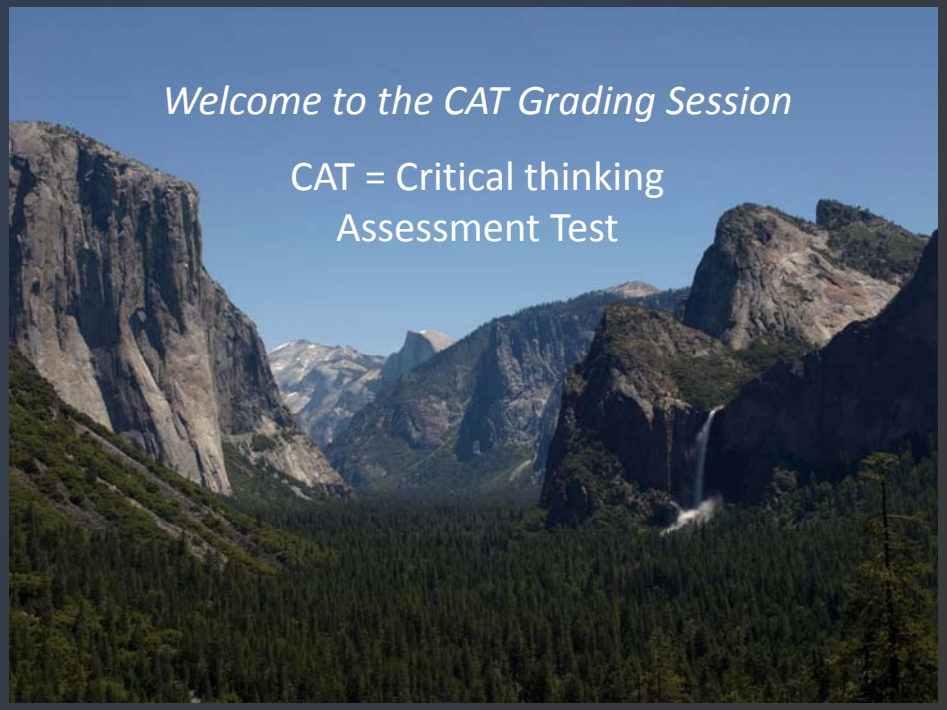
Benefits beyond SHSU

- 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.