# Getting Faculty Involved in Assessing and Improving Students' Critical Thinking

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# Importance of Critical Thinking

## Explosion of Information

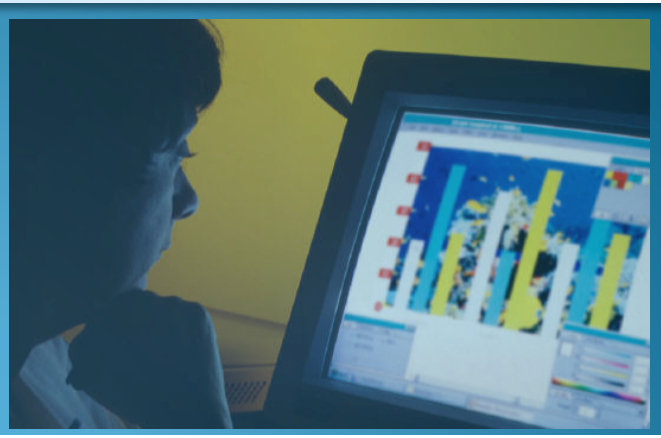
# The Changing Nature of Education

**Remembering Information**

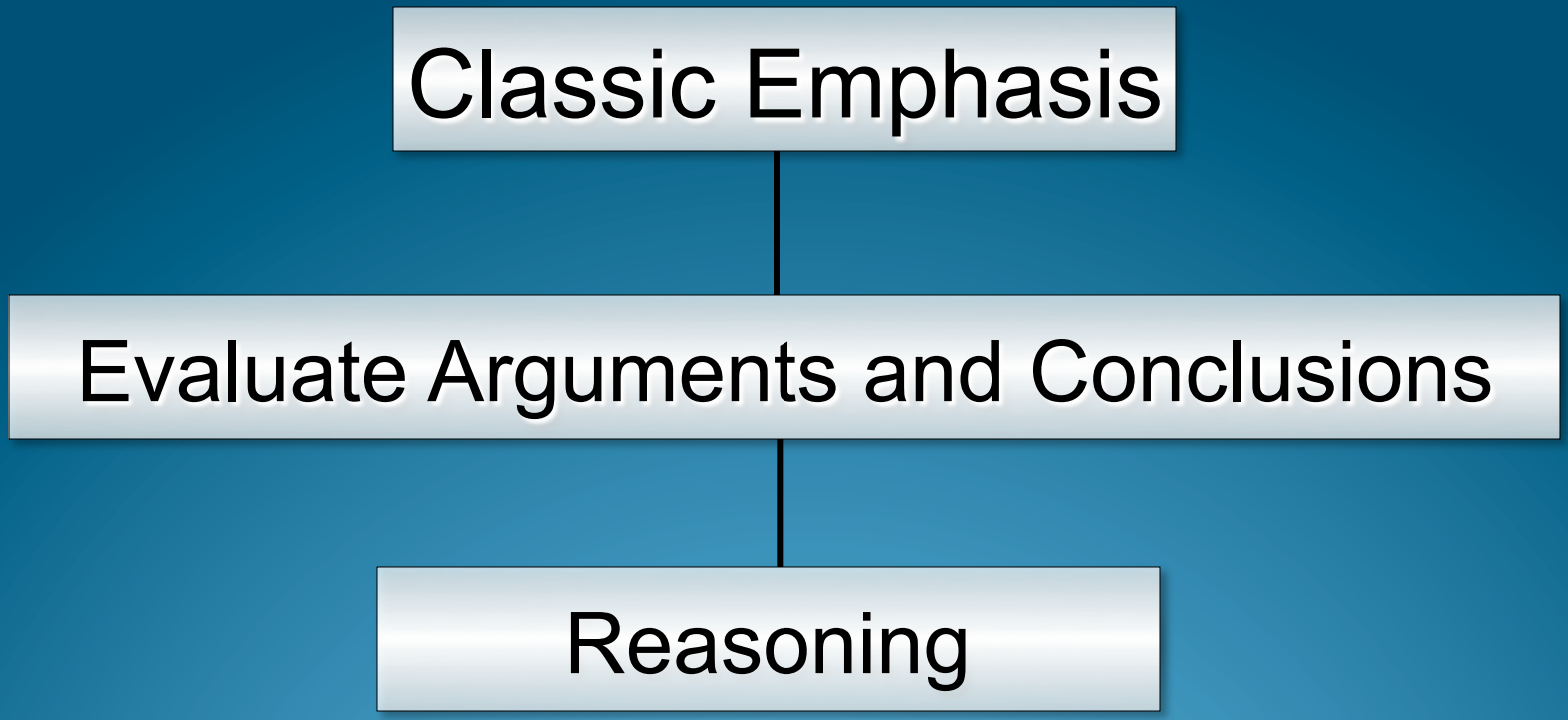
**Finding Relevant Information**

**Understanding & Evaluating Information**

**Using Information Effectively**



# What is Critical Thinking?



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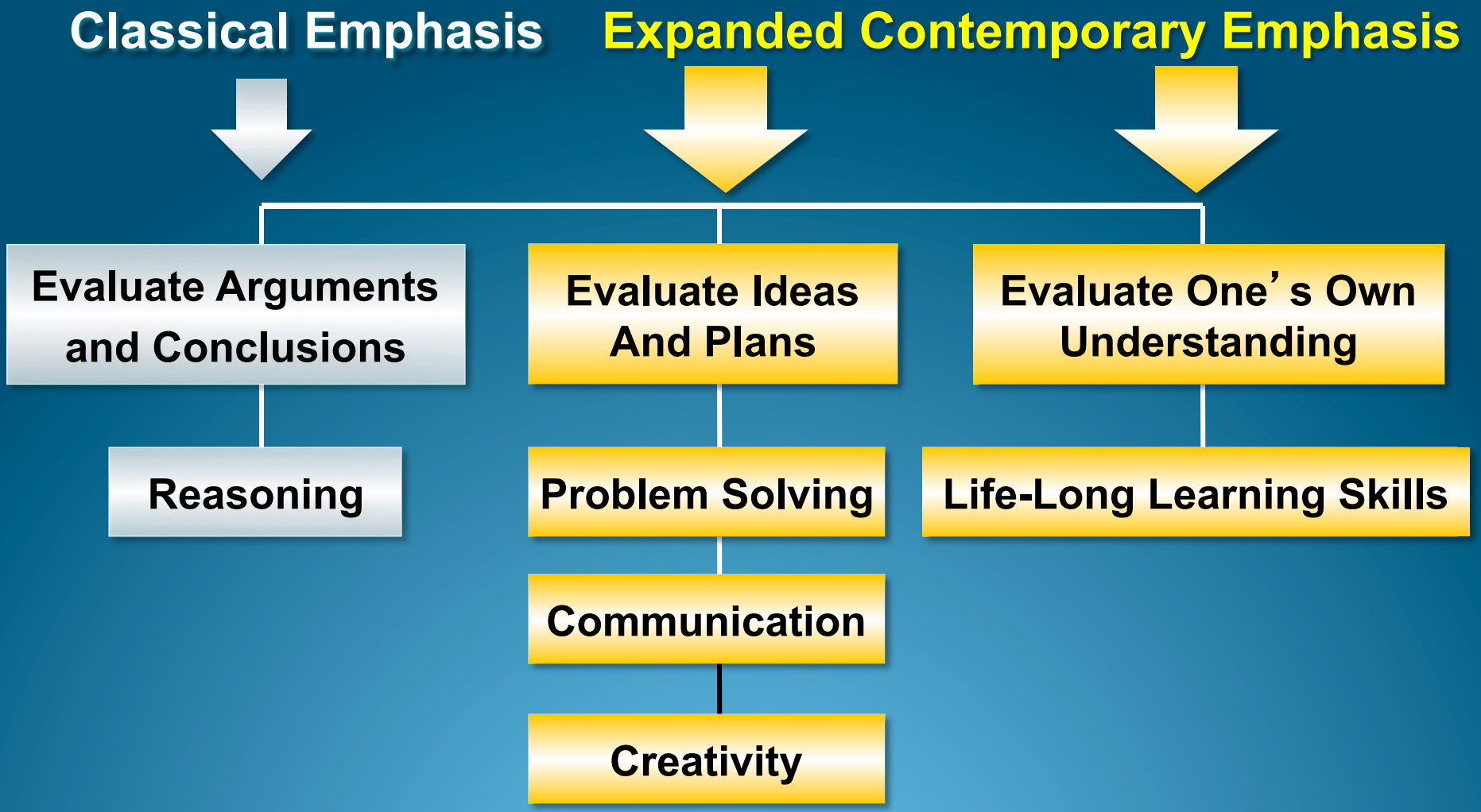


