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

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SACS/COC 2012 Annual Meeting

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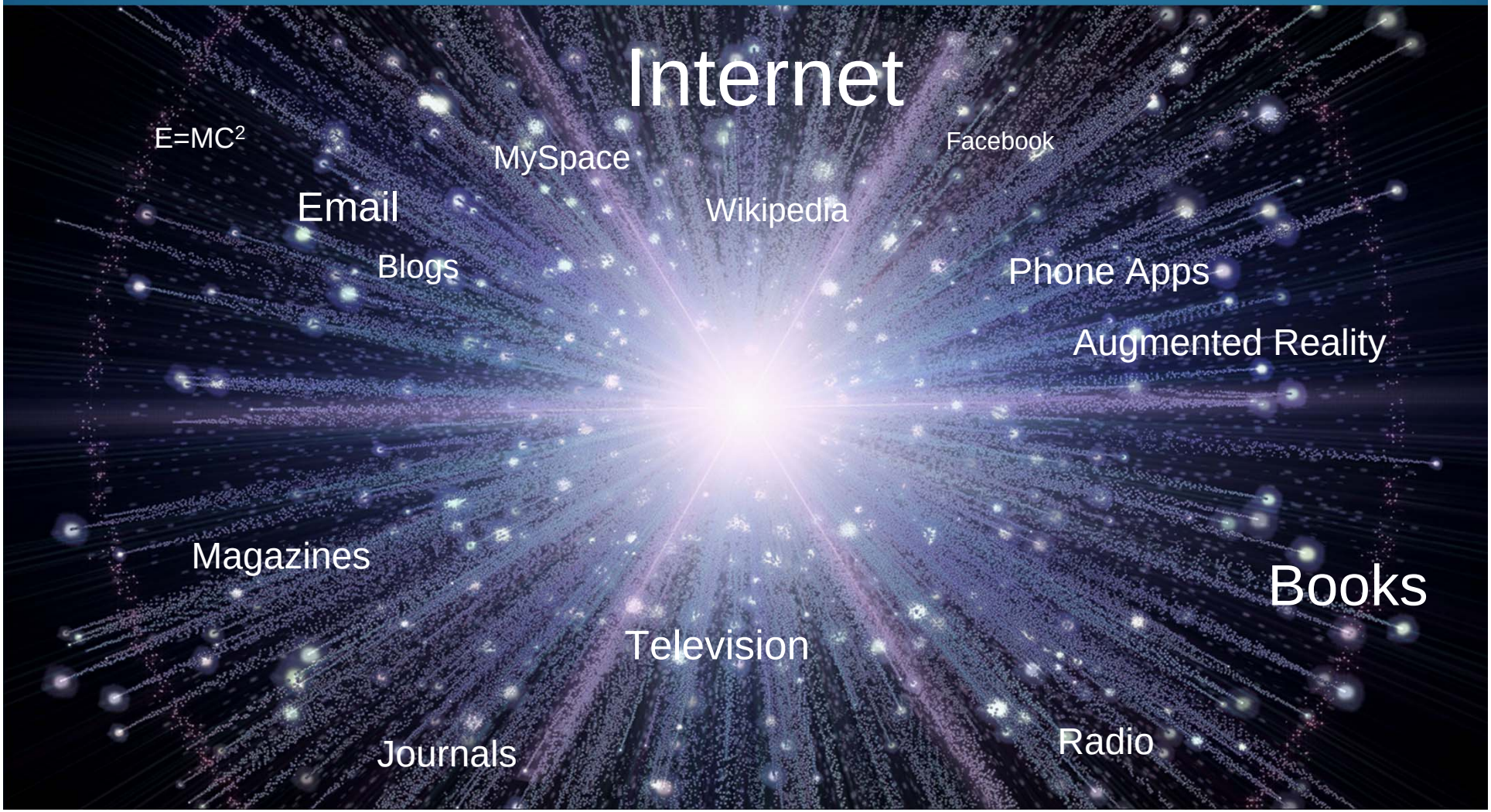
Importance of Critical Thinking

Explosion of Information



The Changing Nature of Education

Remembering Information

Finding Relevant Information

Understanding & Evaluating Information

Using Information Effectively

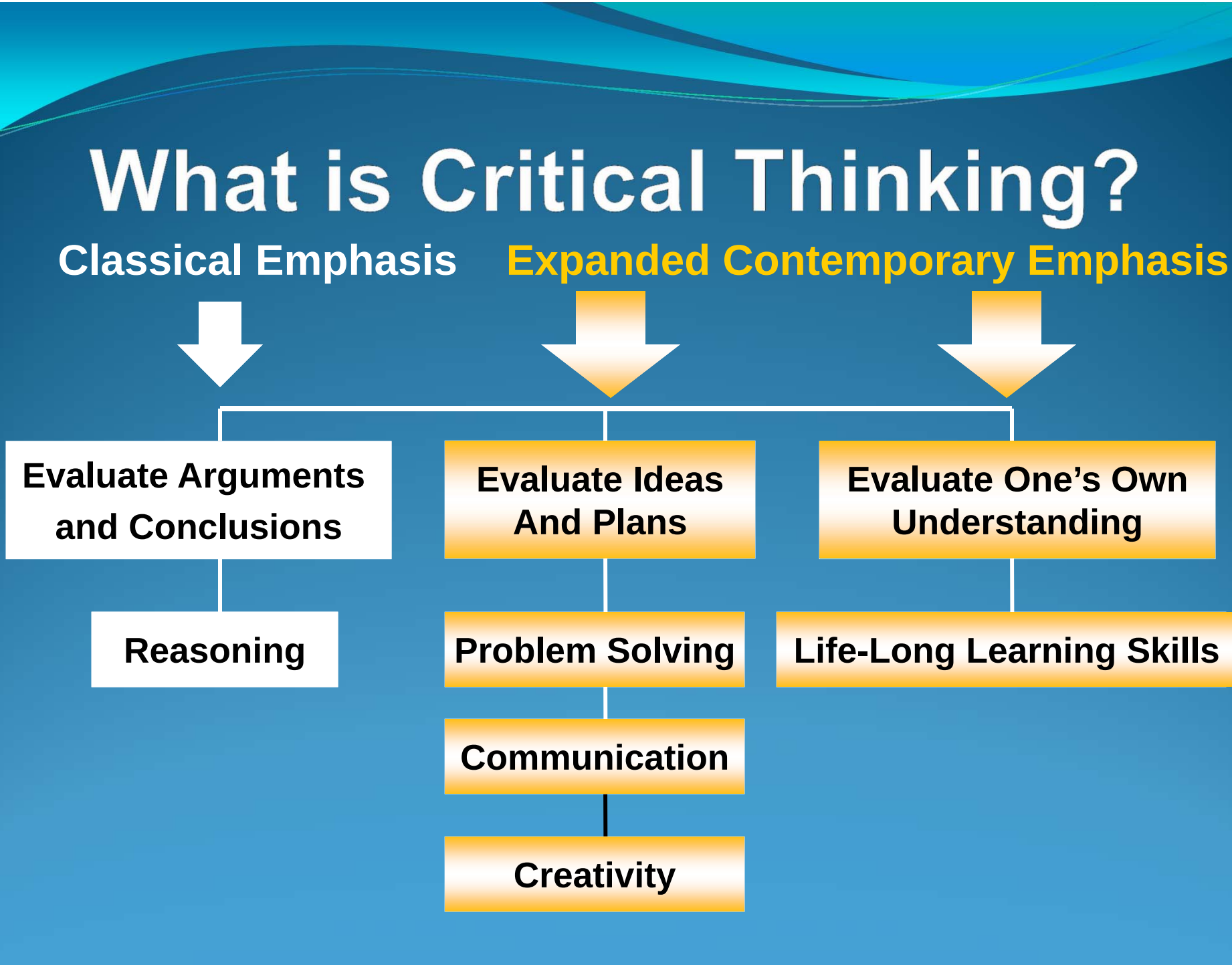
What is Critical Thinking?

