# Teaching that Produces Learning: Best Practices Backed by Research

*New Mexico EPSCOR Faculty Leadership Program*

*January 4, 2012*

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Getting into a teaching and learning frame of mind…

*Go to page 1*: Reflect and Choose one quote of particular interest. Join with a colleague and share why this quote is of particular interest to you.

On/Off

On/Off

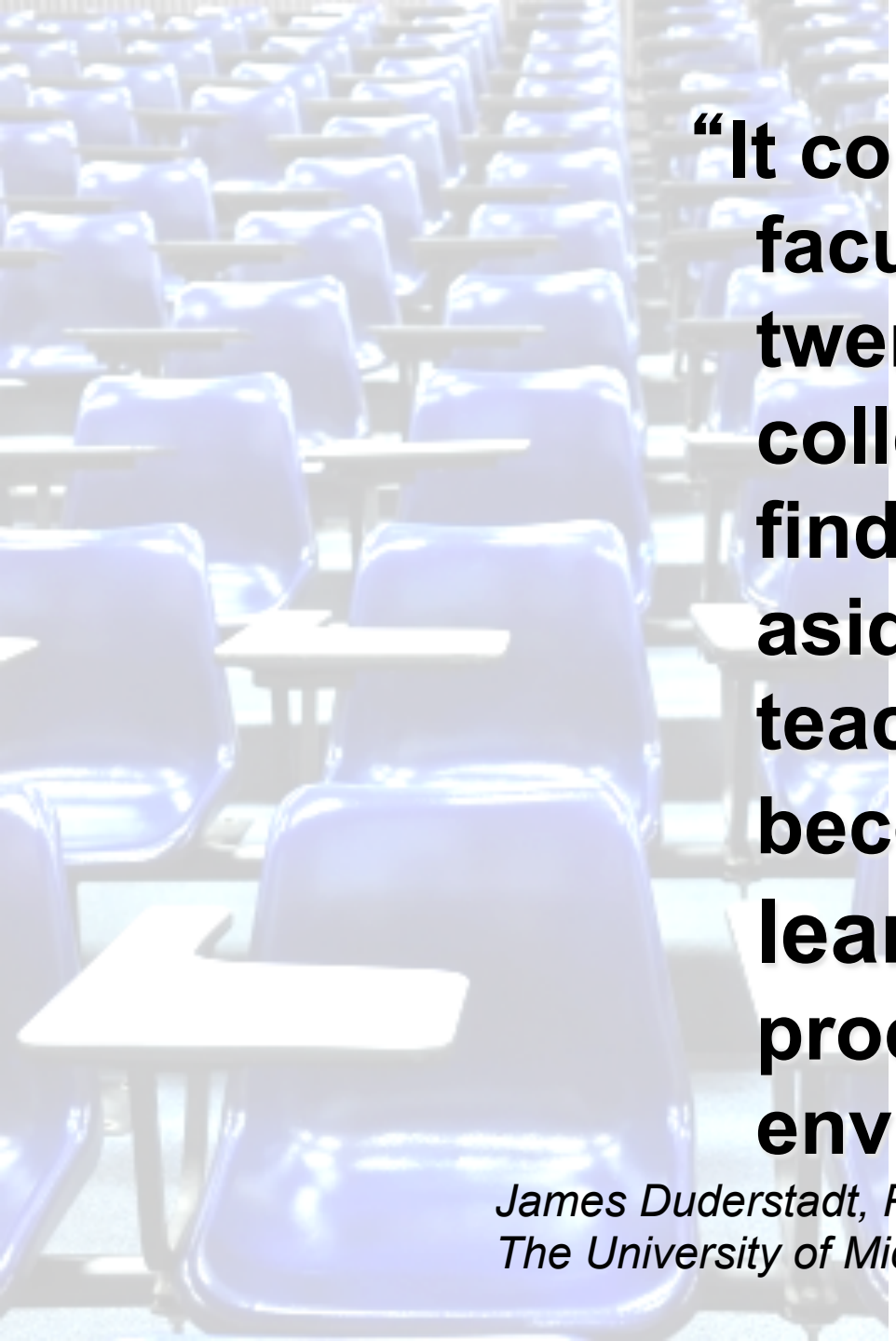

React to these two statements using the response choices provided.

1. An effective teacher focuses on knowing the material, being well prepared and organized, and presenting the material clearly.
2. An effective teacher focuses on how well the students are learning, asking questions that probe student understanding, and building student confidence in their learning.

   A. Statement 1 is much closer to my perception of teaching than Statement 2
   B. Statement 2 is much closer to my perception of teaching than Statement 1
   C. Statements 1 and 2 are equally close to my perception of teaching

**“It dawned on me about two weeks into the first year that it was not teaching that was taking place in the classroom, but learning.”**

*Pop star Sting, reflecting upon his early career as a teacher*



**"It could well be that faculty members of the twenty-first century college or university will find it necessary to set aside their roles as teachers and instead become designers of learning experiences, processes, and environments."**

*James Duderstadt, President Emeritus,*
*The University of Michigan*

# Teaching that Produces Learning: Best Practices Backed by Research

Objective:

Participants will be able to place future teaching and course design into a framework that is defined by research into how learning works.

Learning through active and reflective engagement with ideas, not “covering content.”


My abilities and perceptions of how to be an effective teacher are *mostly* based on:

A. My past experiences as a teacher or graduate teaching assistant
B. How I have been taught and the courses/ instructors that I liked the most
C. An understanding of what research demonstrates about the approaches to teaching that generate learning


# What are our teaching/learning goals?

Think about your past experience as a teacher ***or*** your evolving view of what your future teaching will be like.

How do you see your ***primary*** role as a teacher? Although more than one statement may apply to your course, please select ONLY ONE.

A. Teaching students facts and principles of the subject matter
B. Providing a role model for students
C. Helping students develop higher-order thinking skills (application, analysis, synthesis, evaluation)
D. Preparing students for jobs/careers
E. Helping students develop basic learning skills

# What are our teaching/learning goals?

A. Teaching students facts and principles of the subject matter

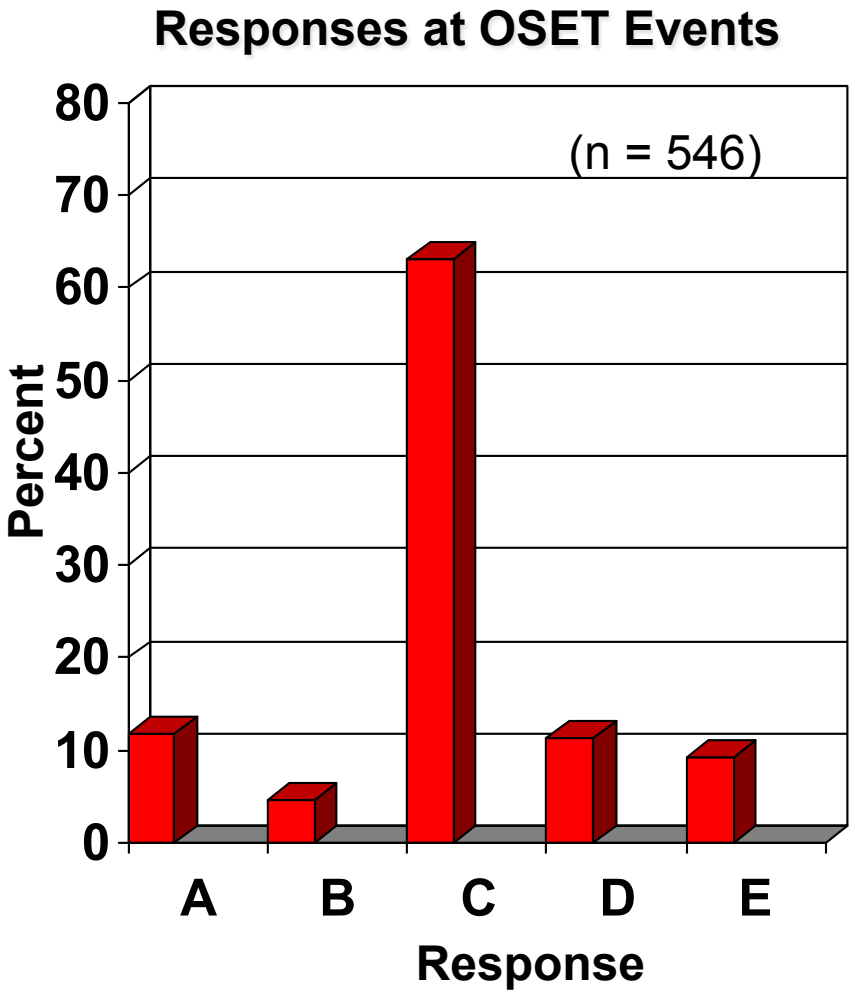
B. Providing a role model for students

C. **Helping students develop higher-order thinking skills (application, analysis, synthesis, evaluation)**

D. Preparing students for jobs/careers

E. Helping students develop basic learning skills

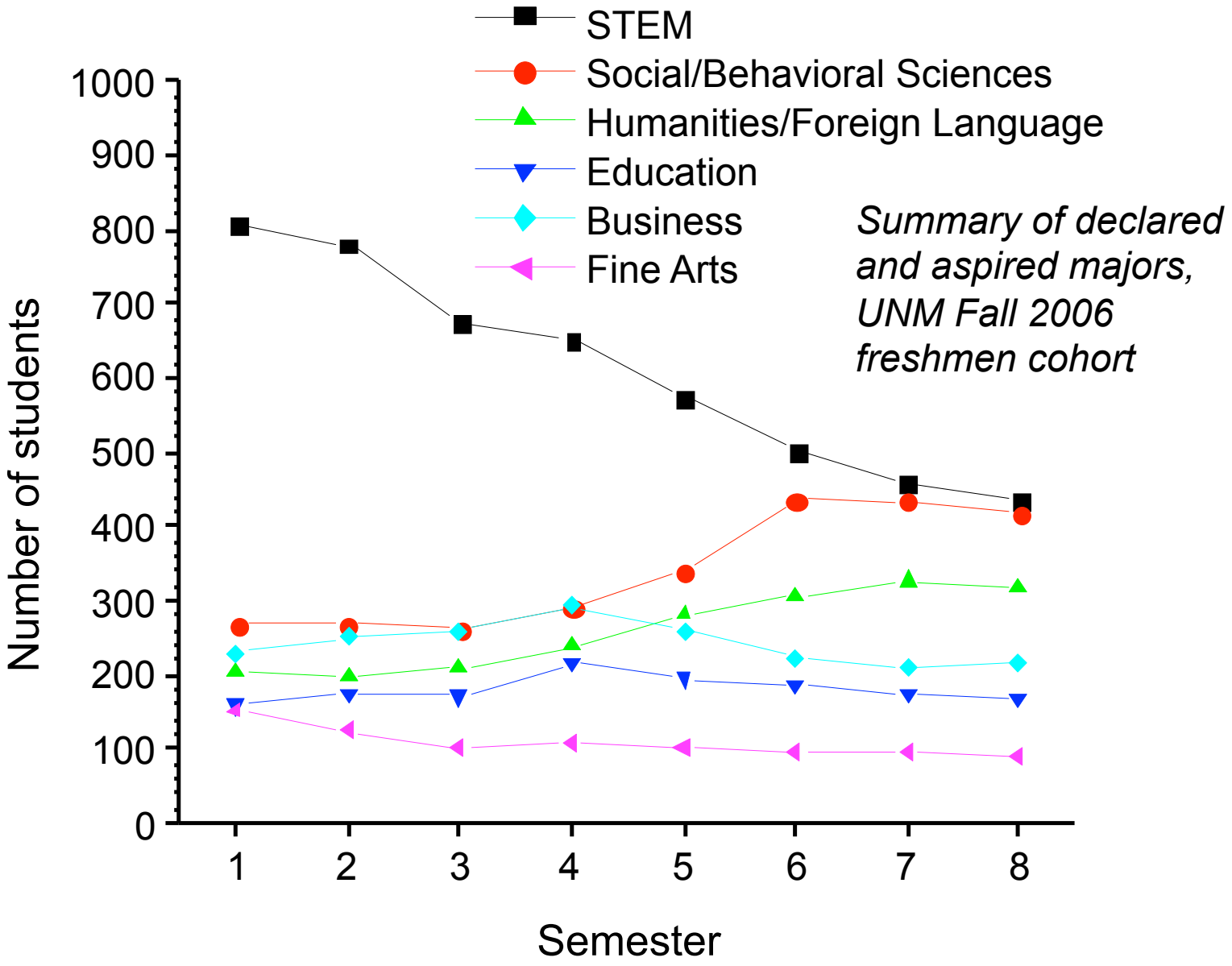
**Analytical (critical), practical, and creative thinking**




In your current faculty position, which one of these roles do you consider to be *most* important.

A. Teaching and mentoring undergraduate students
B. Teaching and mentoring graduate students
C. Conducting research and other scholarly work
D. Not applicable; I neither am in a faculty position nor aspire to have a faculty position.