# Why Assess Critical Thinking?

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

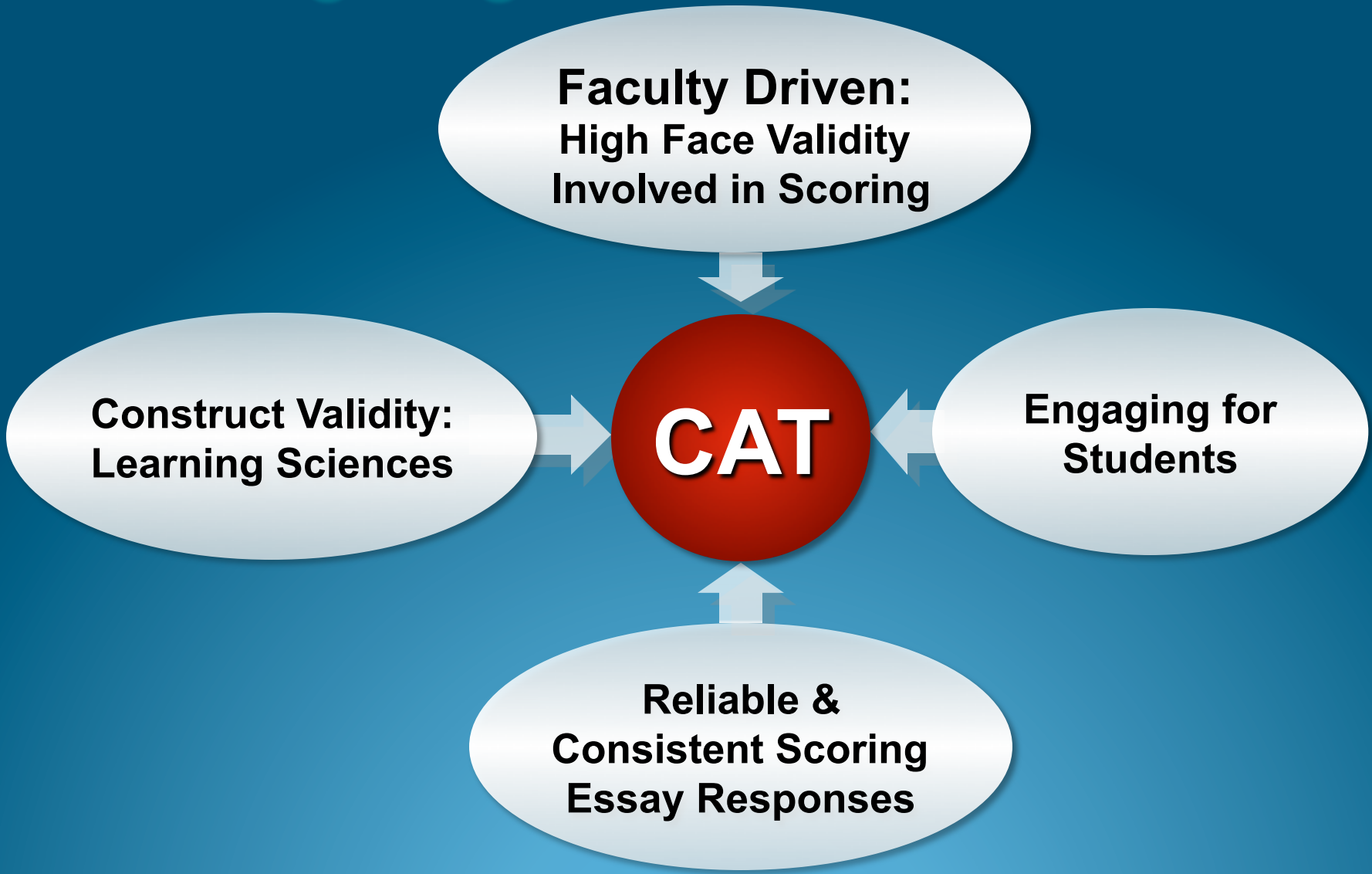

Collaborate With Other
Institutions To Refine CAT
2004 - 2007


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

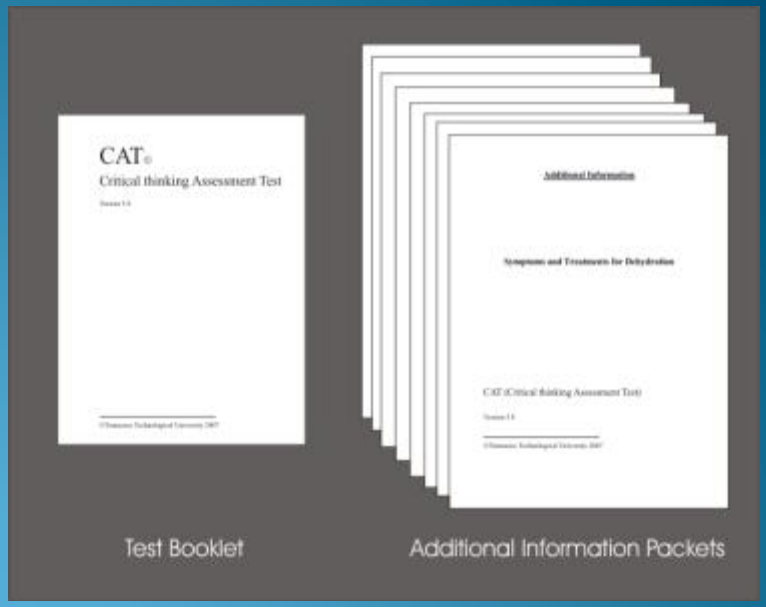