Classic Emphasis

Evaluate Arguments and Conclusions

Reasoning

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

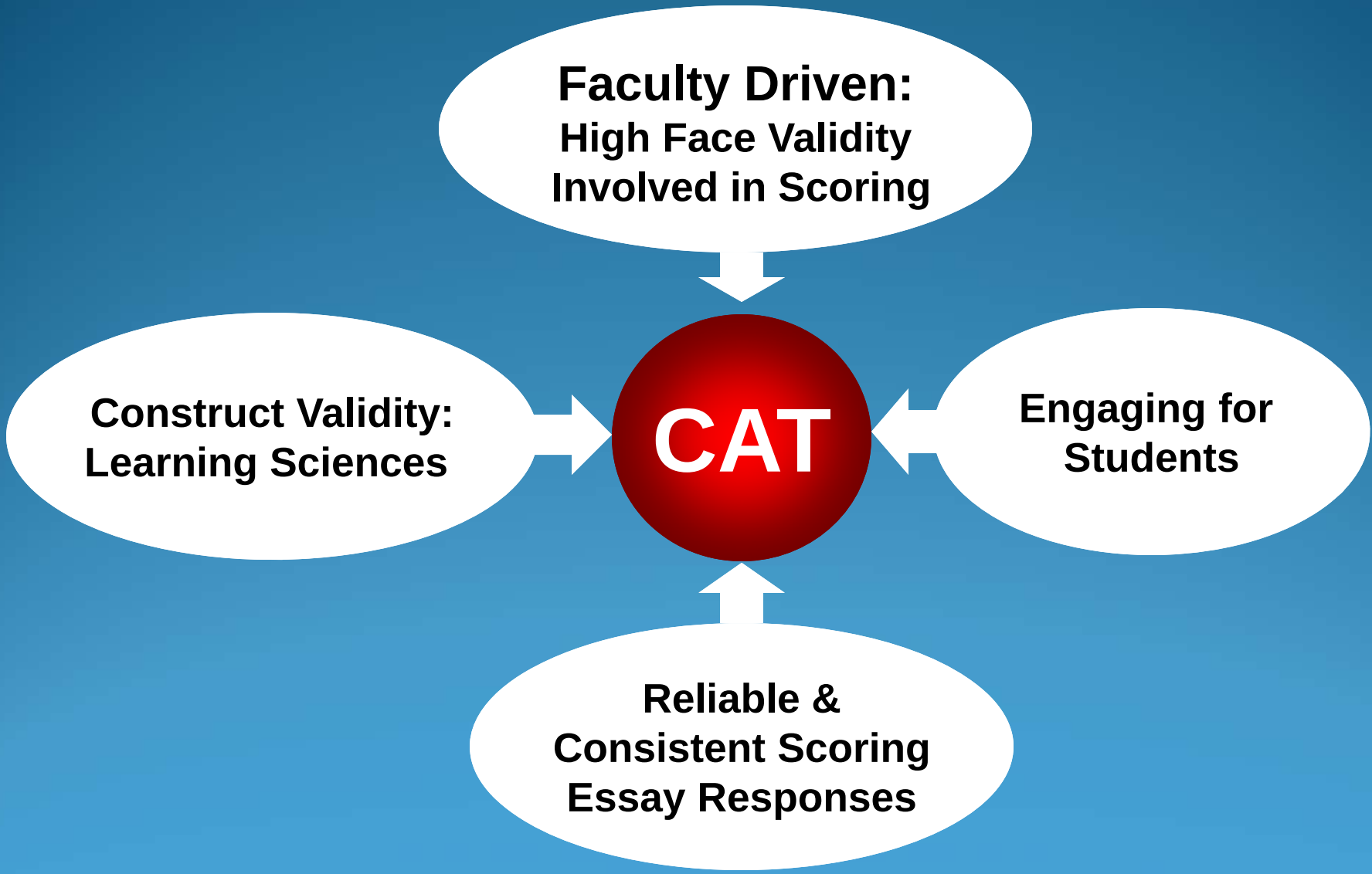
Collaborate With Other
Institutions To Refine CAT
2004 - 2007