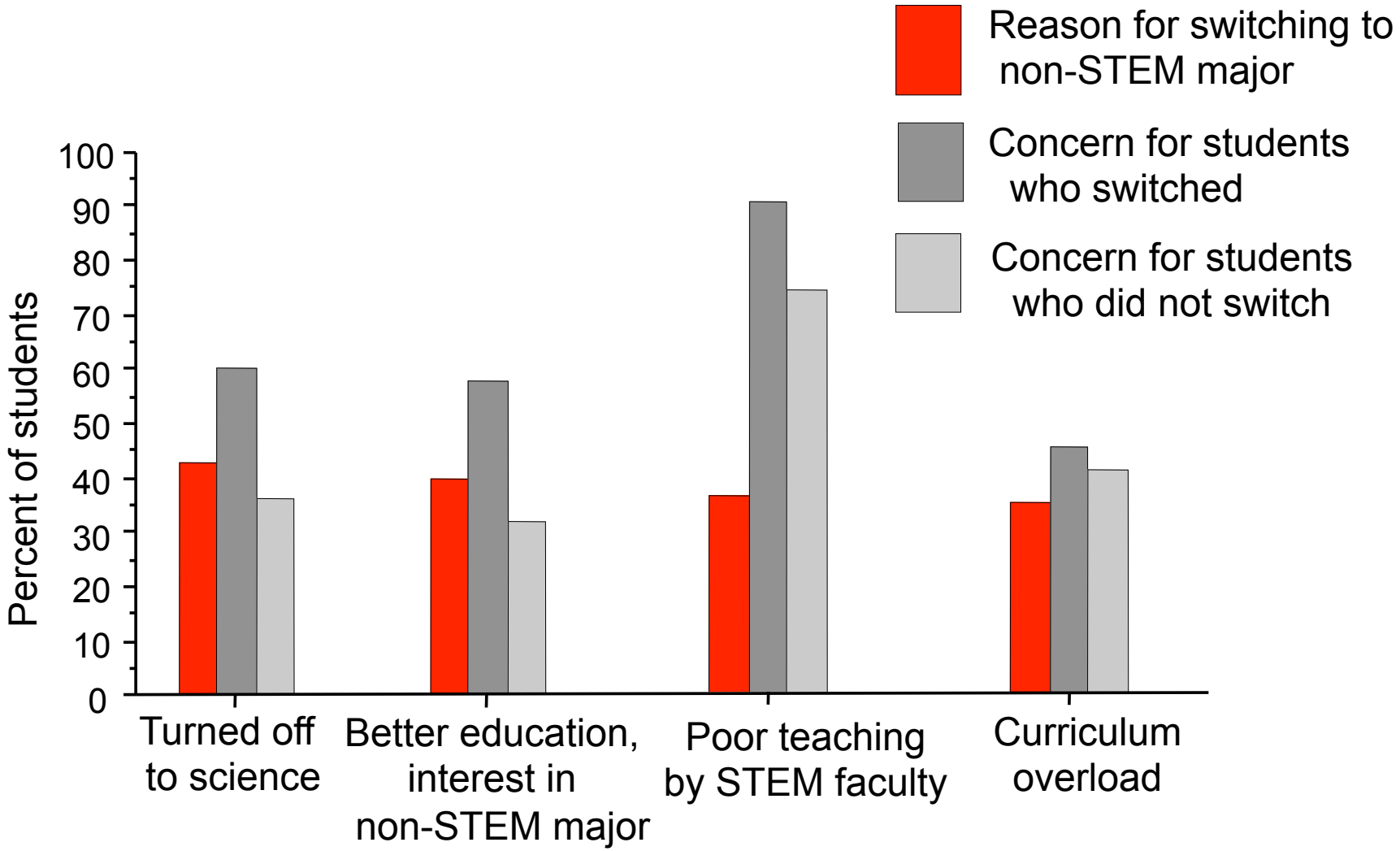
# STEM disciplines suffer the greatest undergraduate student attrition.




Which of these aspects of pursuing a STEM degree is of greatest concern to undergraduate STEM majors?

A. Tests in STEM courses are too hard.
B. Poor teaching in STEM courses
C. The rigor of STEM courses compared to non-STEM classes
D. Course curriculum for STEM degrees is overwhelming

# Teaching quality is the strongest concern of STEM majors. Faculty instructional and curricular choices are the reasons that students leave STEM majors.




(Seymour and Hewitt, 1997, *Talking About Leaving*)

# Instructional choices can be biased against some students.

"**It now appears that all traditionally taught college courses are markedly (though unintentionally) biased against many non-traditional students**, and, indeed, against most students who have not attended elite preparatory schools. Thus, when we teach merely in traditional ways we probably discriminate strongly on grounds quite different from those we intend. **Easily accessible changes in how we teach have been shown repeatedly to foster dramatic changes in student performance with no change in standards**."

C.E. Nelson, 1996, *American Behavioral Scientist*, 40(2):165

Resource: "Dysfunctional illusions of rigor…", p. 21

# What Does it Mean “to Learn?”

- What is your definition of “learning?”
- What is your definition of “teaching?”


# Example definitions of teaching and learning

- *"Learning is the stabilization, through repeated use, of certain appropriate and desirable synapses in the brain."*
- *"Teaching means any activity that has the conscious intention of, and potential for, facilitating learning in another person."*

R. Leamnson, 1999, *Thinking about teaching and learning*

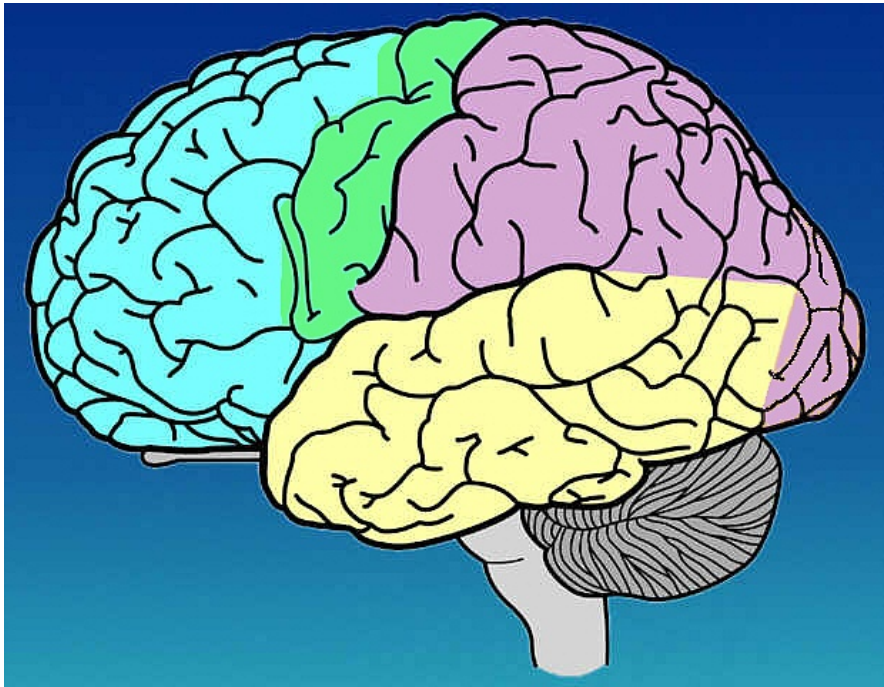
# Learning changes the physical structure of the brain.

"When we come to know something, we have performed an act that is as biological as when we digest something."

- Henry Plotkin

Learning requires thinking: Solving problems, reasoning, reading something complex, or doing any mental work that requires some effort so that information is manipulated in working memory.

Willingham, 2009



Learning is the ability to use information after significant periods of disuse

and

it the ability to use the information to solve problems that arise in a context different (if only slightly) from the context in which the information was originally taught.

(R. Bjork, *Memories and Metamemories*, 1994)

# How many types of learning are there?

***Auditory***

***Convergers***

***Competitive***

***Accommodating***

***Feeling***

***Sequential***

***Visual***

***Avoidant***

***Introverted***

***Abstract***

***Concrete***

***Extroverted***

***Reflective***

***Judgment***

***Kinestetic***

***Active***

***Perception***

***Participant***

***Assimilating***

***Thinking***

***Sensing***

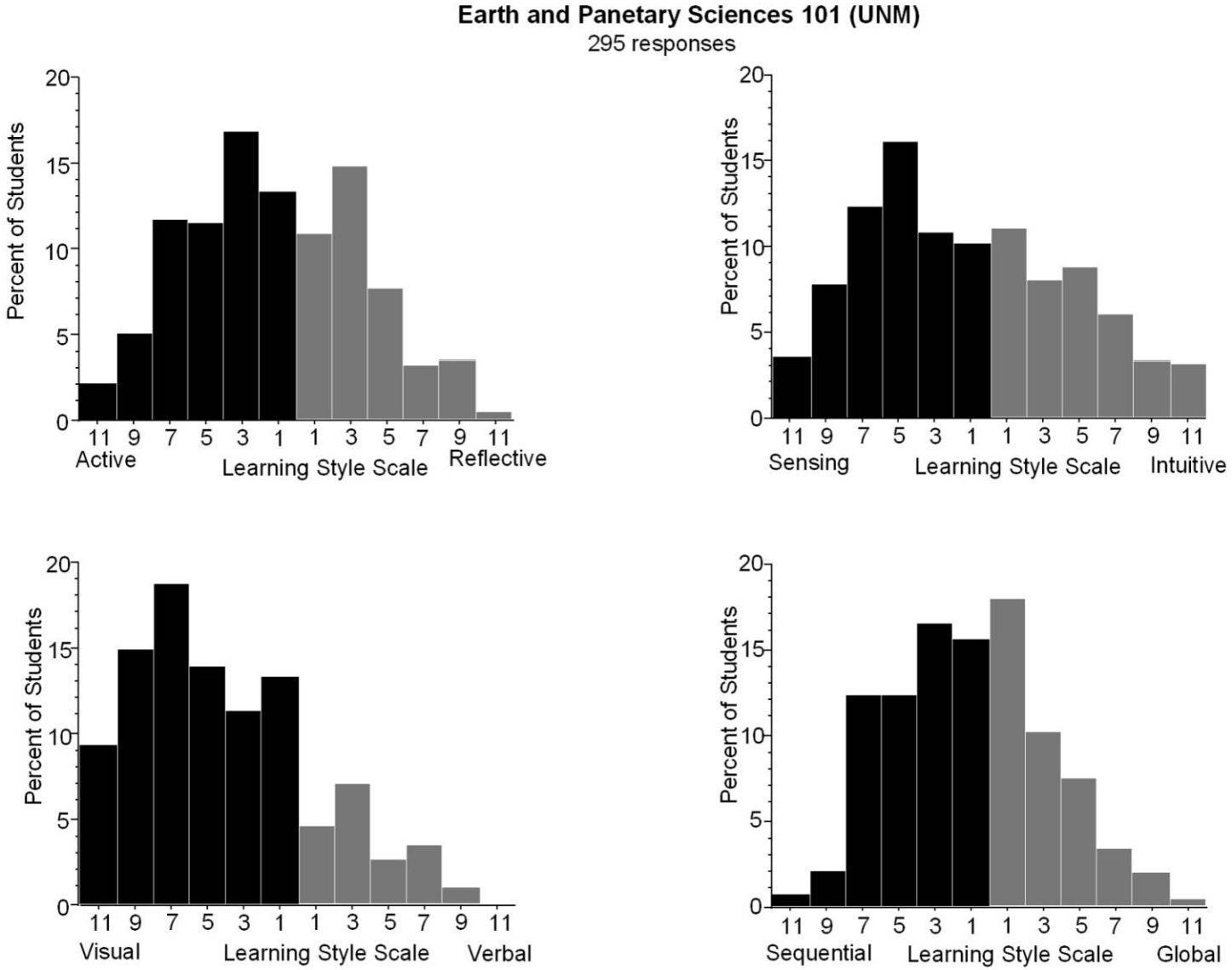
***Intuitive***

***Global***

***Collaborative***

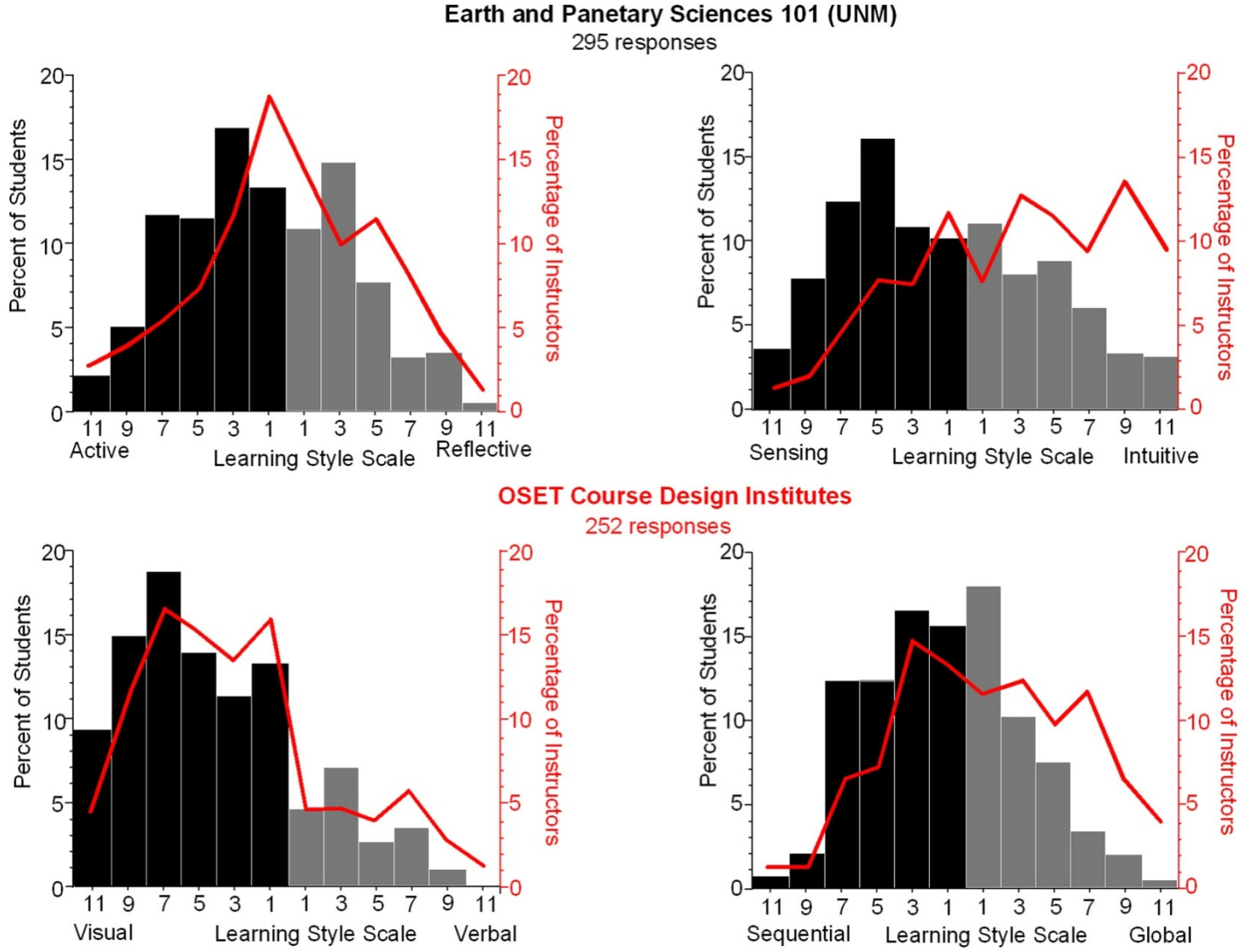
***Divergers***

# Felder-Silverman Index of Learning Styles




Data courtesy of Aurora Pun, UNM E&PS

# Felder-Silverman Index of Learning Styles




(p. 4 of the handout)