- Separate relevant from irrelevant information.
- Integrate information to solve problems.
- Learn & apply new information.
- Use mathematical skills to solve real-world problems.

## Communication

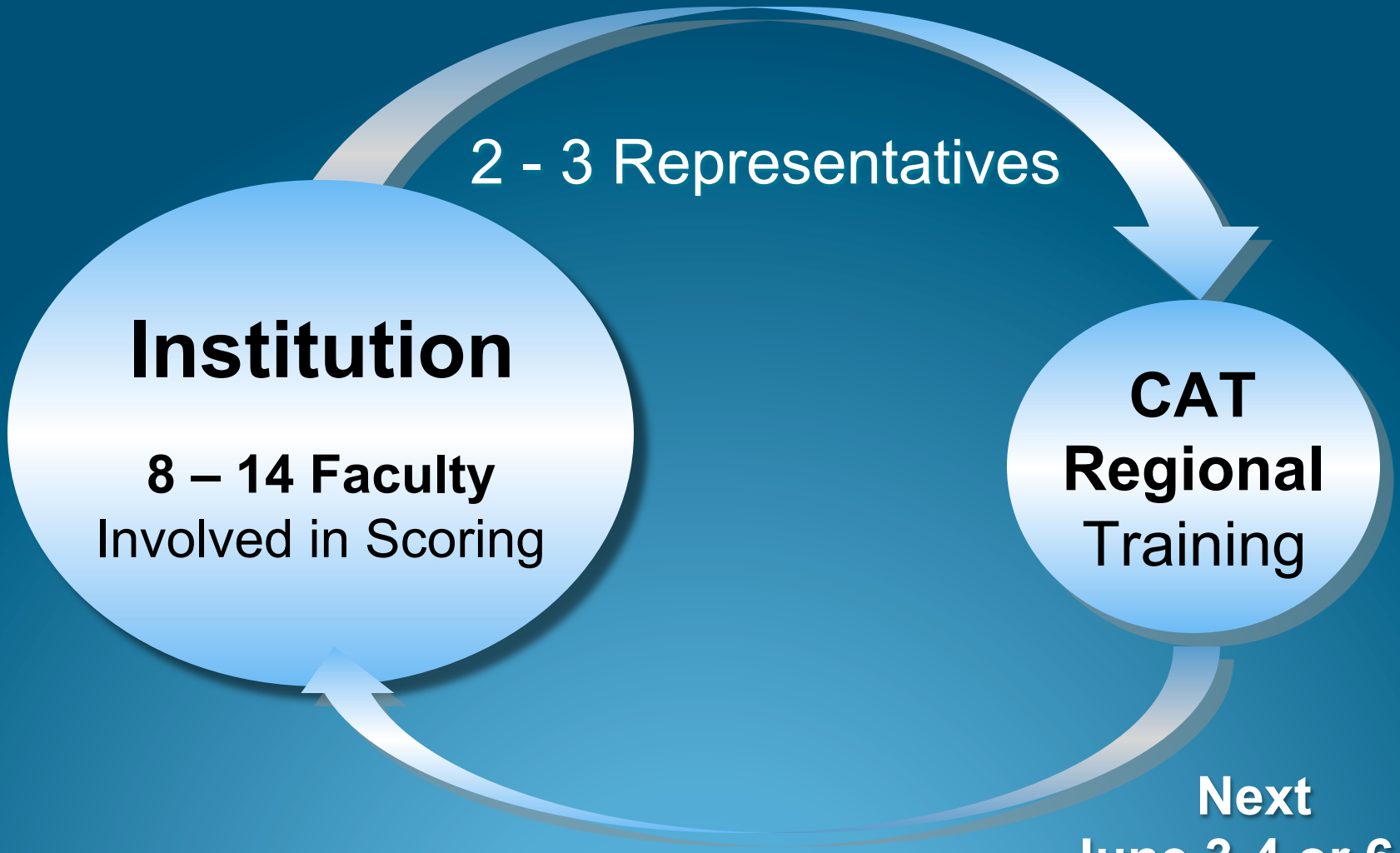
- Communicate ideas effectively.