Develop Training Methods for
National Dissemination & Collect Norms
2007 - 2010

Expand National Dissemination
& Support Assessment in NSF Projects
2010 - 2014

Over 150 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

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

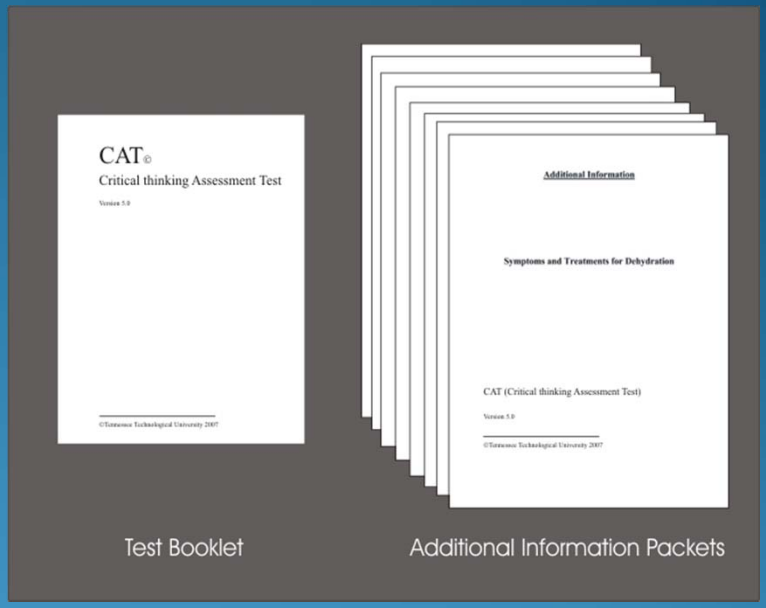
- Separate relevant from irrelevant information.
- Integrate information to solve problems.
- Learn & apply new information.
- Use mathematical skills to solve real-world problems.

Communication

- Communicate ideas effectively.

CAT Features

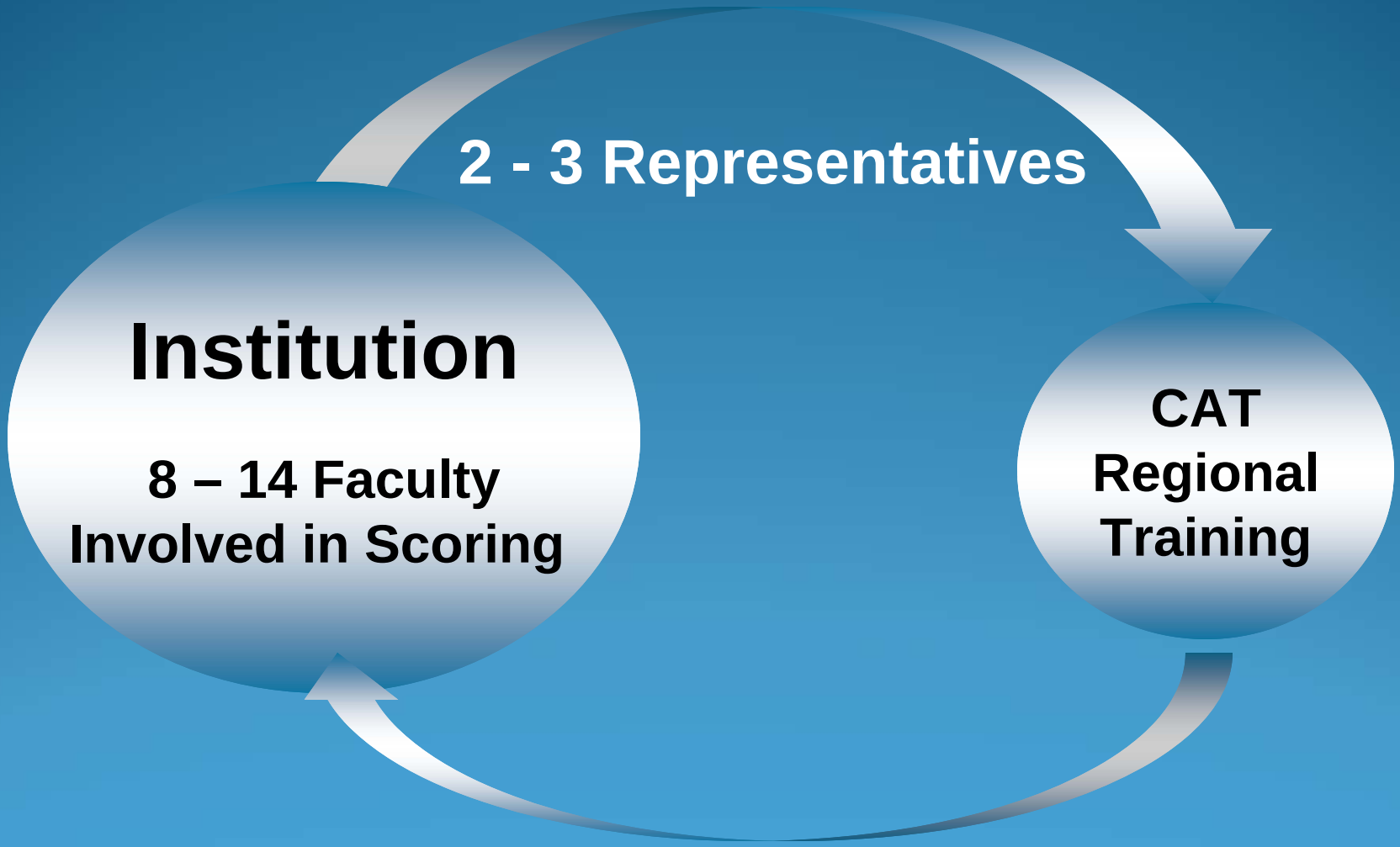
- One hour exam
- Mostly short answer essay
- Faculty scored in workshops
- Detailed scoring guide
- Reliable
- Valid



Cost

$6 Test, $200 Year Participation Fee

National Dissemination Model



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.