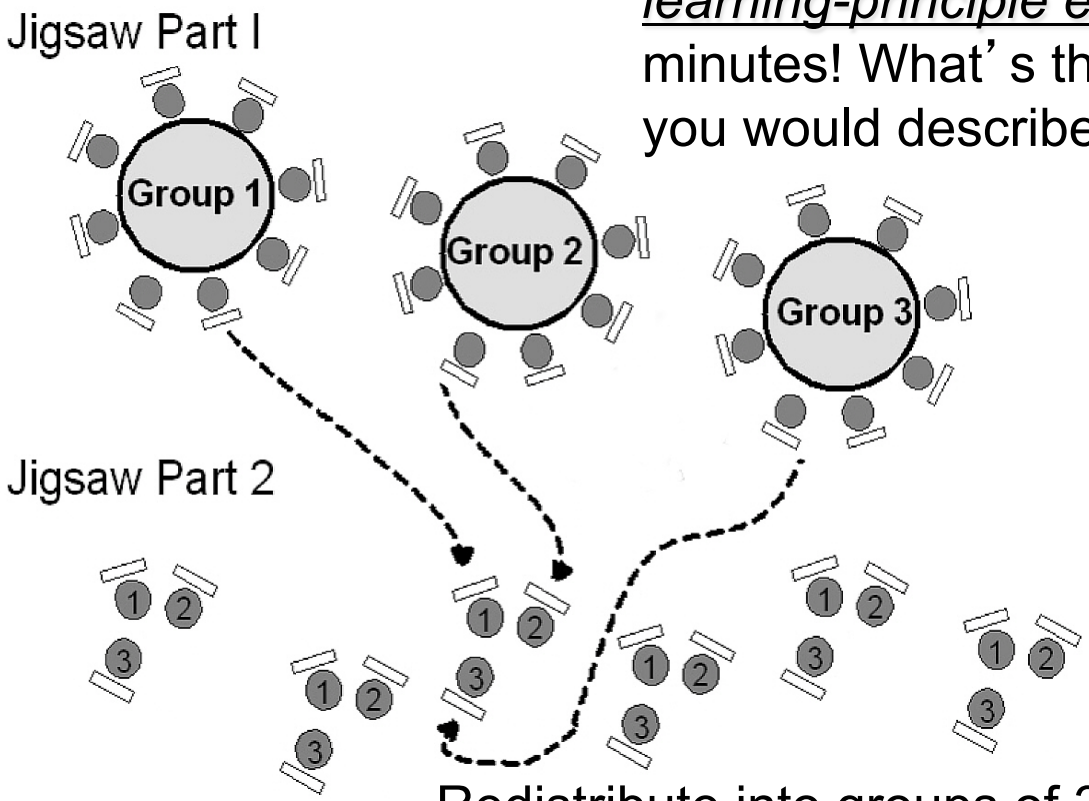
# Implications of learning-style diversity

- Your students may not learn the same way that you do.
- No single instructional approach produces learning equally for all of your students.

➢ Adopt multiple methods to enhance learning *and* to provide variety that maintains student interest.

# Jigsaw Discussion: Understanding the Three Core Learning Principles

Read and then discuss *your assigned learning-principle example only:* 10 minutes! What's the take-home point that you would describe to a colleague?




Redistribute into groups of 3, each person representing a different example. Spend 5 minutes each describing your example and its take-home point. How do the three examples relate to one another?

# Jigsaw Discussion: Understanding the Three Core Learning Principles

***How People Learn,* National Research Council, 2000**

Go to "Understanding the Three Core Learning Principles" on pages 6-9.

**Divide into 3 groups**, one group for each case study:

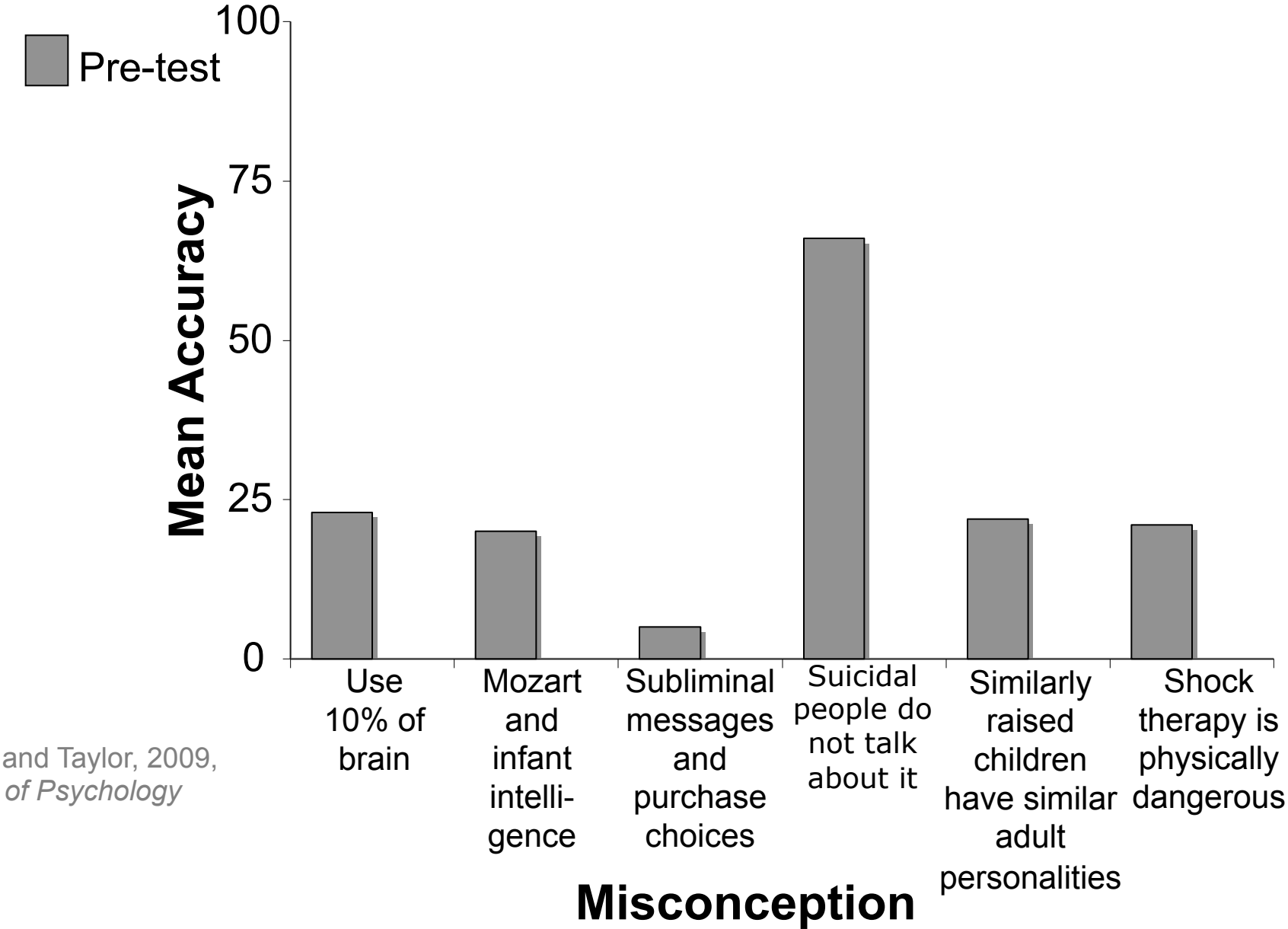
- **The Significance of What You're Sure You Know…"That Just Ain't So"** (p. 7)
- **Knowing What You Do And Do Not Know** (p. 8)
- **"Memory is What Thinking Does"** (p. 9)

Read and then discuss *your example only:* 10 minutes! What's the take-home point that you would describe to a colleague?

Redistribute into groups of 3, each person representing a different example. Spend 5 minutes each describing your example and its take-home point.

How do the three examples relate to one another?

# The significance of what you're sure you know…"that just ain't so."




Kowalski and Taylor, 2009, *Teaching of Psychology*

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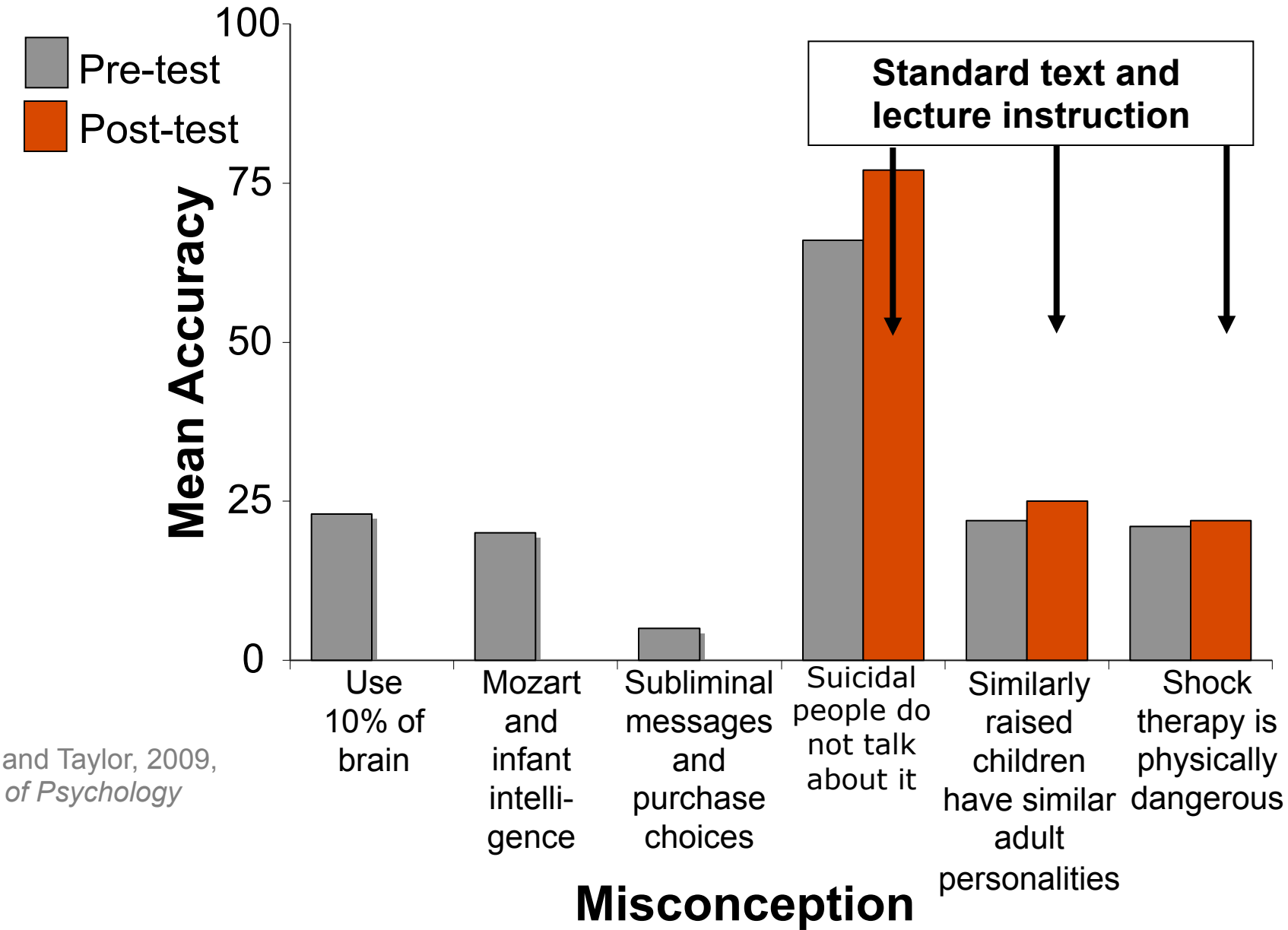