# CAT Features

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



# 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____

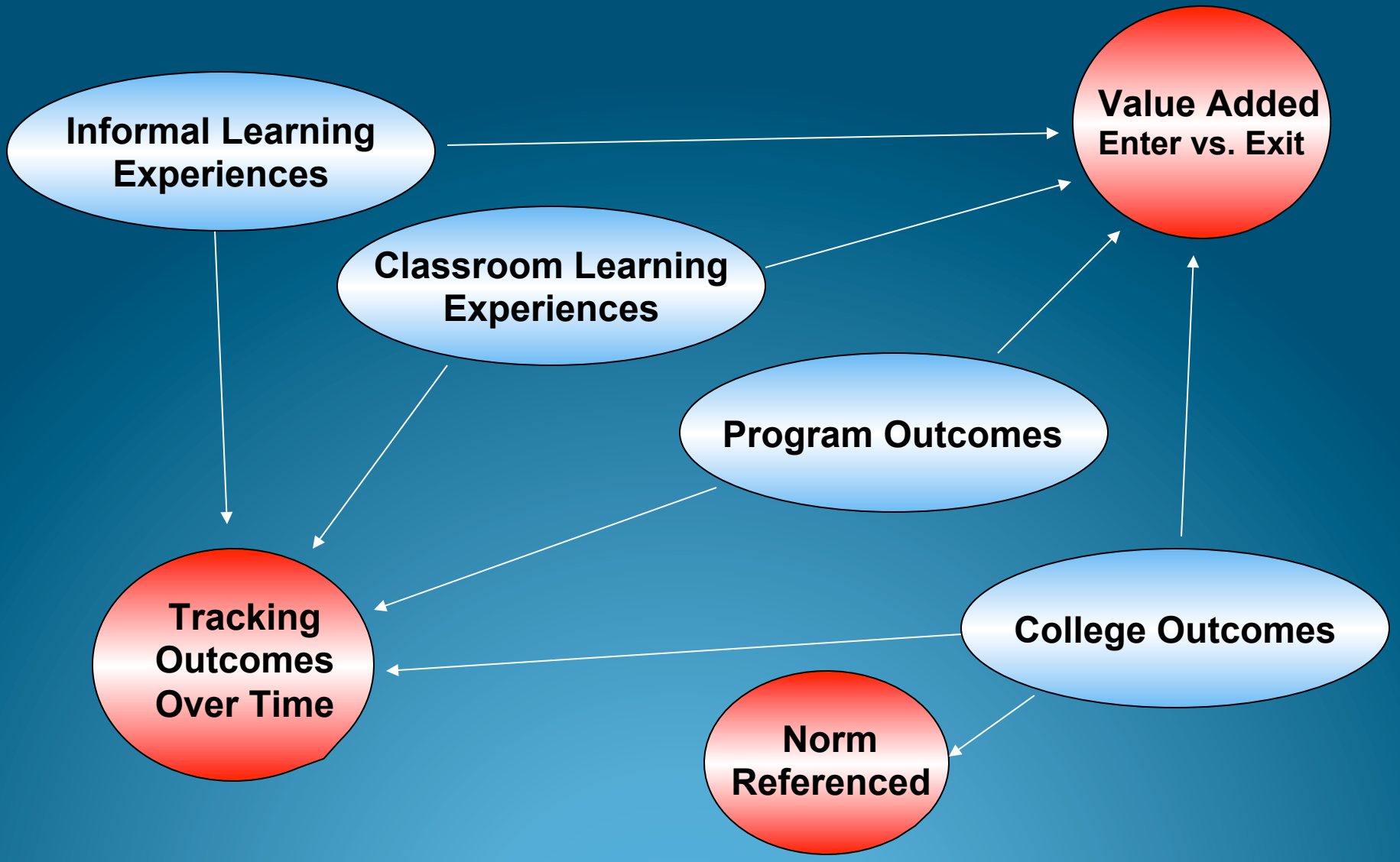
Are there other explanations for the data besides the scientist's theory? If so, describe.