_____

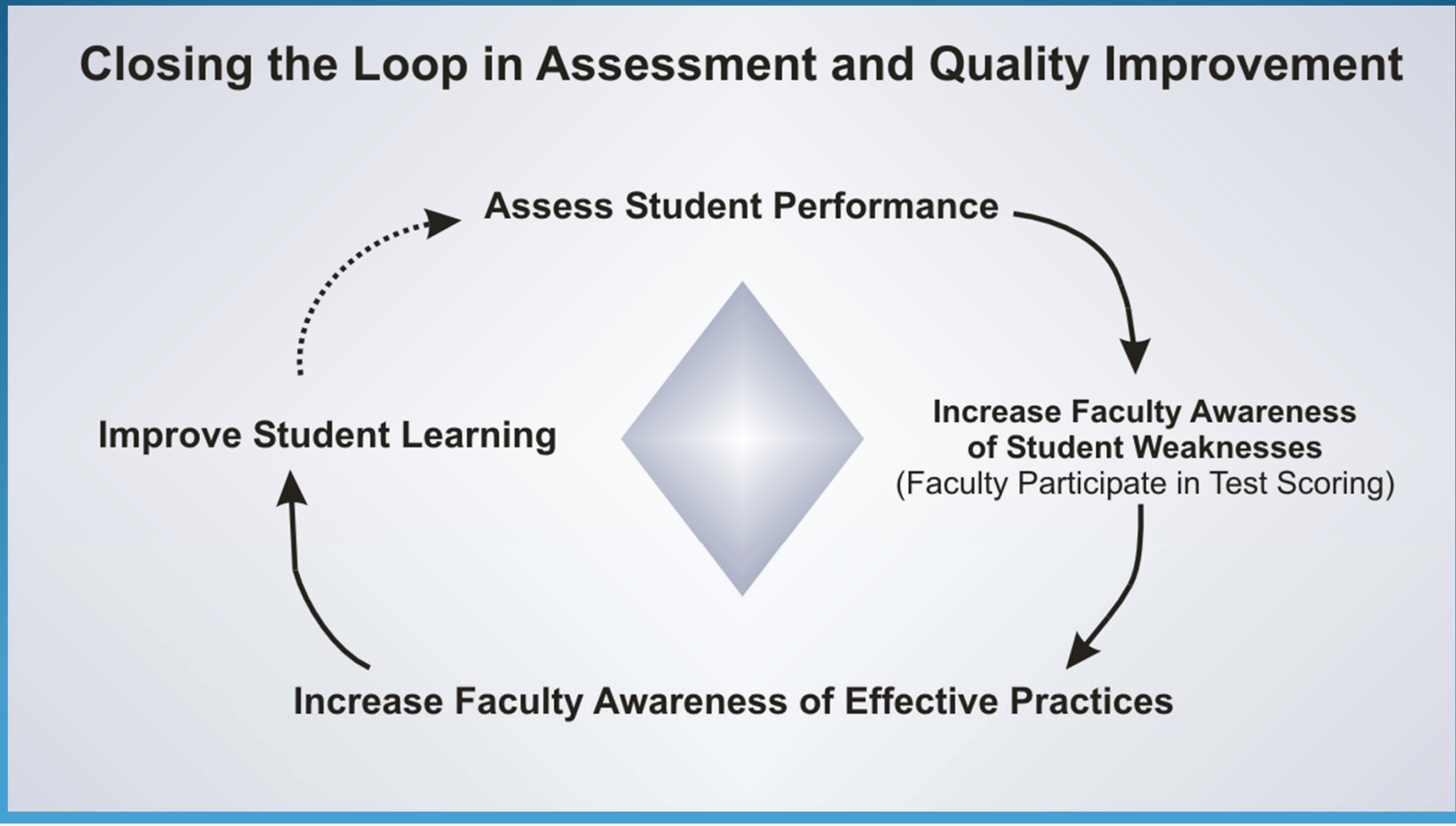
What kind of additional information or evidence would support the scientist's theory?