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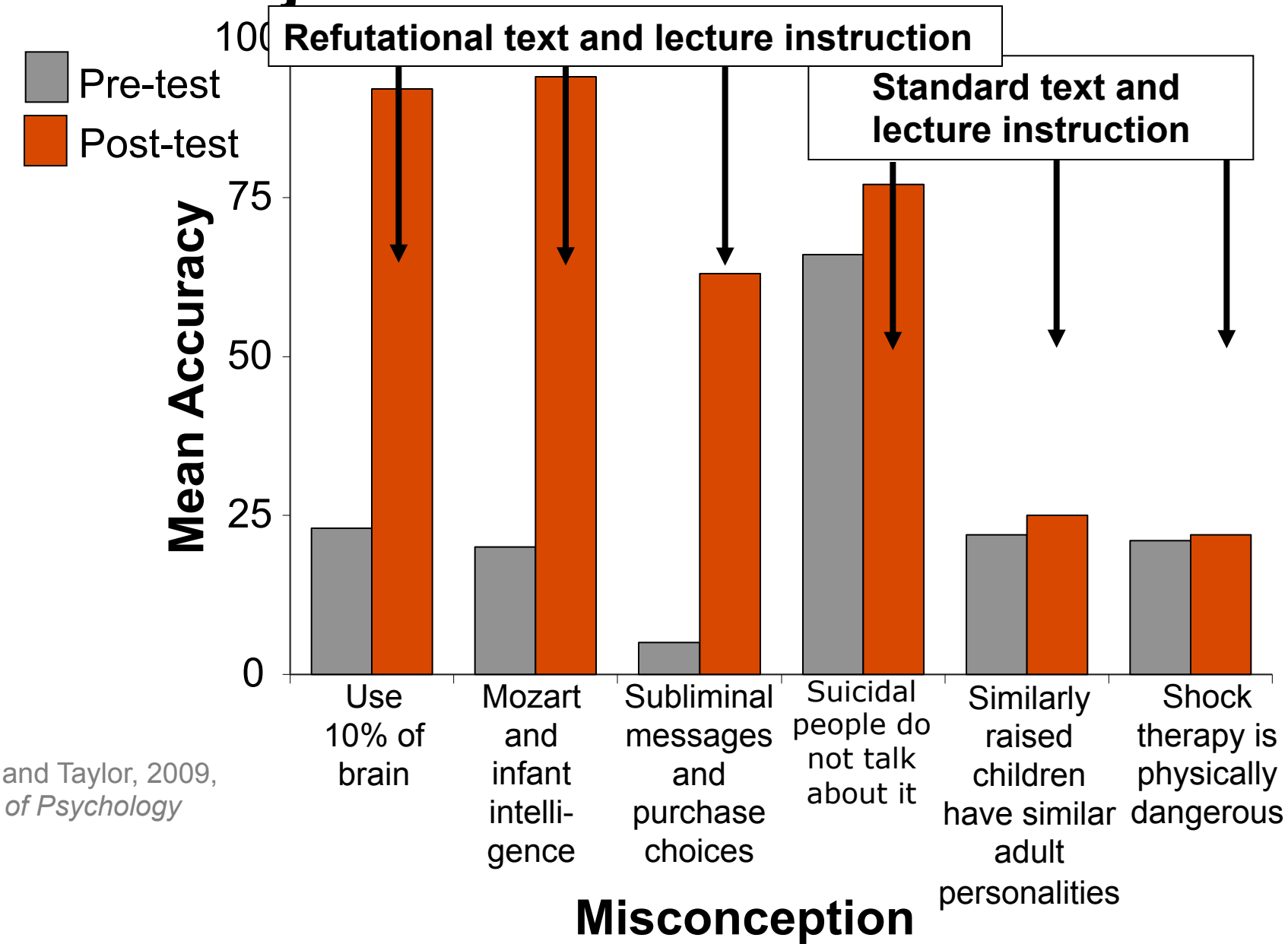


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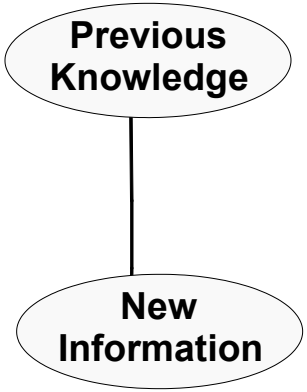
# Core learning principle #1: Knowledge is associative—it is linked to prior mental models and cognitive structures

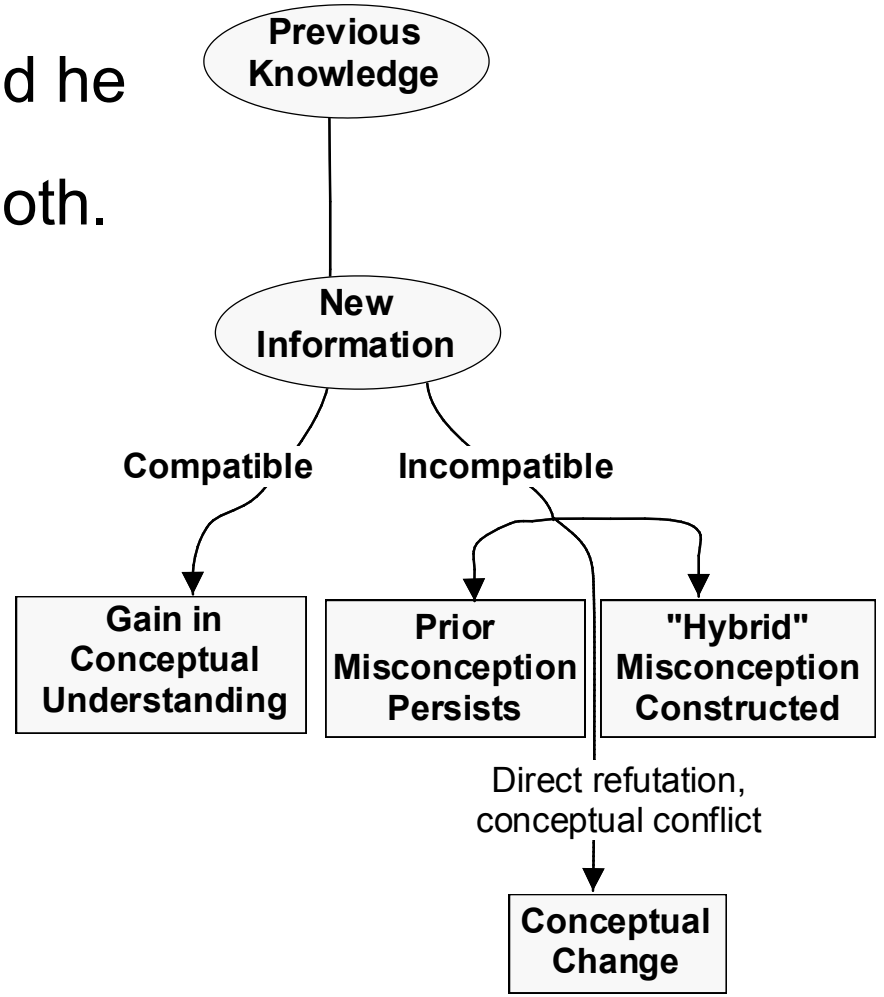



Teaching is not about pouring knowledge into the learners' empty brains

*How People Learn,* National Research Council, 2000

# Core learning principle #1: Knowledge is associative—it is linked to prior mental models and cognitive structures, and can include prior misconceptions.

If a learner's initial misunderstanding is not engaged he or she may fail to grasp new concepts, correct concepts, or both.



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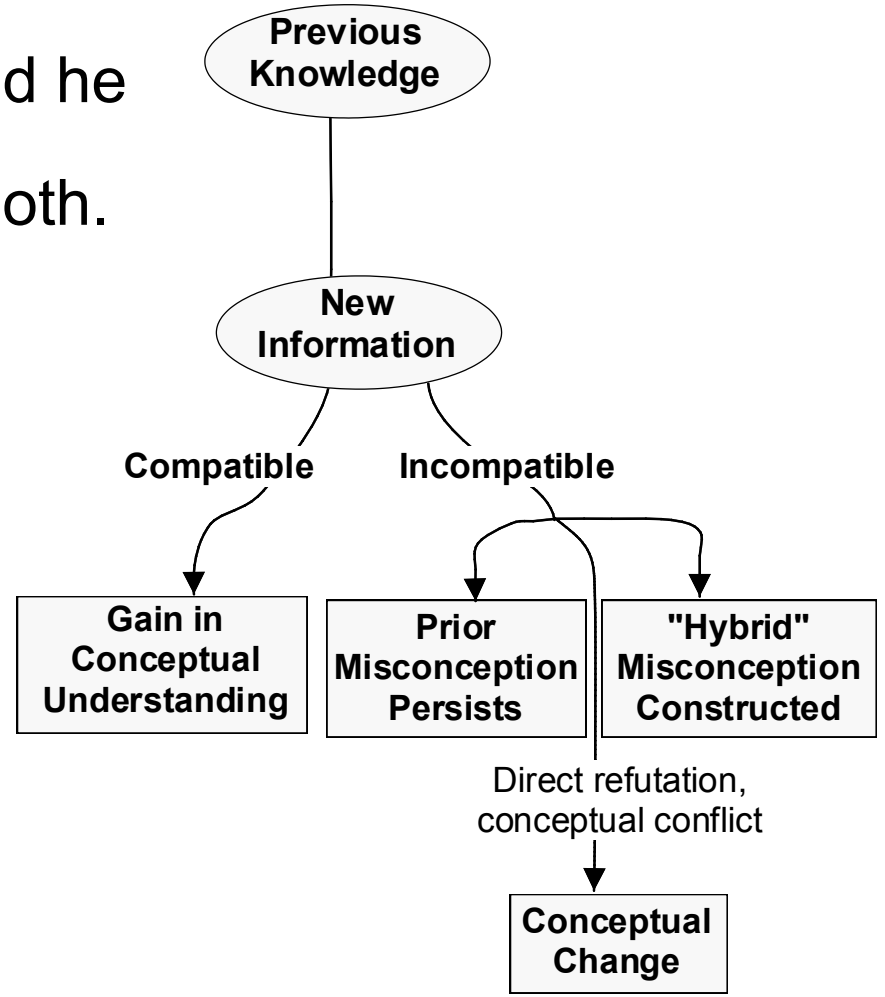
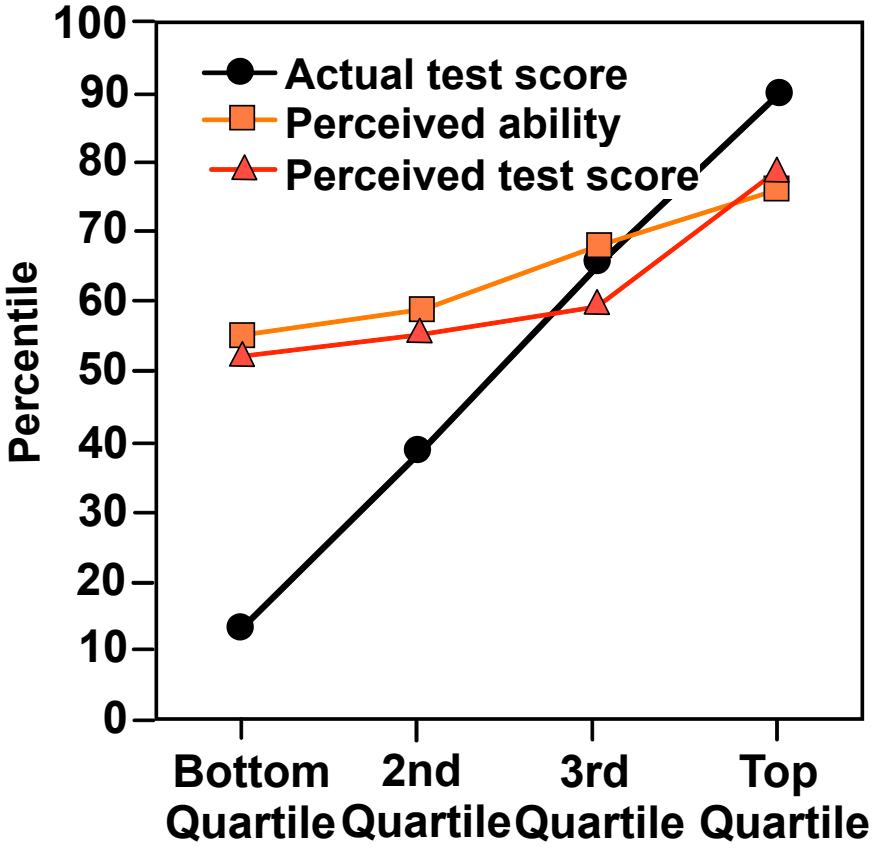


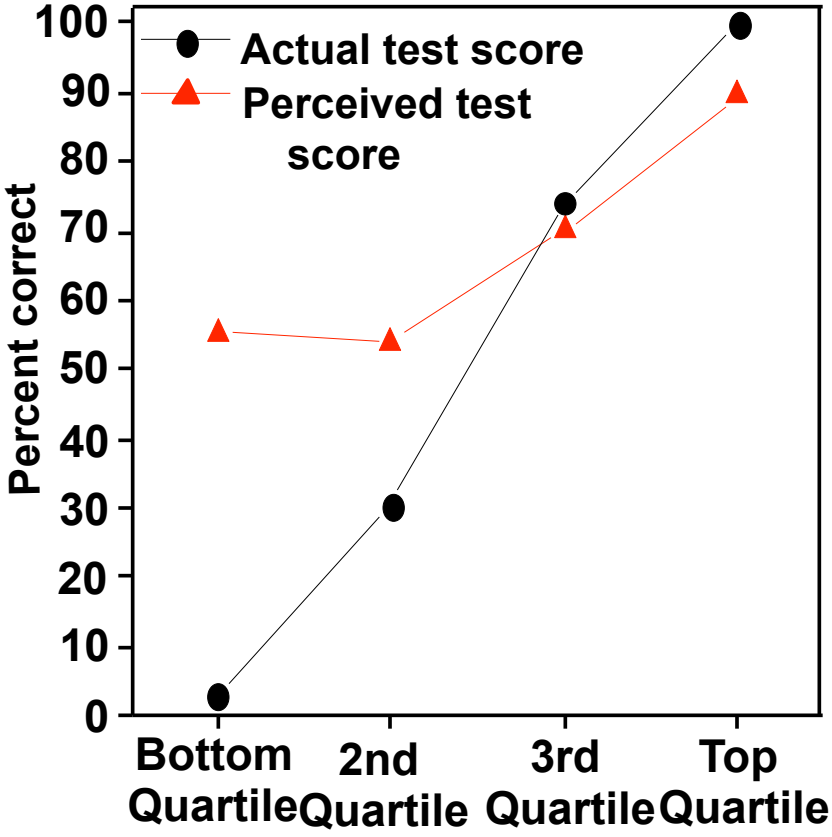

***"It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so."***

***-*** *Mark Twain*

# Knowing what you do and do not know.

High-performing students possess better *metacognition* than low-performing students.