_____

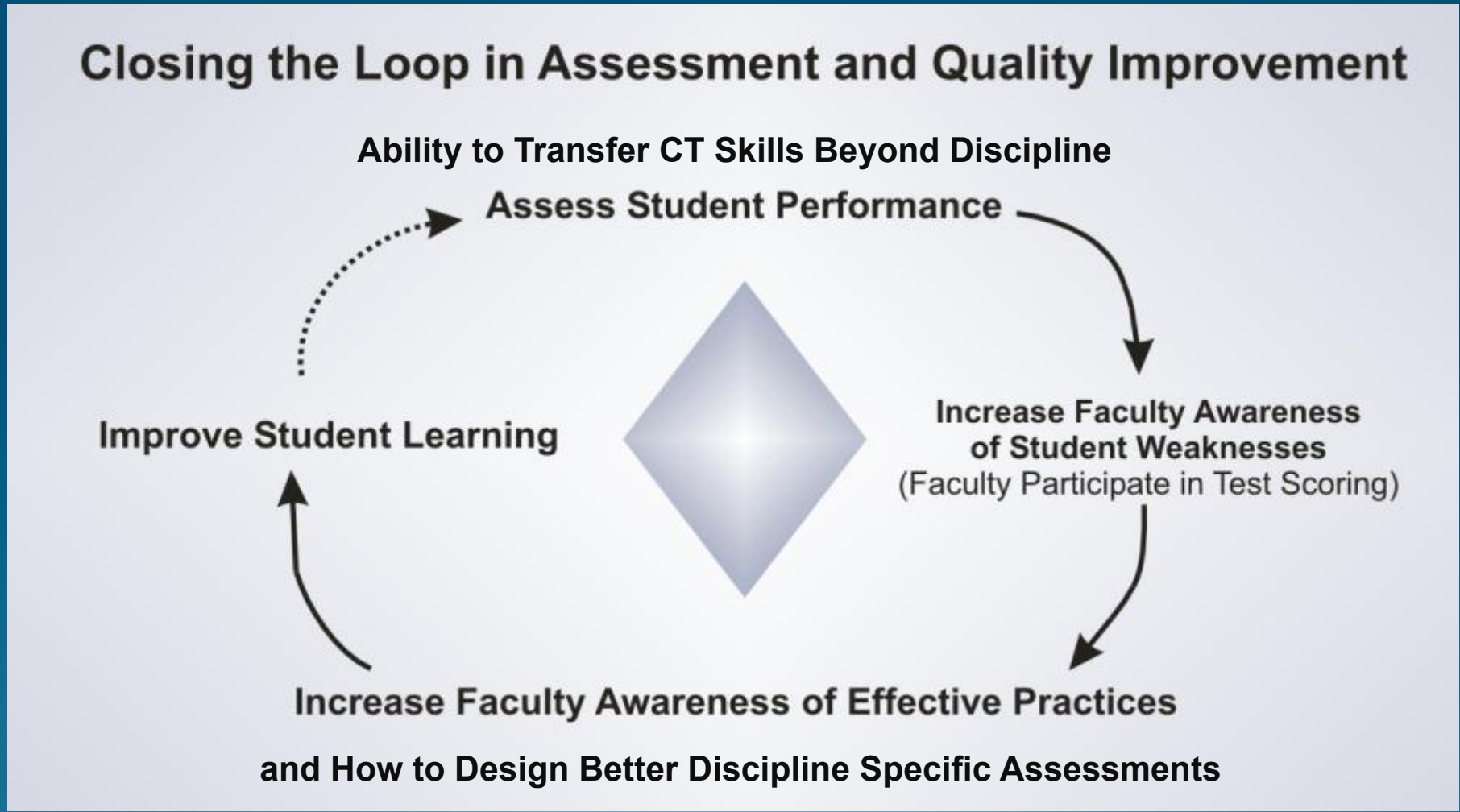
What kind of additional information or evidence would support the scientist's theory?

_____

# Assessment Uses of CAT



# Closing the Loop in Assessment and Quality Improvement



# Engaging Critical Thinking To Change Faculty Minds

*(Northwestern University* **with** *City Colleges of Chicago)*

## Overview

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

**DUE-0942404**

# 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.

# Hypotheses

**Primary Hypotheses:**

**Compared to faculty in standard faculty development programs, faculty who engage in inquiry into their student's learning will make greater changes in their:**

**A) conceptions of teaching**

**B) approaches to teaching critical thinking**

**i.e. they will move from a focus on transmitting content to changing student conceptions**

**Secondary Hypothesis**

**Student gains on the CAT will be larger when faculty introduce activities to enhance critical thinking**

**i.e. post-program gains will be greater than baseline gains**

# Theoretical Rationale

## Faculty Approaches to Teaching:

Research[1] suggests three hierarchically-related categories of Faculty approach (and related conceptions of) to teaching:

- *Transmission* (teacher centered)
- *Acquisition* (student centered)
- *Conceptual Change* (learning centered)

The third is correlated with deeper learning outcomes[1,2]

## Faculty Change in Approach to Teaching

Further research[2] has indicated that faculty change to the third category through faculty development programs is more problematic.