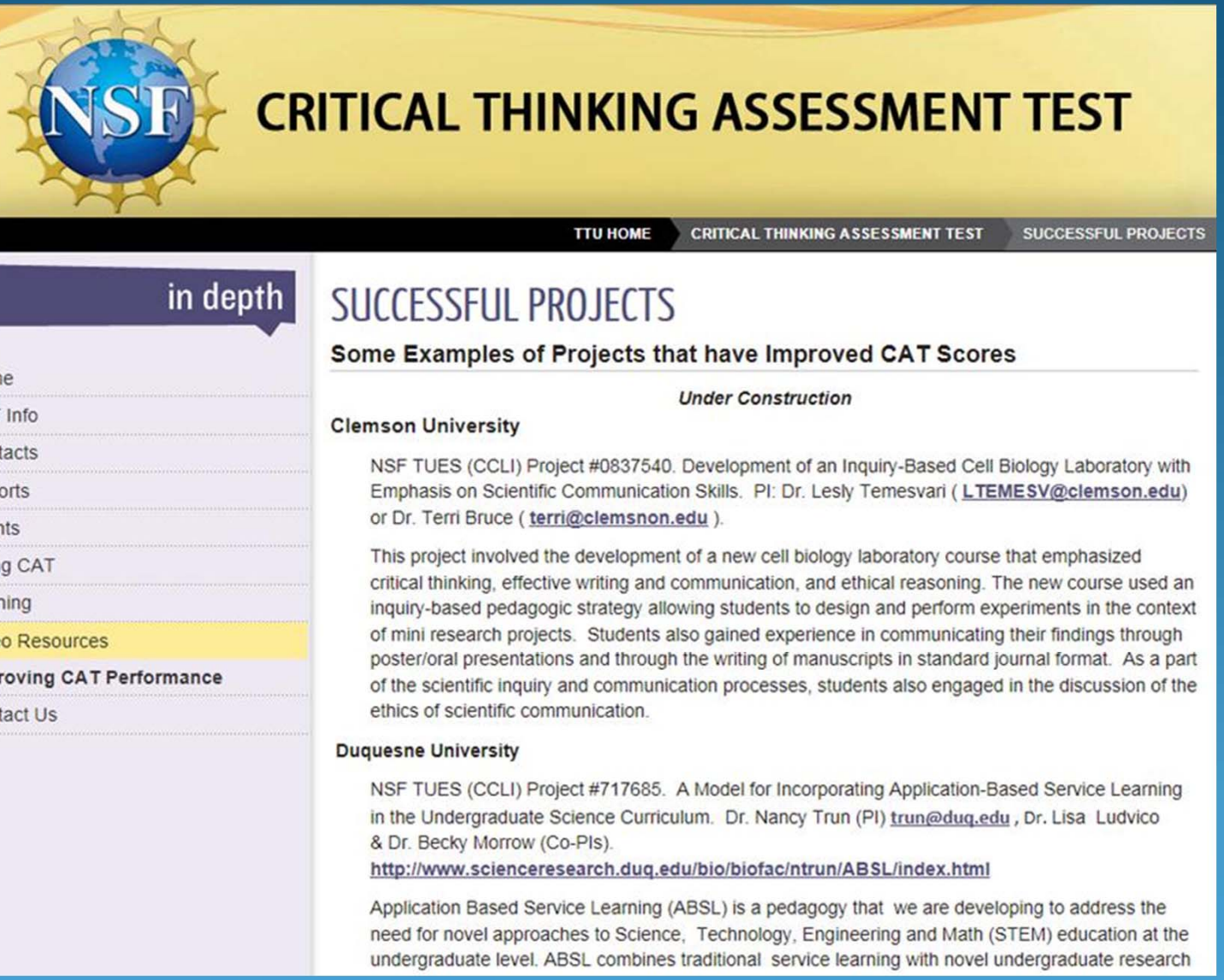
_____

Assessment Uses of CAT

- Informal Learning Experiences
- Classroom Learning Experiences
- Program Outcomes
- College Outcomes

Closing the Loop in Assessment and Quality Improvement



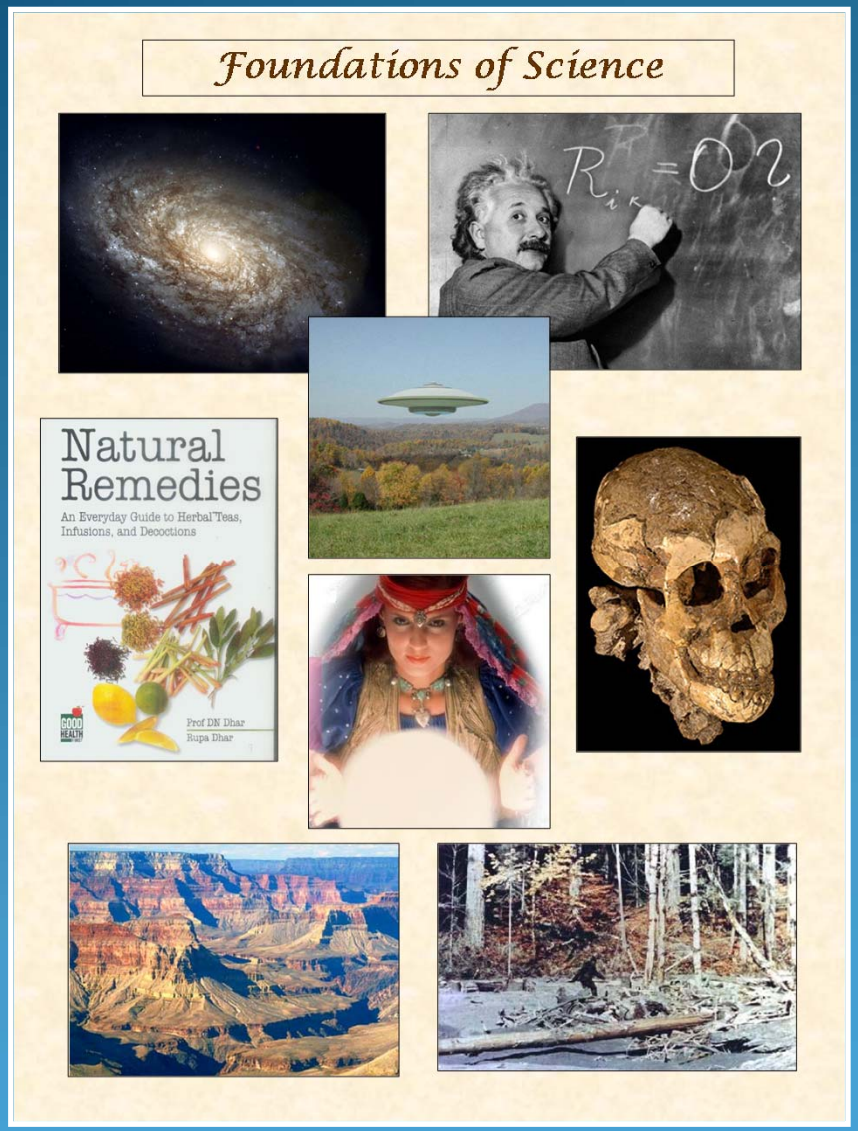

CRITICAL THINKING ASSESSMENT TEST
TTU HOME
CRITICAL THINKING ASSESSMENT TEST
SUCCESSFUL PROJECTS
in depth
Home
CAT Info
Contacts
Reports
Grants
Using CAT
Training
Video Resources
Improving CAT Performance
Contact Us
SUCCESSFUL PROJECTS
Some Examples of Projects that have Improved CAT Scores
Under Construction
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 (LTEMESV@clemson.edu) or Dr. Terri Bruce (terri@clemsnon.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).
http://www.scienceresearch.duq.edu/bio/biofac/ntrun/ABSL/index.html
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