(after Kruger and Dunning, 1999, *J. of Personality and Social Psychology*)

## Core principle #2: Learners must develop metacognition to take control of their own learning.

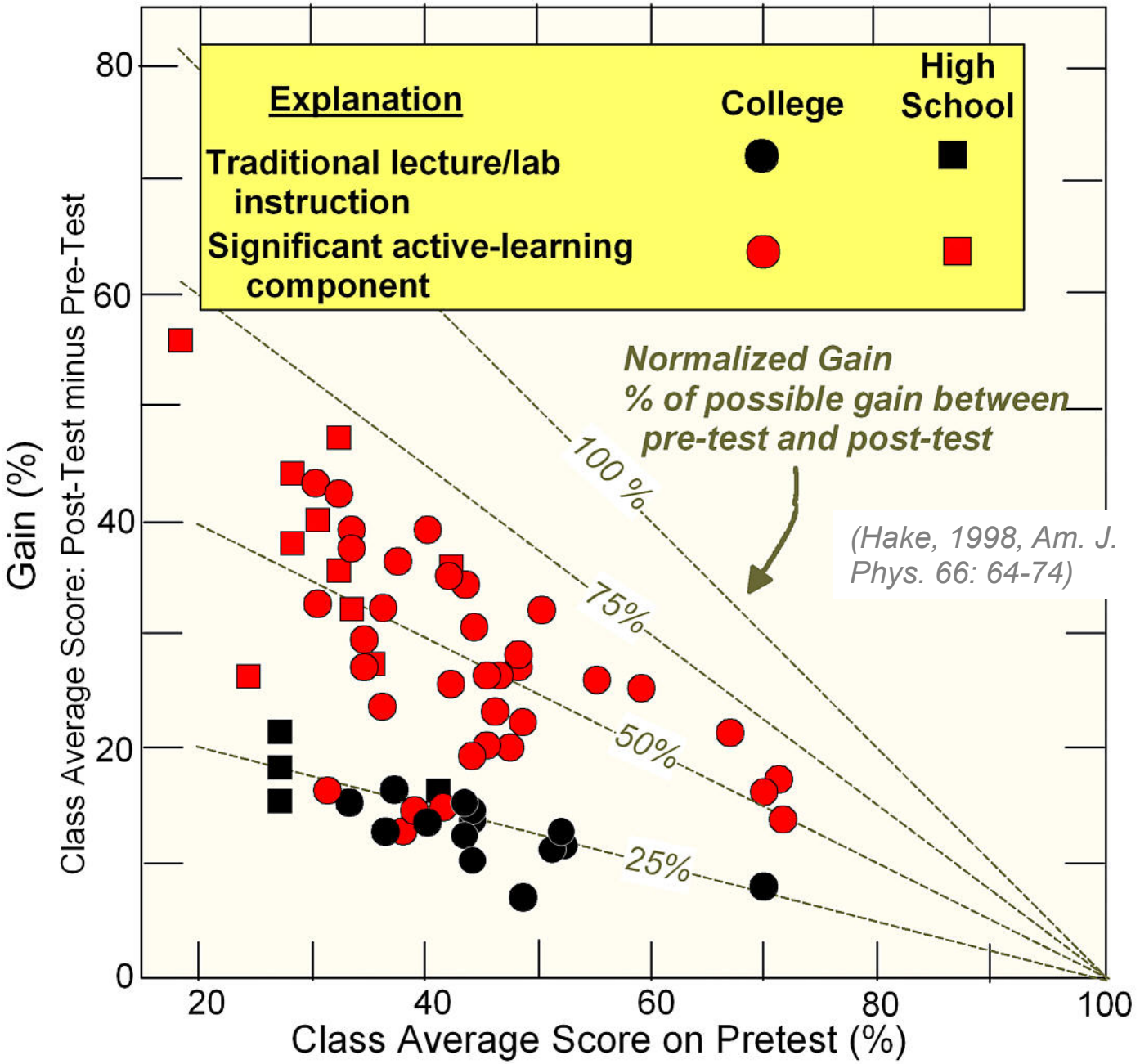
**Metacognition: Knowing what you do and do not know.**

Metacognition must be integrated into the curriculum by defining learning outcomes and providing opportunities for students to monitor their progress in achieving them.

*How People Learn,* National Research Council, 2000

# “Memory is what thinking does”

- Daniel Willingham



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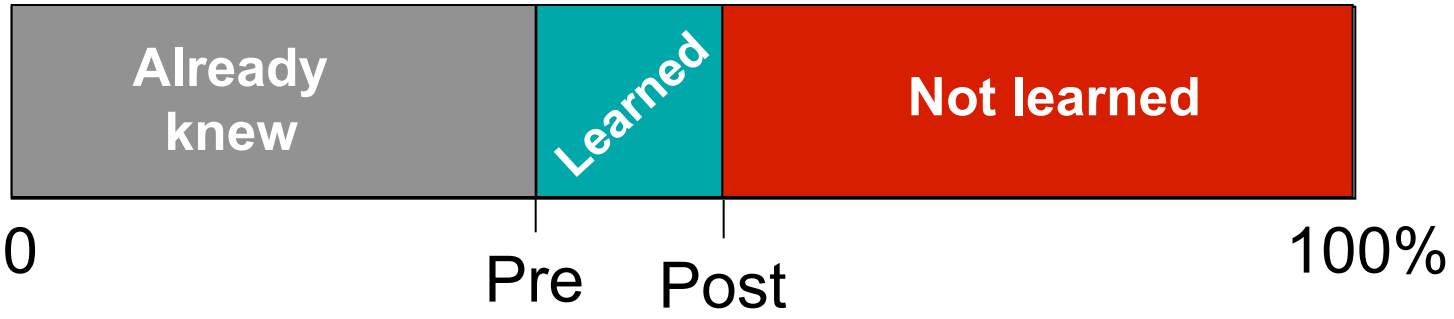
Example of learning in first-semester physics measured by pre and post testing with the Force Concept Inventory

62 classes, 6542 students; Hake, 1998, *Am. J. Phys*.

Traditional; lecture and demonstration classes



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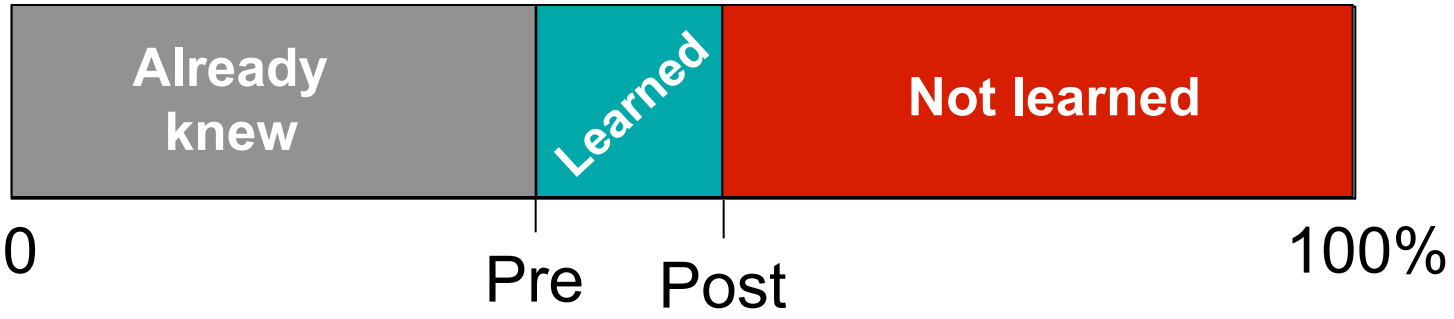
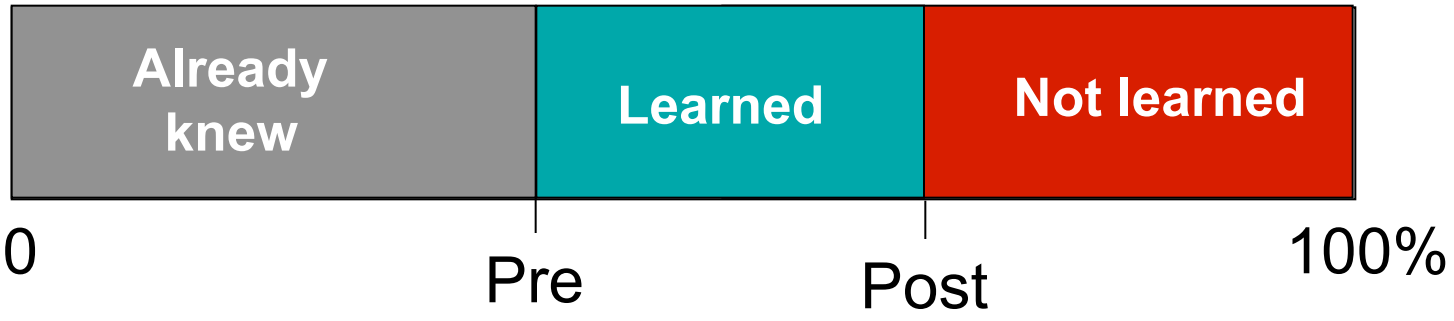



Interactive engagement classes



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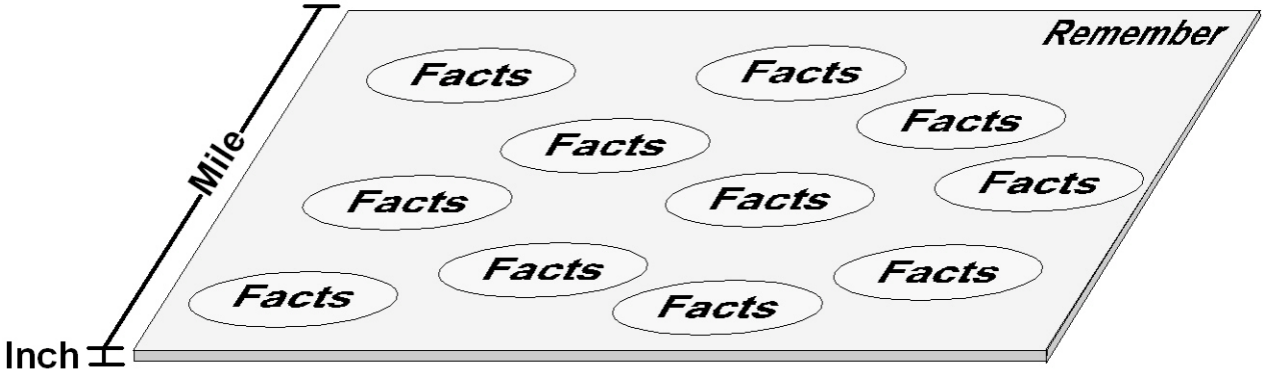
State of affairs: An emphasis on covering the content (especially in survey/introductory courses)

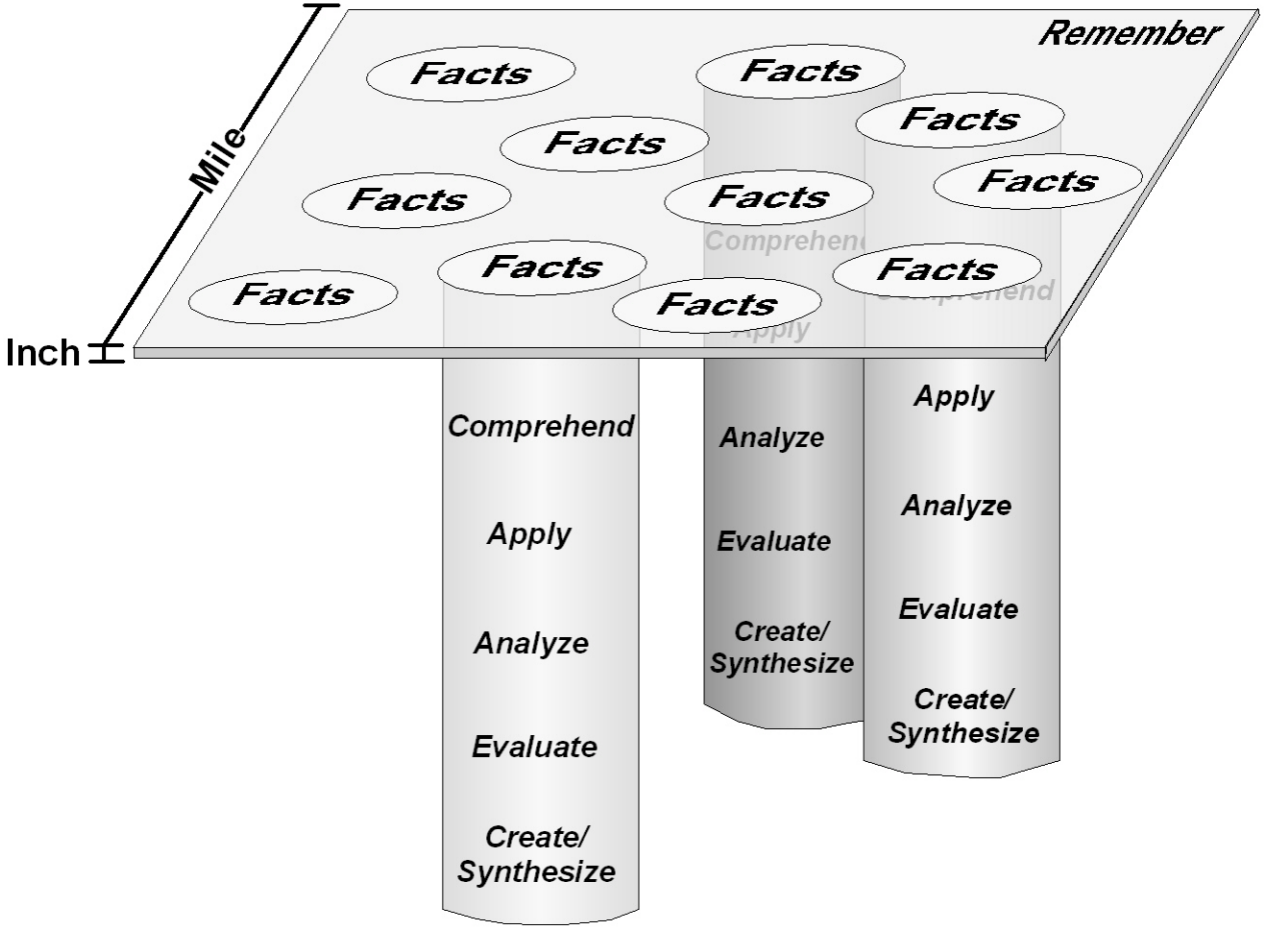



Instruction is typically teacher centered….