(1. Prosser & Trigwell 1999, 2. Light & Calkins 2008)

# 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

**Summer — Year 1 — Fall & Winter** **Summer — Year 2 — Fall & Winter**

**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

**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

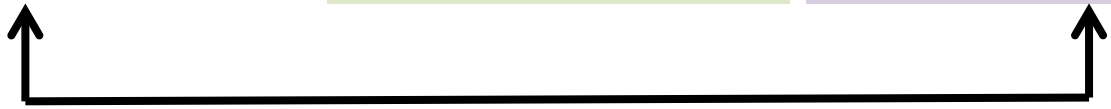
**Intervention**
Faculty review CAT & course specific assessment data

Faculty participate in interactive workshops on critical thinking pedagogy

Faculty develop plans to enhance students' critical thinking

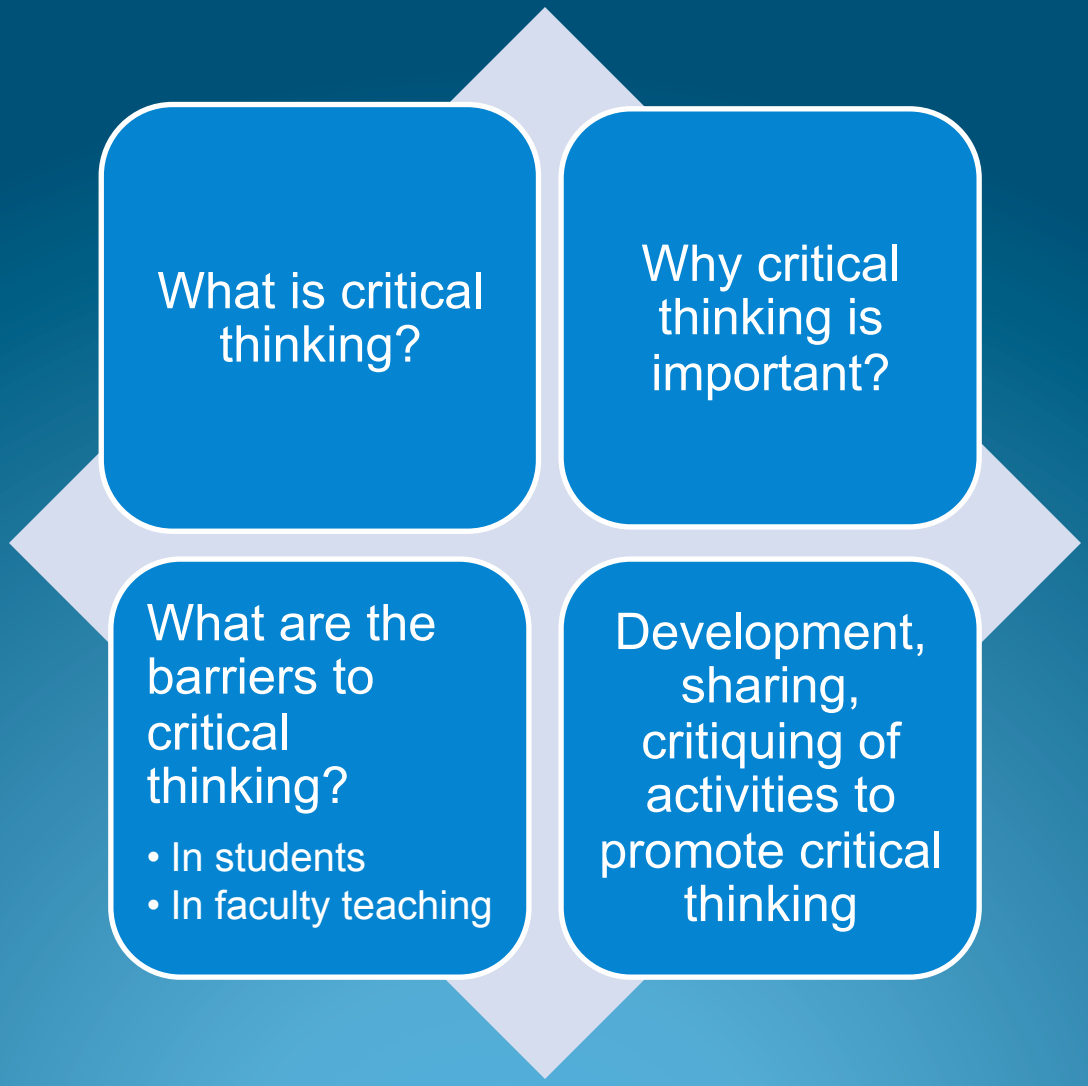
**Post**
Faculty make changes to their teaching

CAT test & course specific assessments administered pre & post course



**Year 2 Spring:** Compare: student learning gains; faculty teaching practices; faculty approaches to teaching; faculty conceptions of critical thinking & assessment

# Critical Thinking Workshops



# Study Measures

## Faculty

- Approaches to Teaching Inventory (ATI) (Trigwell, Prosser & Ginns. 2005)
- Conceptions of Assessment Survey (Brown 2002)
- Interviews
- Observation of teaching practice
- Reported changes in teaching of critical thinking
- Syllabus analysis

## Students

- CAT
- Course specific analogs

# 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

# CAT Findings: Student Gains in Critical Thinking

- Very preliminary results – still collecting the final data from one third of the courses
- Interpretation of the results will include looking closely at activities with respect to particular critical skills.
- **A Case Illustration**

# 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

# Instructor Comments on Activities

*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.