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

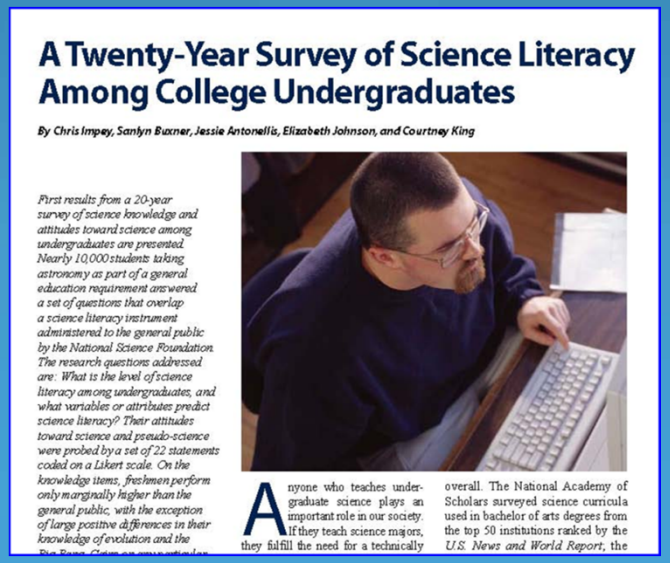
✓engender scientific habits of mind

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

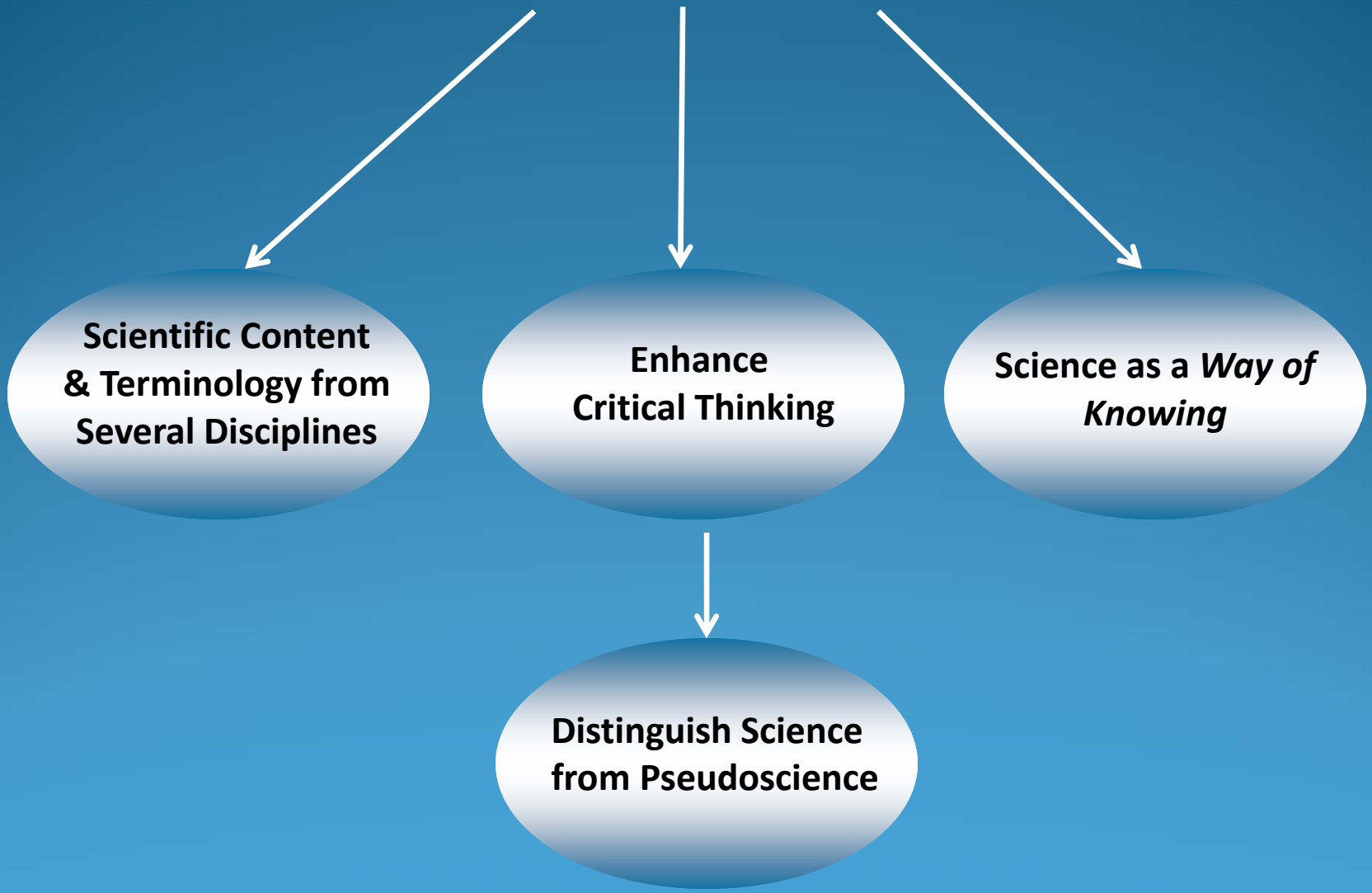
By Chris Impey, Sanlyn Buxner, Jessie Antonellis, Elizabeth Johnson, and Courtney King

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

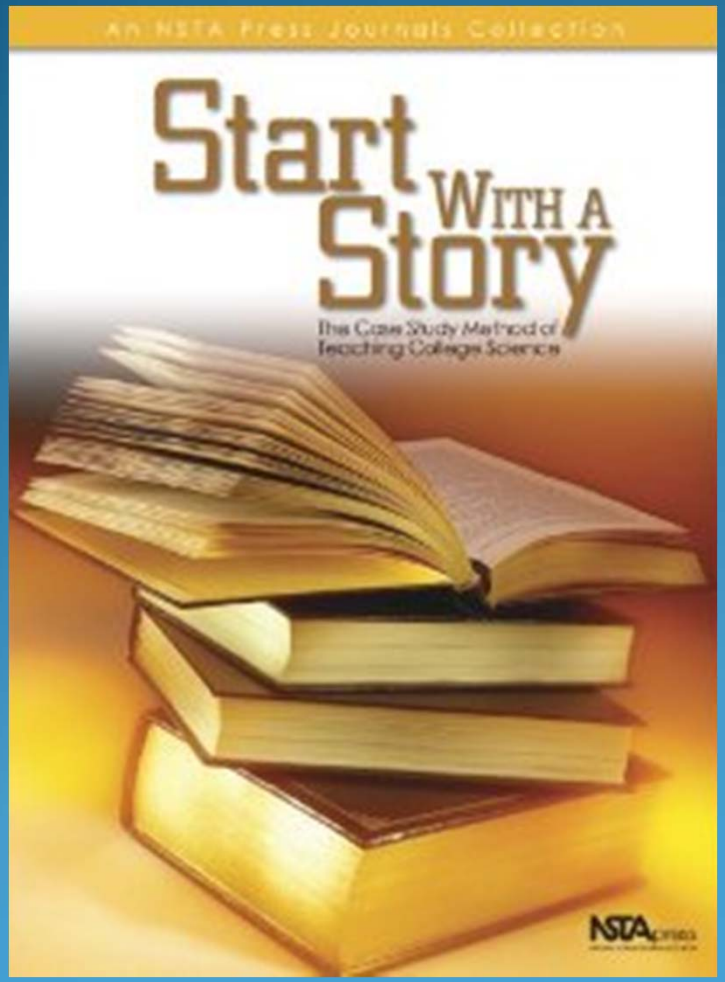
Anyone who teaches undergraduate science plays an important role in our society. If they teach science majors, they fulfill the need for a technically