…and learners are typically passive.

# Core principle #3: To develop competence, learners must

a) have a deep foundation of factual knowledge
b) understand facts and ideas within a conceptual framework
c) organize knowledge for retrieval and application




*How People Learn,* National Research Council, 2000

## Core principle #3: To develop competence, learners must

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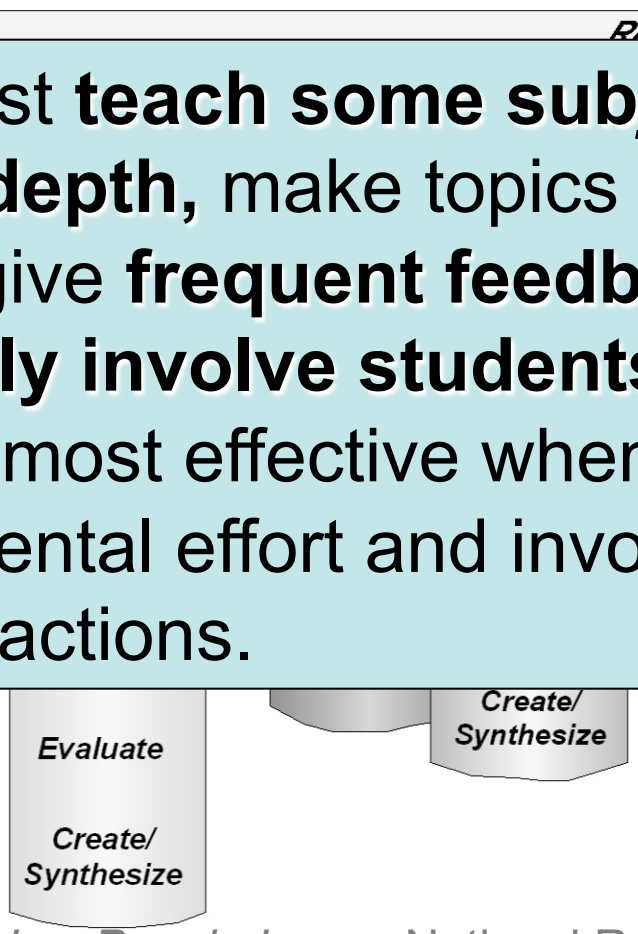
Teachers must **teach some subject matter in depth,** make topics **relevant**, give **frequent feedback**, and **actively involve students** — learning is most effective when it requires mental effort and involves social interactions.

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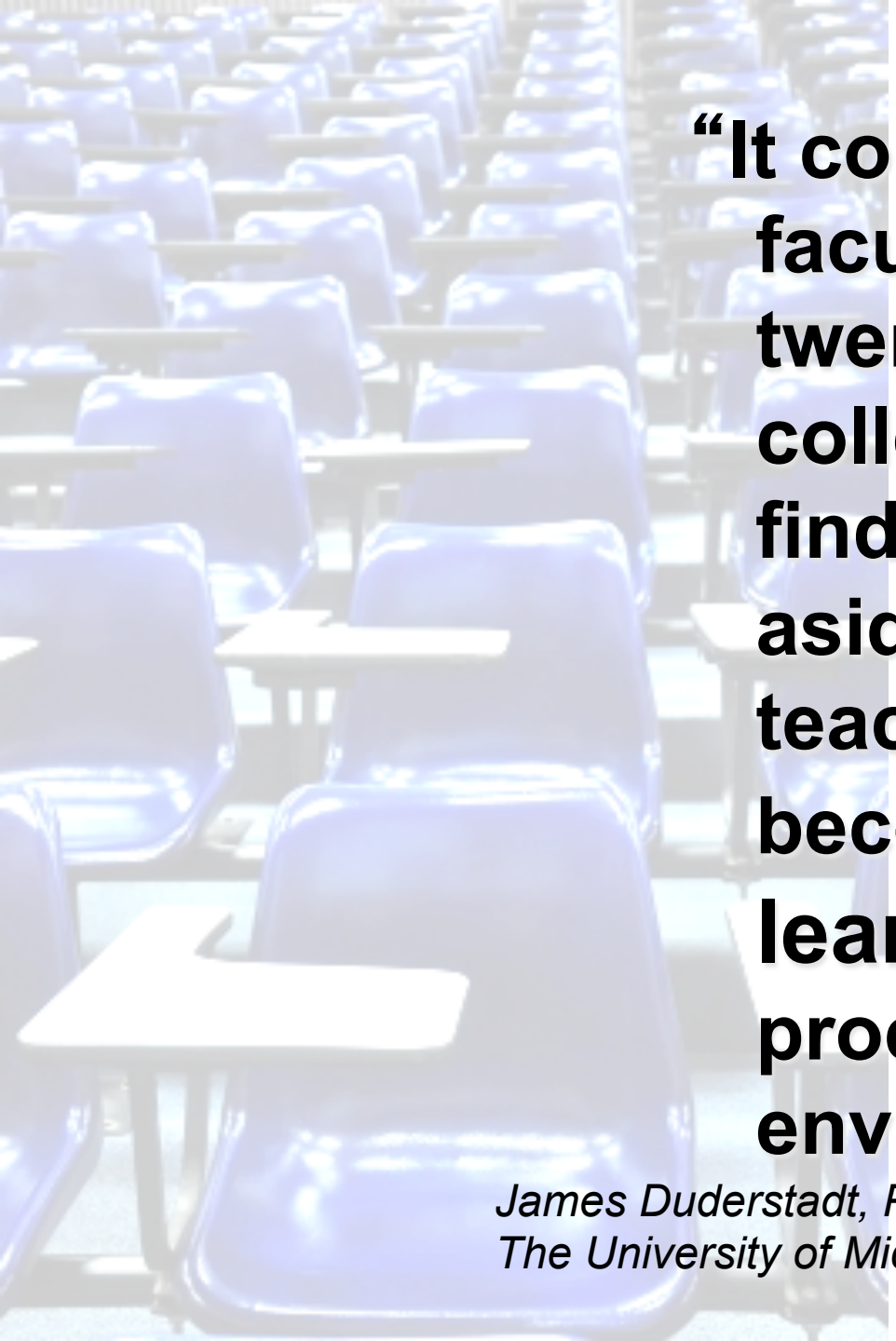

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# Most faculty teach as they were taught


What is the typical attention span of a college student while listening to a lecture?

A. 15 minutes
B. 30 minutes
C. 45 minutes
D. 60 minutes

# Studies show that student lecture audiences have short attention spans.

- After *10-20 minutes*, students' minds begin to wander and retention of information falls off dramatically.
- Taking notes and asking questions occupies only 49% of students' time during a lecture; the remainder is spent thinking about people, time, body, and fantasy.

# Studies show that student lecture audiences have short attention spans.

- 95% of students report being frequently or occasionally bored in class

- 38% of students report that they frequently or occasionally fall asleep in class.

2009 College Senior Survey, HERI

# Reflections of a Nobel laureate physics professor

“When I first taught physics as a young assistant professor, I used the approach that is all too common when someone is called upon to teach something. First I thought very hard about the topic and got it clear in my own mind. Then I explained it to my students so that they would understand it with the same clarity I had.

“At least that was the theory.

“But I am a devout believer in the experimental method, so I always measure results.”

# Reflections of a Nobel laureate physics professor

**“Student reaction to my brilliantly clear explanations.”**

“Whenever I made any serious attempt to determine what my students were learning, it was clear that this approach just didn’t work. An occasional student here and there might have understood my beautifully clear and clever explanations, but the vast majority of students weren’t getting them at all.”

*-Carl Wieman*

Wieman, C., 2007, Why not try a scientific approach to science education?: *Change*, Sept./Oct.

*A lecture is a process by which the notes of the professor become the notes of the students without passing through the minds of either*

*R.K. Rathbun*

# “Memory is what thinking does”

- Daniel Willingham

“Don’t re-teach yourself. Standing at the front of the room talking and writing on the board is you re-enforcing what *you* know. *Engage* your students… we need to *work* with the material, *talk* about it, *think* about it, *not listen to you* all of the time.”

- UNM student panelist, “Improving Native American Student Success”

“It is the one who does the work who does the learning”

Terry Doyle, 2008, *Helping students learn in a learner-centered environment*

Learning takes place in the minds of students and nowhere else, and the effectiveness of teachers lies in what they can induce students to do.

The beginning of the design of any educational procedure is dreaming up experiences for students: things that we want students to do because these are the activities that will help them to learn this kind of information and skill.

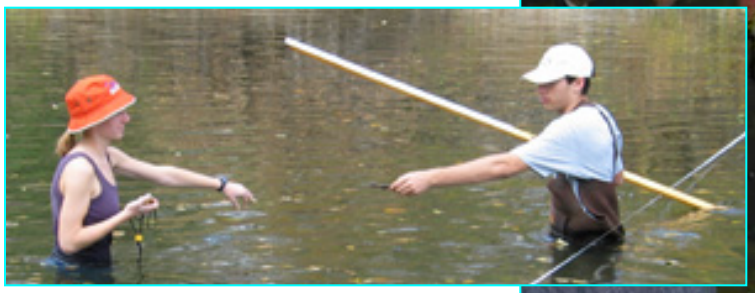
Simon, H. A. (1998). What We Know About Learning. *Journal of Engineering Education*, 87(4), 343-348.

# Active learning includes any class activity that "involves students in doing things and thinking about the things they are doing"

(Bonwell and Eison, 1991, *Active learning: creating excitement in the classroom*)

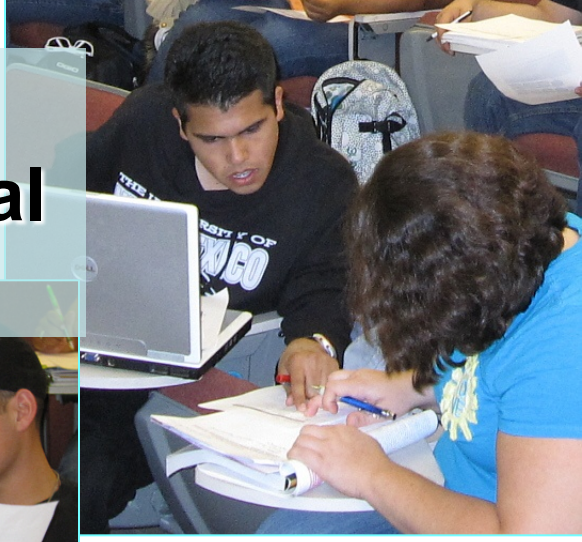
**Students learn best when they take an active role:**

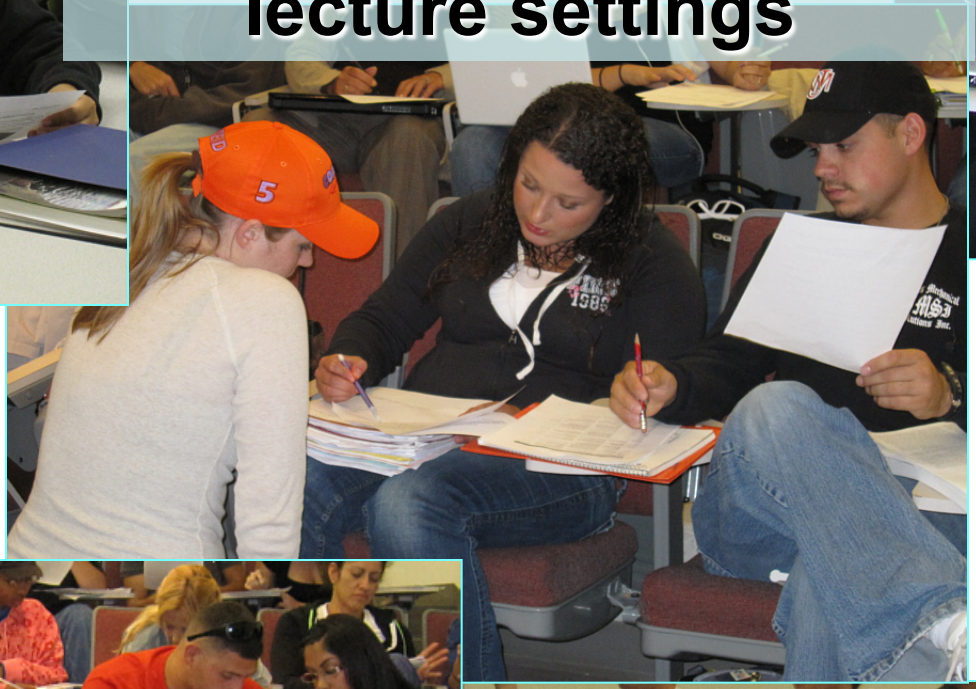
- **When they discuss what they are reading**
- **When they practice what they are learning**
- **When they apply practices and ideas.**



**Well-designed active learning incorporates all 3 core learning principles**

# Active learning CAN take place in traditional lecture settings





# Write-Pair-Share

**Pages 16-17 provide an example of an in-class assignment used in lower-level geology courses.**

***Write short answers to these questions on p. 15:***

- What would the student need to know *beforehand* in order to do this assignment?
- What would the student need to be able *to do while completing* the assignment?
- What advantages/disadvantages exist for having the students do this exercise *versus* the instructor presenting it in class?