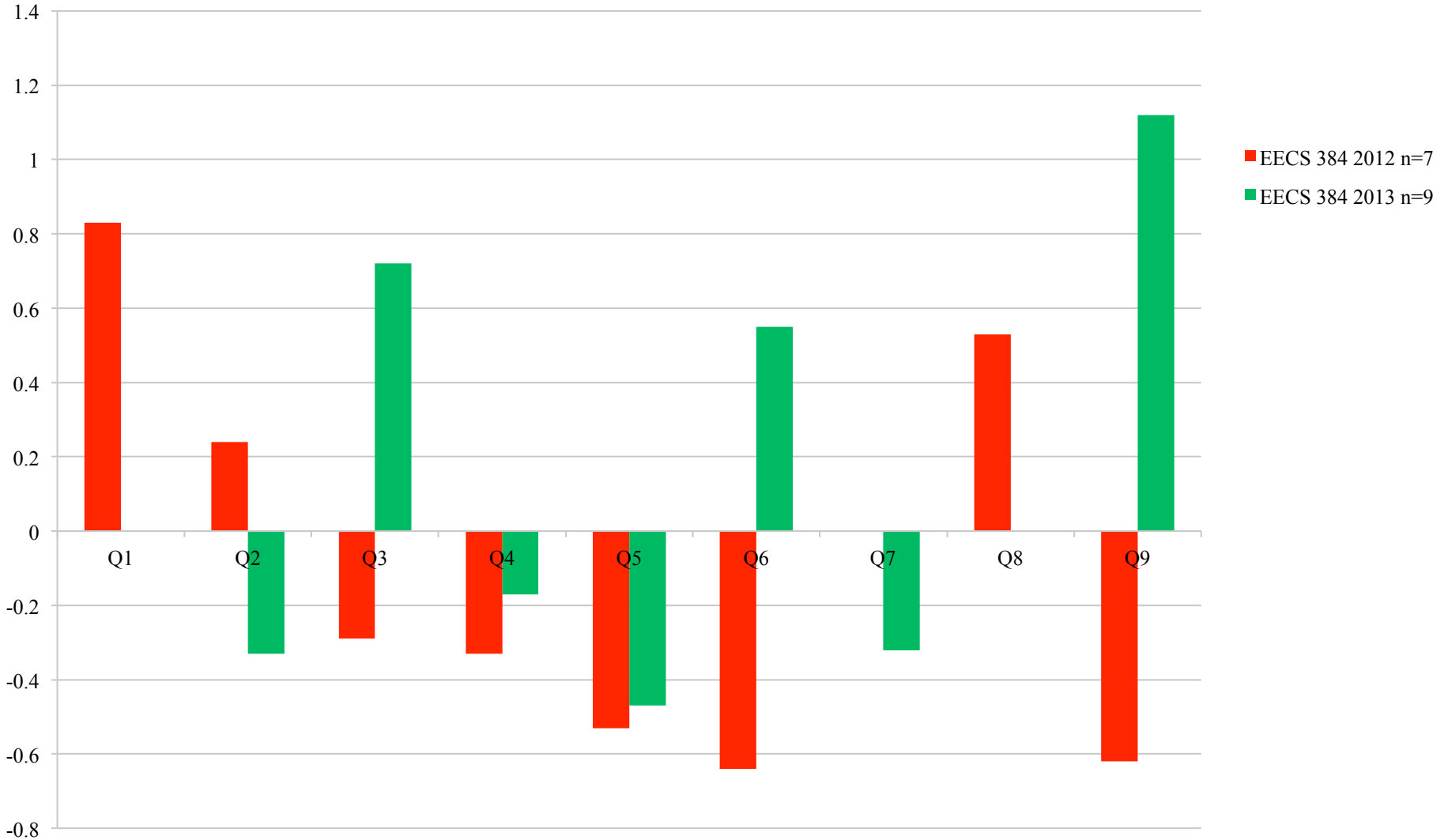
**Learn to present, defend, and evaluate critical responses**

#9 Provide relevant alternative interpretations of information.

# Case Study: Learning Outcomes in terms of CAT Skill Areas and CAT Question

| **Learning Outcomes** | ***CAT Skill Areas*** | | | |
|---|---|---|---|---|
| | Evaluate/ interpret info | Problem Solving | Creative Thinking | Effective Communication |
| Dynamic group thinking skills | 2, 5 | 4,7 | 4,7 | 2, 4, 7 |
| Develop awareness of multiple perspectives | | | | |
| Present, defend, evaluate critical responses | | | 9 | 9 |
| Critical skills with different team partners | | | 3,6 | 3,6 |