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 Review

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)

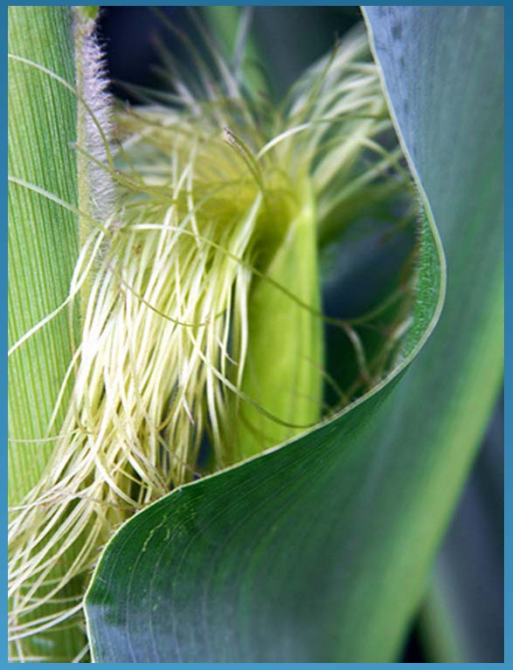
How would you test the idea? What additional evidence would you need to evaluate the claim?

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 therefore 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.



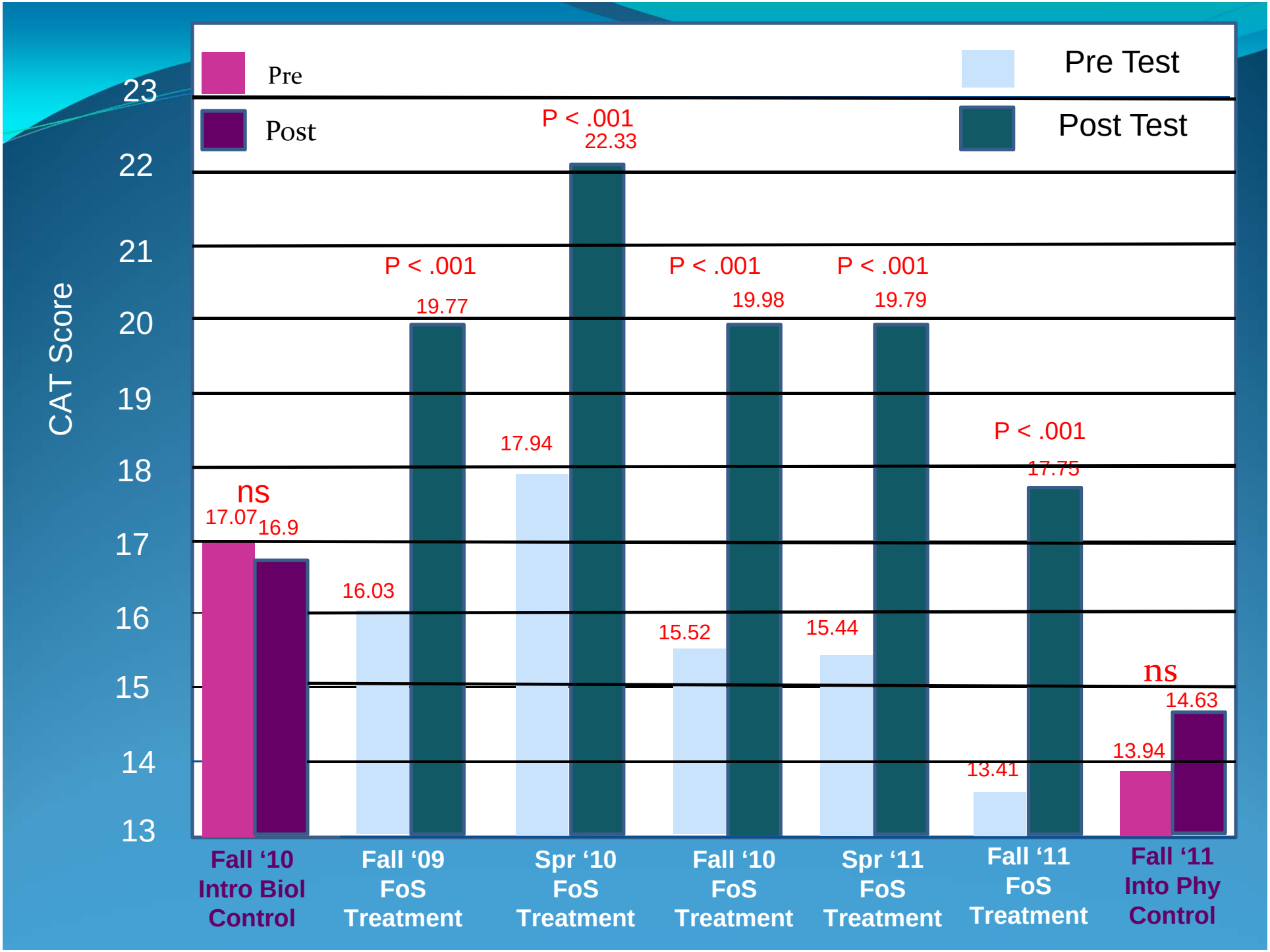
What logical fallacy has Meagan committed?