**DO NOT answer the questions in the assignment!!!!!!!!!**

# Write-Pair-Share

***Now**, discuss your answers with one neighbor; explain your point of view; flesh-out your own answers*

- What would the student need to know beforehand in order to do this assignment?
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# Write-Pair-Share

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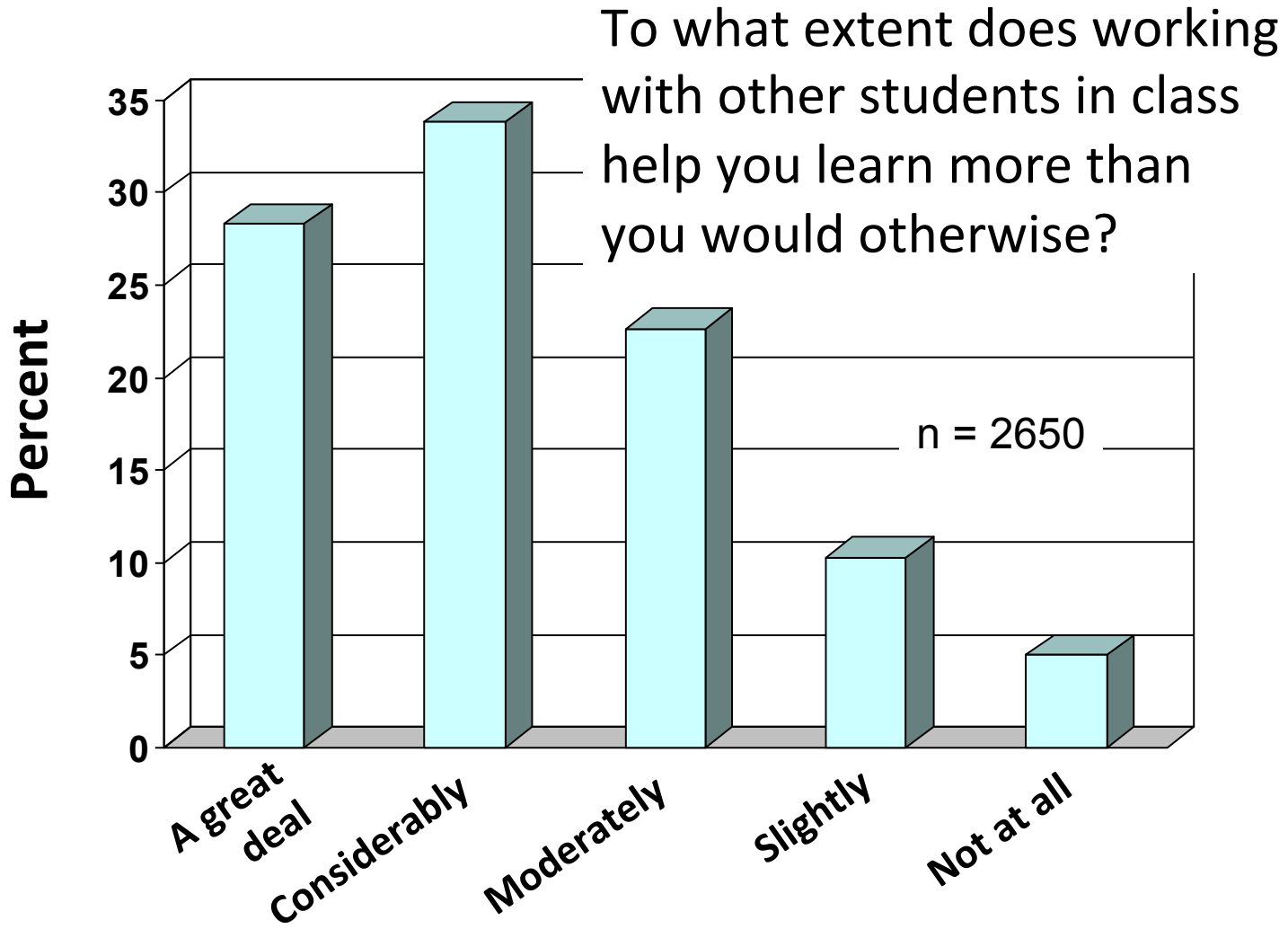
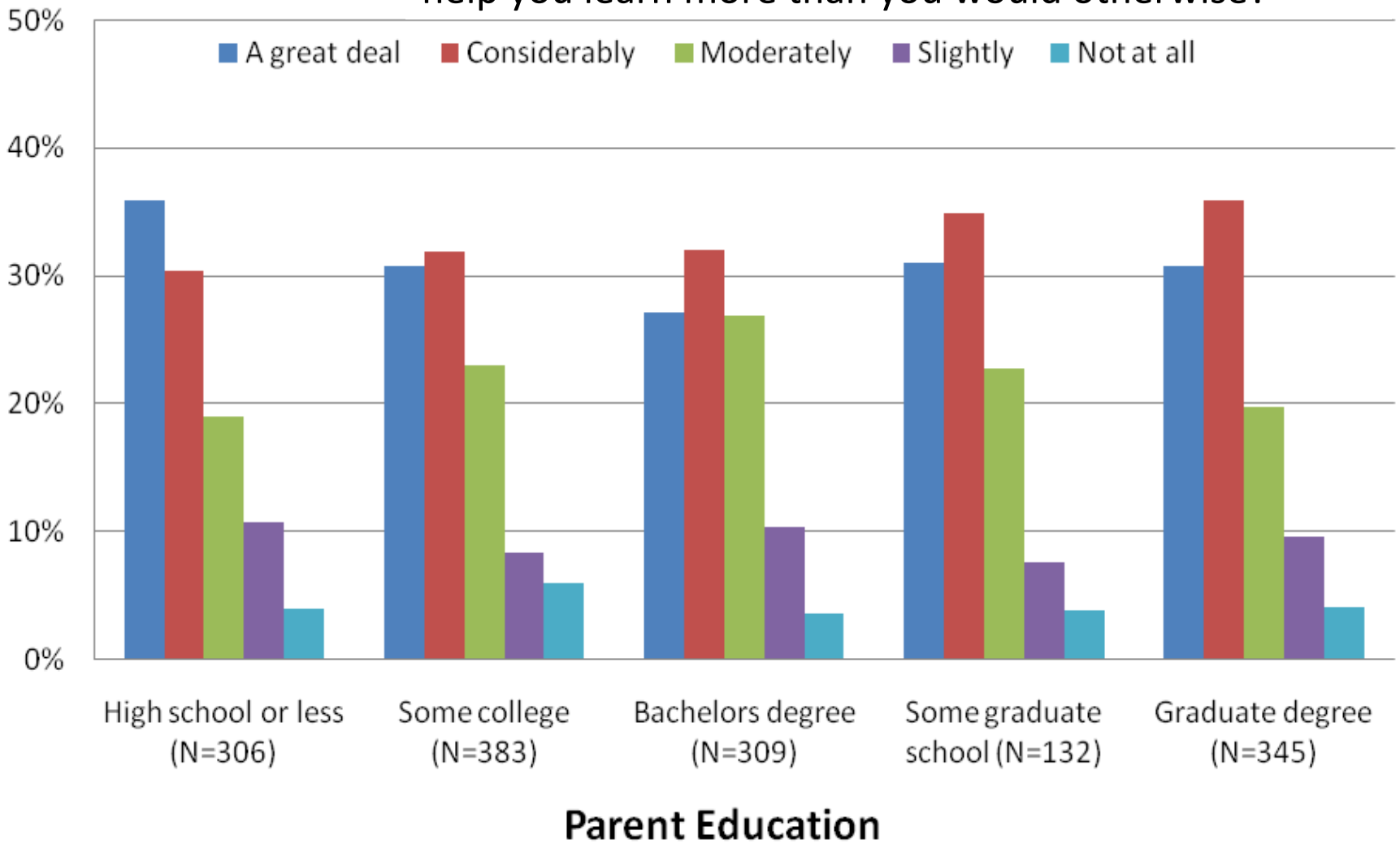
Surveys of students in UNM classes where instructors have, or are in the transition to, replacing most lecture with active, cooperative learning



# First-generation students benefit disproportionately, but all student socioeconomic groups at UNM prefer active, cooperative learning

To what extent does working with classmates in class help you learn more than you would otherwise?

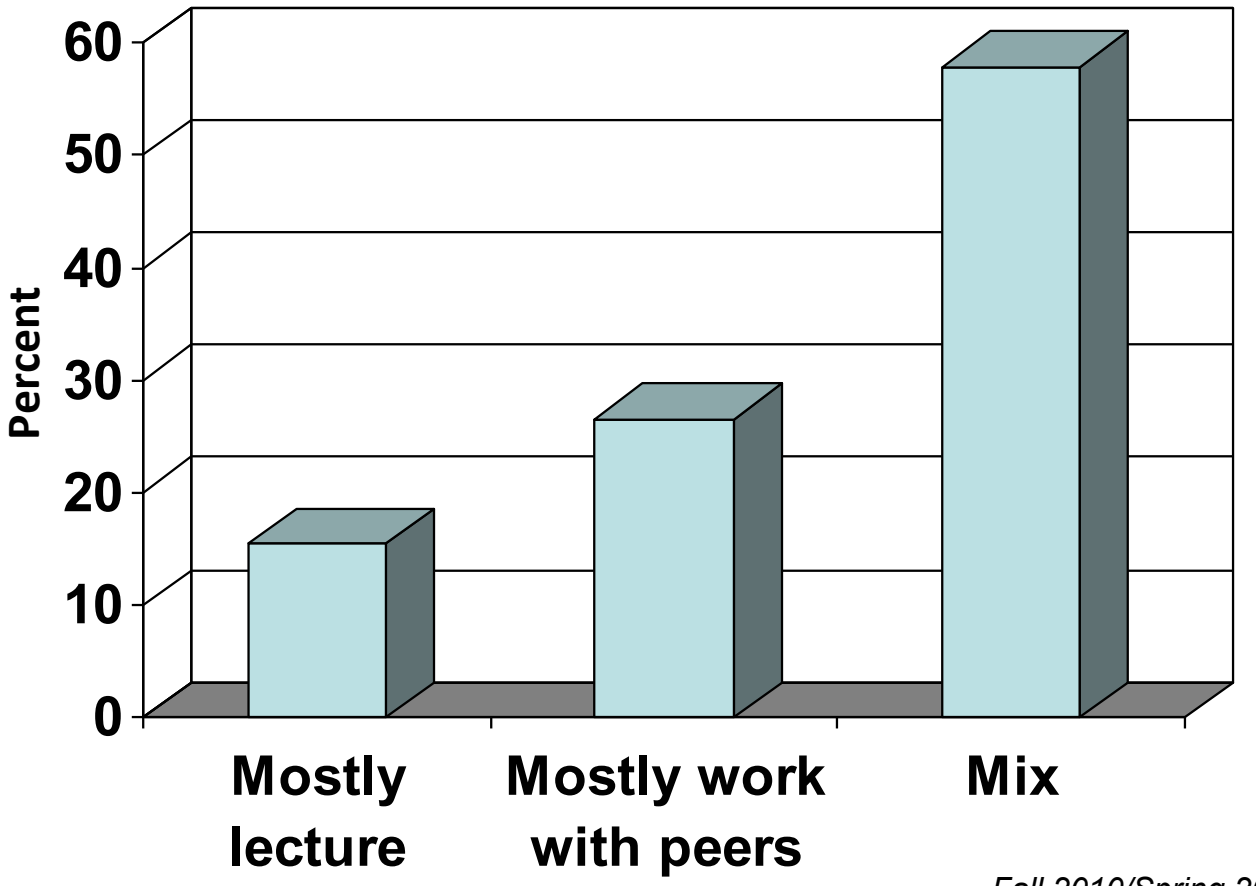


A. Most of the class the instructor lectured about the topics

B. Most of the class time provided opportunities for me to practice solving problems and answering questions while working with classmates and getting help from the instructor

C. There is about an even mix of instructor lecturing and opportunities to learn by working with classmates

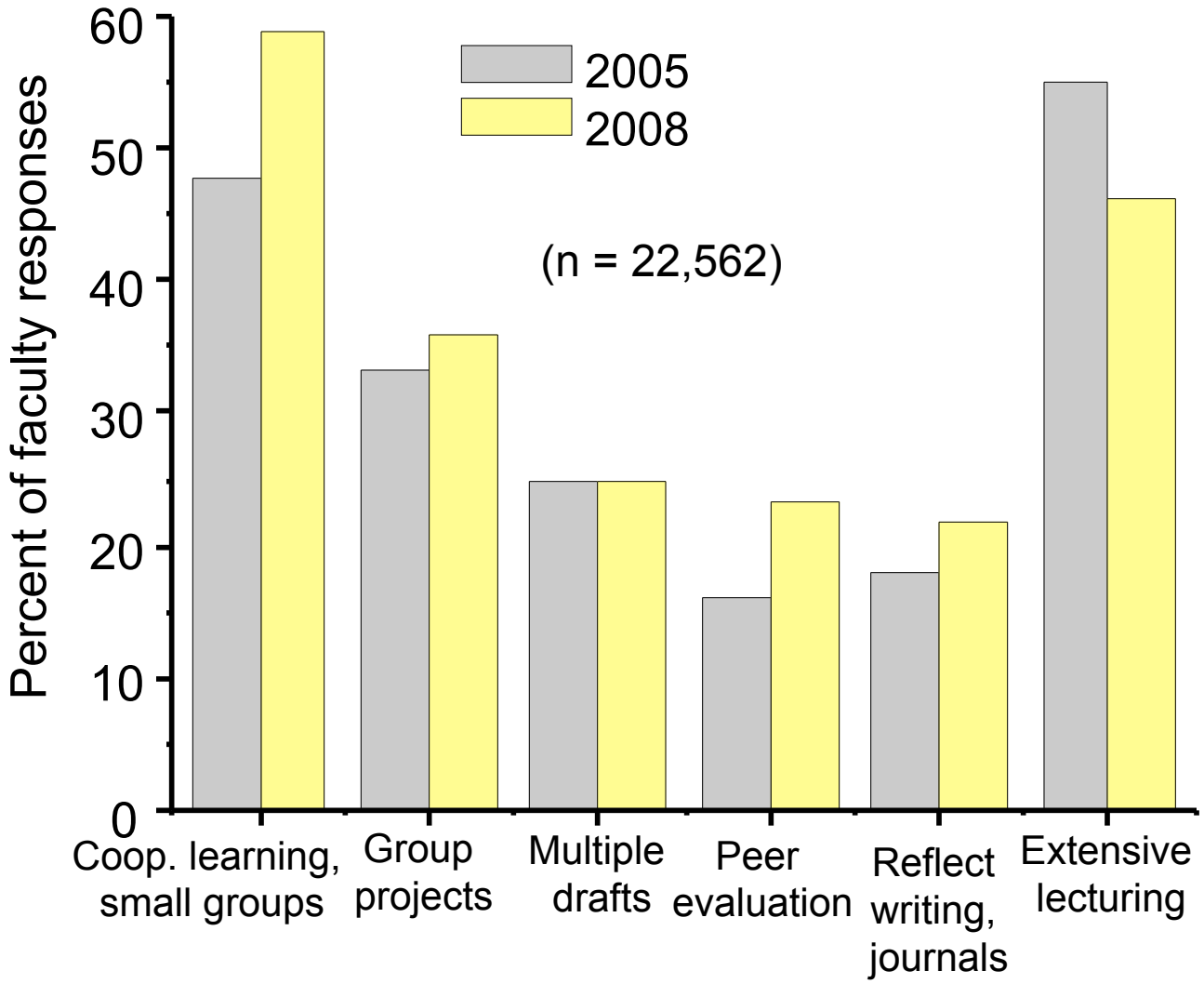
## If you had a choice, how would you *prefer* this class to be taught?