# Results: Student Gains in Critical Thinking



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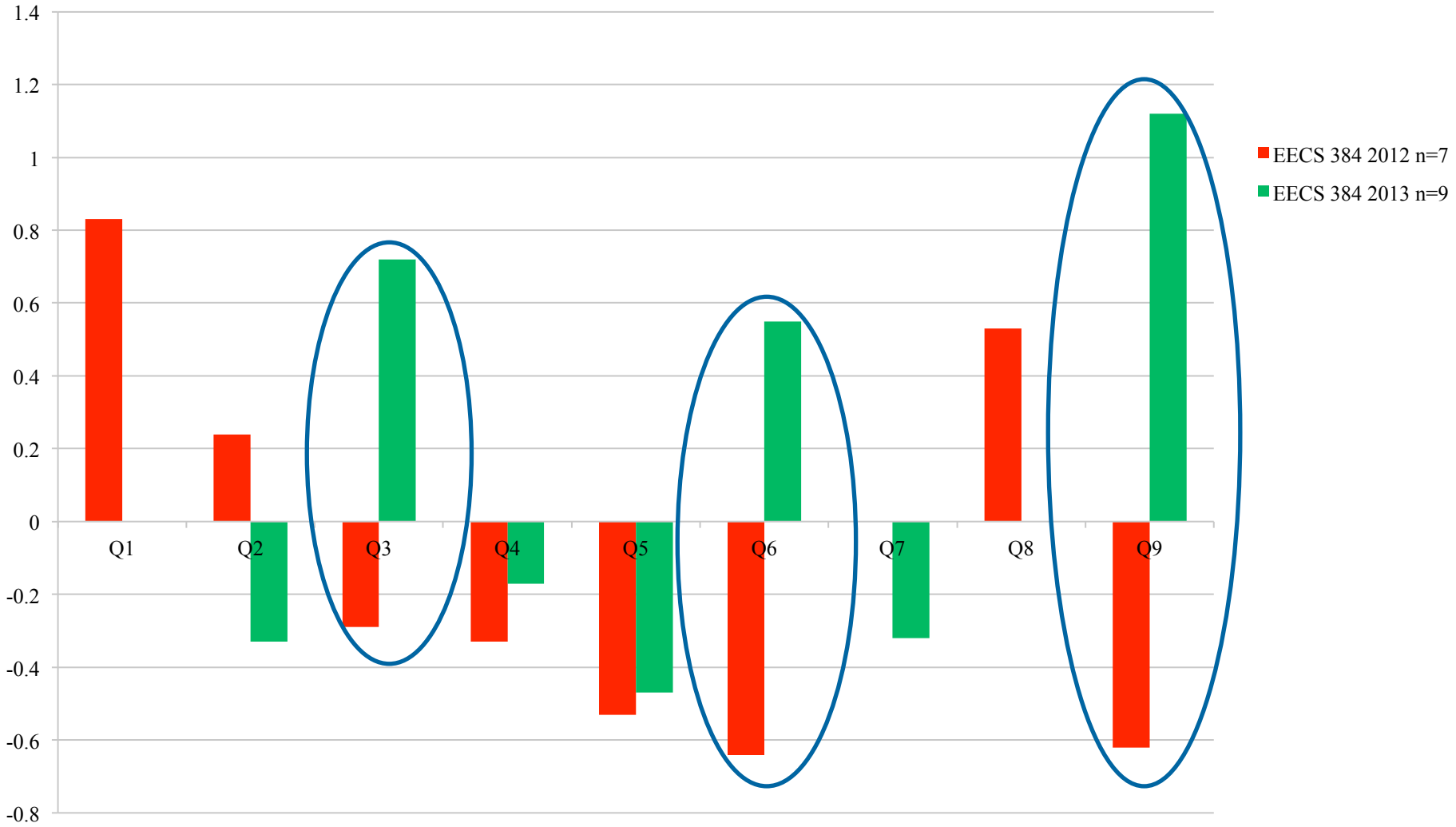

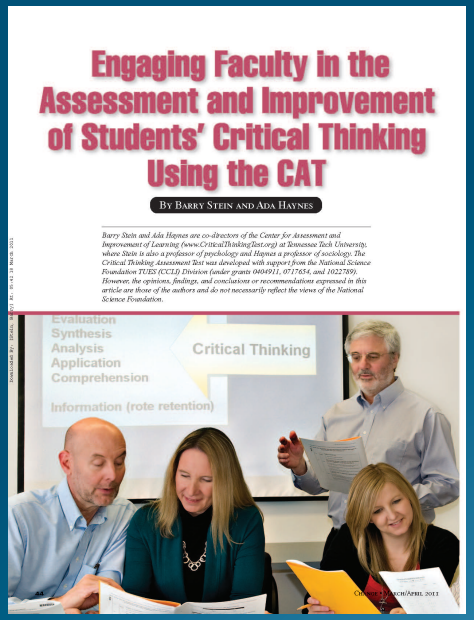


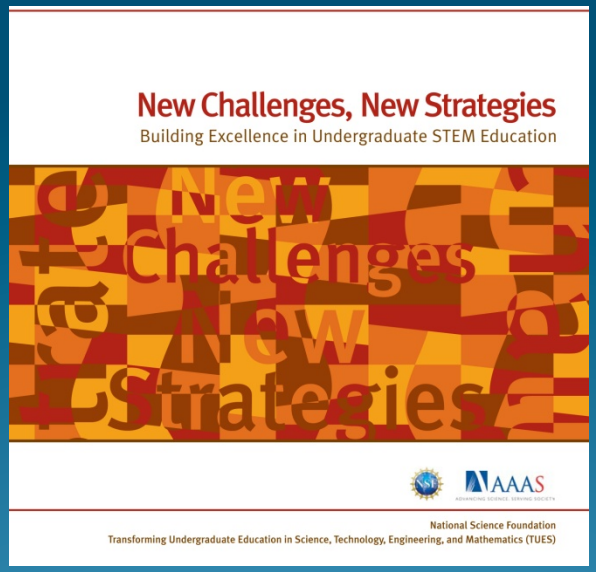


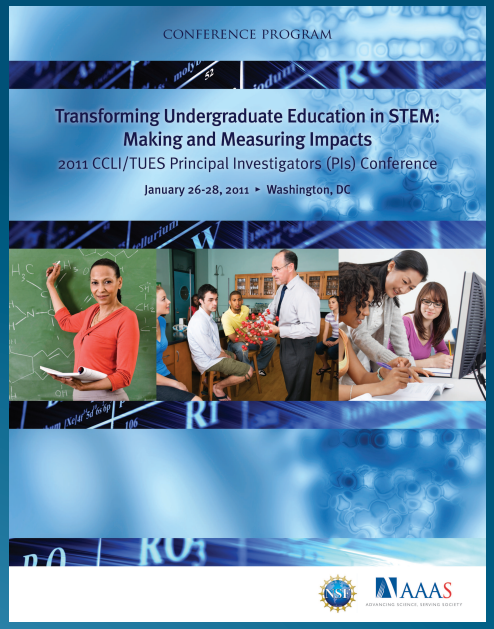


# www.CriticalThinkingTest.org

&

# www.Northwestern.edu/searle/programs/facultyprograms/CTSI_program.html

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