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

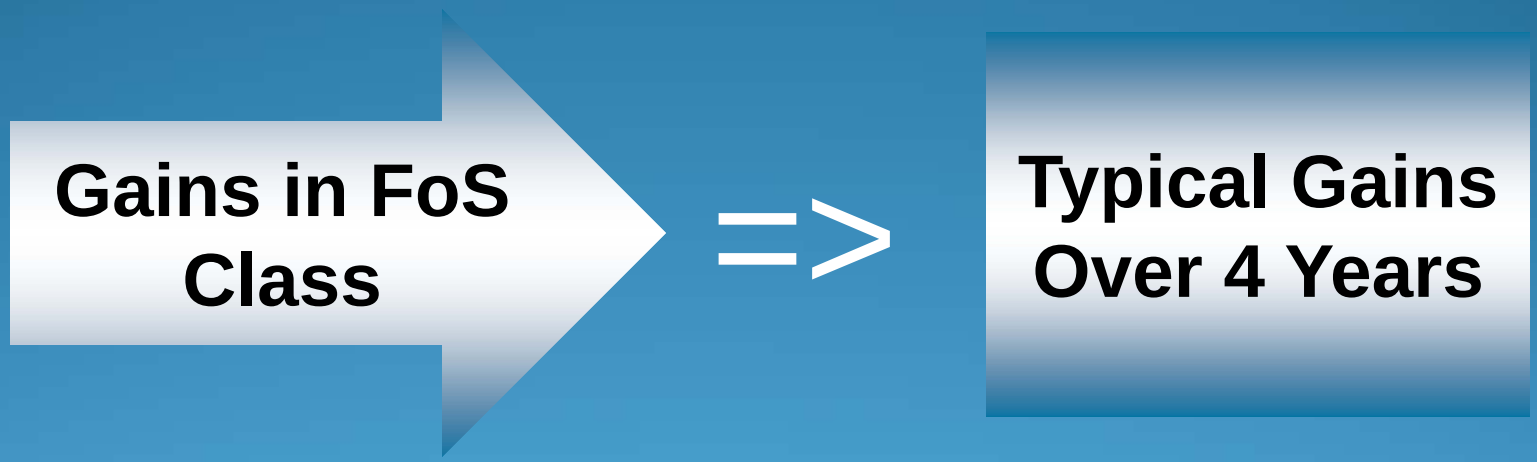
Assessing CT Gains

Pre-Test Post-Test Design Using CAT Instrument

Treatment vs. Control


CAT Score
23
22
21
20
19
18
17
16
15
14
13
Pre
Post
Pre Test
Post Test
ns
17.07
16.9
16.03
P < .001
19.77
17.94
P < .001
22.33
15.52
P < .001
19.98
15.44
P < .001
19.79
13.41
P < .001
17.75
13.94
ns
14.63
Fall '10 Intro Biol Control
Fall '09 FoS Treatment
Spr '10 FoS Treatment
Fall '10 FoS Treatment
Spr '11 FoS Treatment
Fall '11 FoS Treatment
Fall '11 Into Phy Control

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 all Education majors at SHSU

Benefits beyond SHSU

- Info on CT will be presented at Correctional Management Institute of Texas seminar (CT isn't discipline specific)

- Presentations to many universities and contacts with others

- Michigan State University: Just received $50,000 *Gates Foundation grant* to convert FoS course to a MOOC

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.

Lessons Learned – cont'd

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

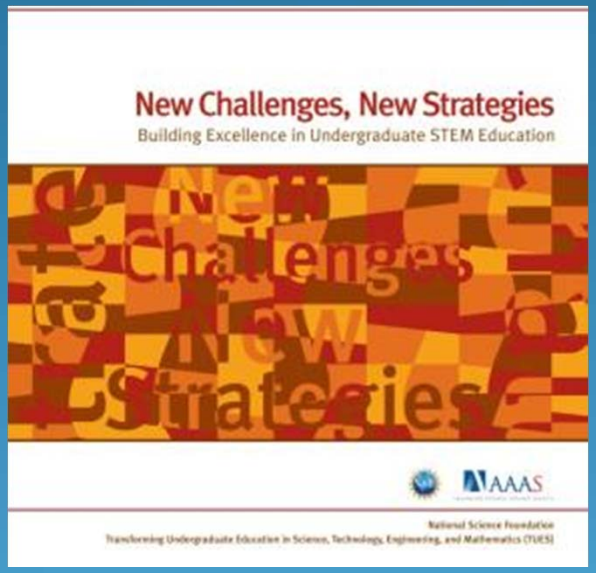
TTU spot checks representative sample of the tests

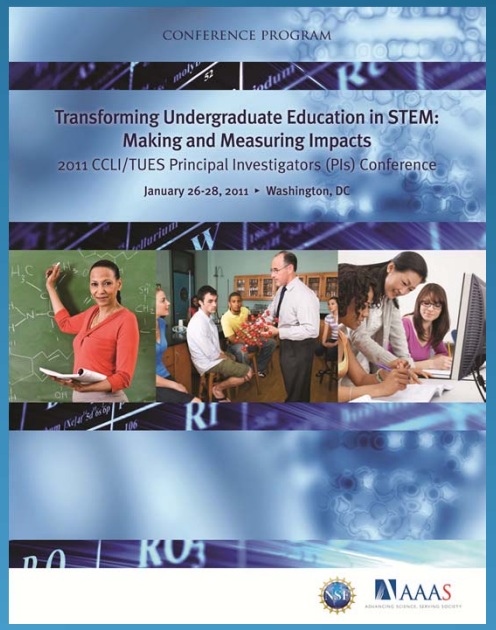
Can statistically correct results if the score on a question falls outside the range of acceptable variation

TTU VERY HELPFUL with any questions we've had

Thank You

www.CriticalThinkingTest.org





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