n = 2635

*Fall 2010/Spring 2011 PLF-class surveys*

# Nationally, college and university faculty are shifting toward more learner-centered approaches in the classroom.




(HERI, 2009, The American College Teacher National Norms for 2007-2008)

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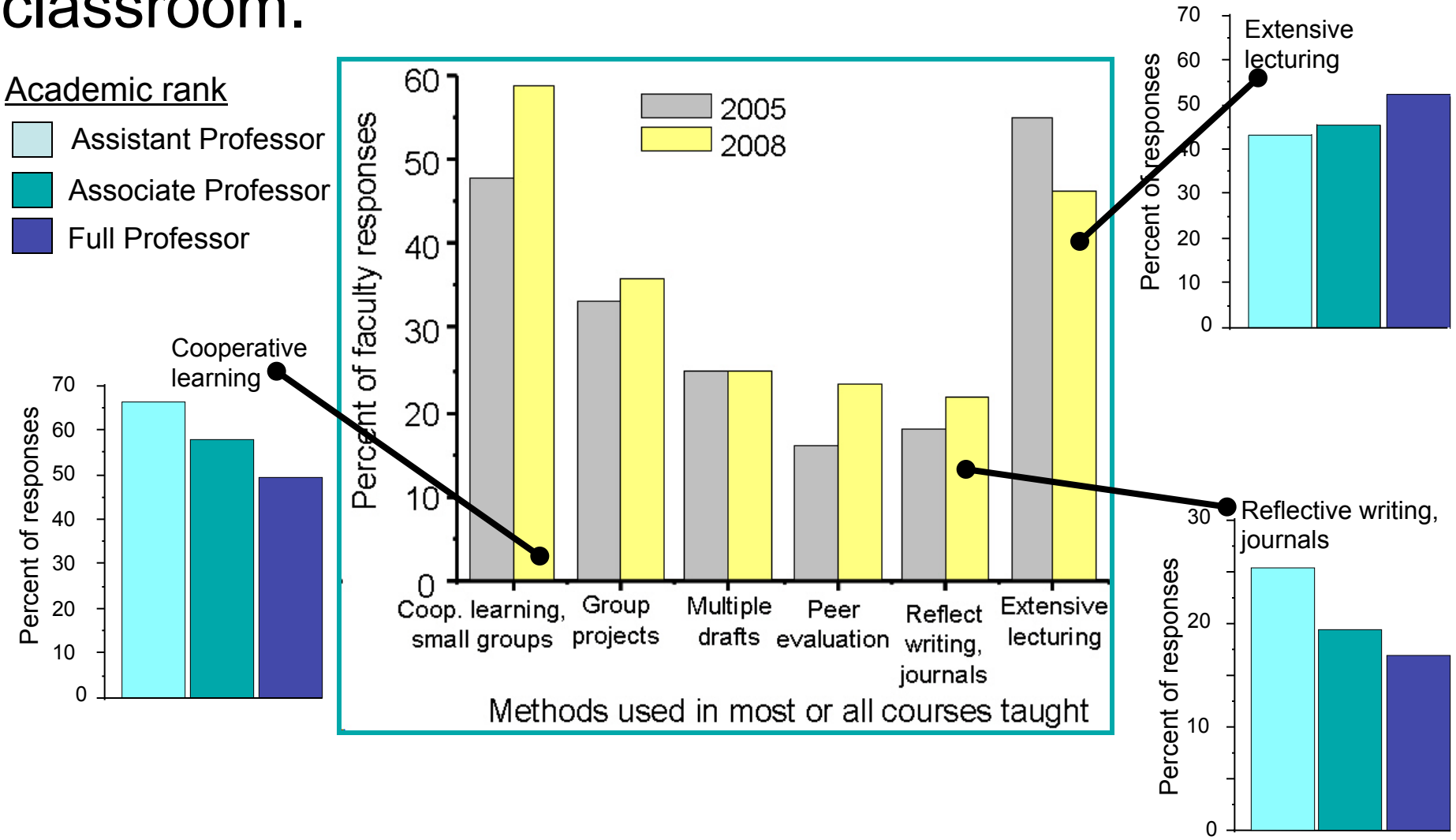


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Reflect….how did the instructional choice of utilizing these three active learning devices address the three core learning principles (address misconceptions, encourage metacognition, learn actively and deeply)

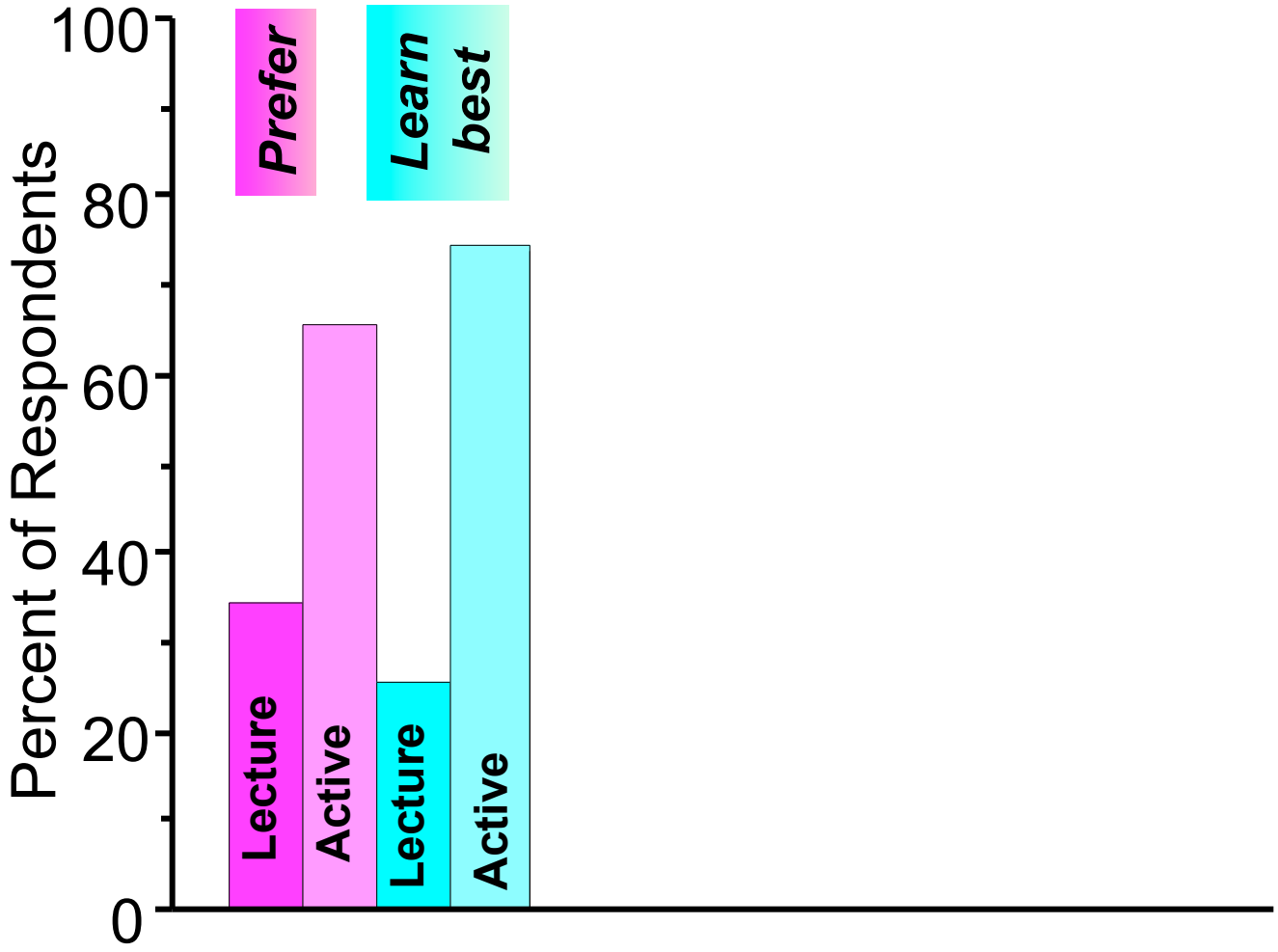
1. Jigsaw discussion of the core learning principles
2. Write-pair-share analysis of the assignment on ancient climate
3. Assignment of the ancient-climate exercise in place of lecture in a class

***Education is not about an expert teacher pouring knowledge into the empty brain of the novice learner. Instead, it's about developing a passion for reasoned thinking that allows one to construct conceptual understanding.***


**http://oset.unm.edu gsmith@unm.edu**

# The majority of students self-assess that they learn best when learning actively

Active learning = discussions, experiential learning, small-group work




Source: Profile of the American College Student, 2008

(n = 11,518)

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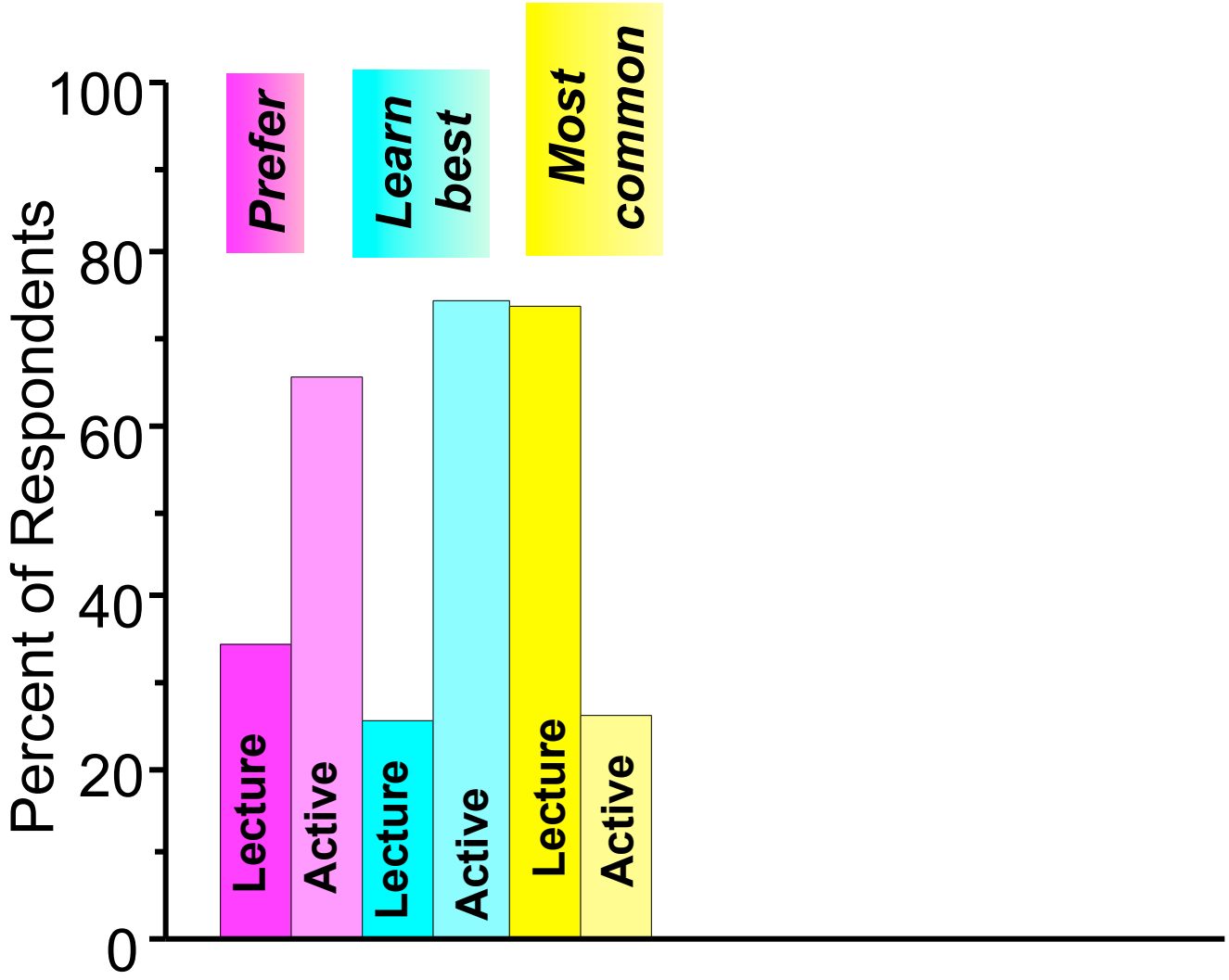


Source: Profile of the American College Student, 2008

(n = 11,518)


*"Have some respect for my learning style."*

New Yorker