CAE's Tier I Teaching Excellence Workshop

Implementation of Lecture Tutorials

Ed Prather
& Gina Brissenden

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Think-Pair-Share:
A Revised "How-To" Guide

Faculty often ask us what they can do to "get out of lecture mode" in their classrooms. After completing a CAE Teaching Excellence Workshop, participants commonly report back that Think-Pair-Share is the technique they plan to try first. We agree it's a great place to start! So how do you effectively implement Think-Pair-Share in the classroom? Through years of classroom experimentation, we've come up with a set of steps and phrases we find motivate students to earnestly engage with your TPS ... More >>

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Hot Reading to Help You
Have a Cool Summer While Preparing for Fall
In our Teaching Excellence Workshops, we mention many articles and books worth reading—or, as we like to tell our students, articles and books "worth knowing"—related... More >>

Lecture-Tutorials: A How-To Guide
In This Month's Teaching Strategy, we are highlighting our expanded Lecture-Tutorials How-To Guide with a more comprehensive set of guidelines originally published... More >>

Think-Pair-Share:
A Revised "How-To" Guide
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Additional Teaching Strategies >>

» Seeing the Universe through NASA's Eyes

NASA's Image of the Day Gallery
Light Toned Deposit in the Aureum Chaos Region on Mars
The High Resolution Imaging Science Experiment (HiRISE) camera aboard NASA's Mars Reconnaissance Orbiter acquired this closeup image of a light-toned deposit in Aureum Chaos, a 368 kilometer (229 mile) wide area in the eastern part of Valles Marineris, on Jan. 15, 2015, at 2:51 p.m. local Mars time.... Read More >>

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Workshops

Teaching Excellence Workshops

Since 2004, CAE workshops have reached 3,554 participants from all 50 states, DC, Puerto Rico, Canada, South America, Europe, Asia, and Africa.

Workshops Locations
Click a location to register for a specific workshop

Fall/Winter 2014/15

1. Jamestown, North Carolina
   Regional Teaching Exchange
   October 4, 2014
2. College Park, Maryland
   New Faculty Workshop
   November, 2014
3. Seattle, Washington
   Tier I,CATS
   January 3 - 4, 2015

Spring/Summer 2015

4. East Lansing, Michigan
   Regional Teaching Exchange
   April 10, 2015
5. Oceanside, California
   Regional Teaching Exchange
   May 2, 2015
6. Orangeburg, South Carolina
   Tier I,CATS
   June 13-14, 2015
7. College Park, Maryland
   New Faculty Workshop
   June 22-25, 2015
8. Honolulu, Hawaii
   Tier I,Special Topics
   August 4, 2015

Fall/Winter 2015/2016

12. Milwaukee, Wisconsin
    Tier I,CATS
    September 26-27, 2015
13. Jamestown, North Carolina
    Regional Teaching Exchange
    October 3, 2015
14. Everett, Washington
    Regional Teaching Exchange
    October 17, 2015
15. College Park, Maryland
    New Faculty Workshop
    November, 2015
16. Kissimmee, Florida
    Tier I
    January 3-4, 2016

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Instructional & Workshop Materials

Workshop Materials for Past Participants

Click here to receive NASA Stickers

1. **Images from Lecture-Tutorials for Introductory Astronomy, Third Edition**
   Here you will find individual .jpg versions of all the artwork in Lecture-Tutorials for Introductory Astronomy, Third Edition. You will also find Power Point slides of each image grouped by sections in the book.
   - Images from Lecture-Tutorials for Introductory Astronomy, Third Edition (Zip, 41.69 MB)

2. **Classroom Materials**
   - A-B-C-D Voting Card (PDF, 115 KB)

3. **Radio Curriculum**
   - Lecture-Tutorial: Rotation, Vibration, and Synchrotron Radiation – Astronomical Interactions of Light and Matter (DOCX, 928 KB)
   - Lecture Slides: Rotation, Vibration, and Synchrotron Radiation – Astronomical Interactions of Light and Matter (PPTX, 3.94 MB)
   - Assessment Questions: Rotation, Vibration, and Synchrotron Radiation – Astronomical Interactions of Light and Matter (DOCX, 695 KB)

4. **Unpublished Ranking Tasks**
   - Apparent & Absolute Magnitude
     - Activity 1 (PDF, 151 KB)
     - Activity 2 (PDF, 78 KB)
     - Activity 3 (PDF, 80 KB)
     - Activity 4 (PDF, 70 KB)
   - Doppler Shift
     - Activity 1 (PDF, 145 KB)
     - Activity 2 (PDF, 72 KB)
     - Activity 3 (PDF, 70 KB)
     - Activity 4 (PDF, 68 KB)
   - Gravity
     - Activity 1 (PDF, 95 KB)
     - Activity 2 (PDF, 346 KB)
     - Activity 3 (PDF, 64 KB)
     - Activity 4 (PDF, 287 KB)
     - Activity 5 (PDF, 398 KB)
     - Activity 6 (PDF, 74 KB)
     - Activity 7 (PDF, 116 KB)

NSF: Collaboration of Astronomy Teaching Scholars (CATS)

- Leilani Arthurs, UNL
- Duncan Brown, Syracuse Univ.
- Sanlyn Buxner, Univ. of Arizona
- David Consiglio, Bryn Mawr College
- Tim Chambers, U Michigan
- Steve Desch, Guilford Tech. CC
- Doug Duncan, CU Boulder
- Jeffrey Eckenrode, Pacific Science CTR
- Tom English, Guilford Tech. CC
- John Feldmeier, Youngstown State Univ.
- Amy Forestell, SUNY New Paltz
- Rica French, MiraCosta College
- Adrienne Gauthier, Dartmouth
- Pamela Gay, SIU-Edwardsville
- Dennis Hands, High Point Univ.
- Kevin Hardegree-Ullman, University of Toledo
- Melissa Hayes-Gehrke, Univ. of Maryland
- Seth Hornstein, CU Boulder
- David Hudgins, Rockhurst Univ.
- Chris Impey, Univ. of Arizona
- Jessica Kapp, Univ. of Arizona
- John Keller, Cal Poly SLO
- Julia Kregenow, Penn State
- Michelle Wooten, Univ of Alabama
- Kevin Lee, UNL & NSF
- Patrick Len, Cuesta College
- Chris Lintott, Univ. of Oxford
- Michael LoPresto, Henry Ford CC
- Daniel Loranz, Truckee Meadows CC
- Julie Lutz, Univ. of Washington
- Danny Martino, Santiago Canyon College
- Benjamin Mendelsohn, West Valley College
- Ed Montiel, Louisiana State University
- Peter Newbury, Univ. of British Columbia
- Lee Powell, UN Kearney
- Matthew Price, Ithaca College
- Jordan Raddick, Johns Hopkins Univ.
- Alex Rudolph, Cal Poly - Pomona
- Travis Rector, Univ. of Alaska
- Paul Robinson, Westchester CC
- Wayne Schlingman, Ohio State
- Sébastien Cormier, San Diego College
- Colin Wallace, UNC
- Kathryn Williamson, NRAO
- James Wysong Jr., Hillsborough CC
- Todd Young, Wayne St. College

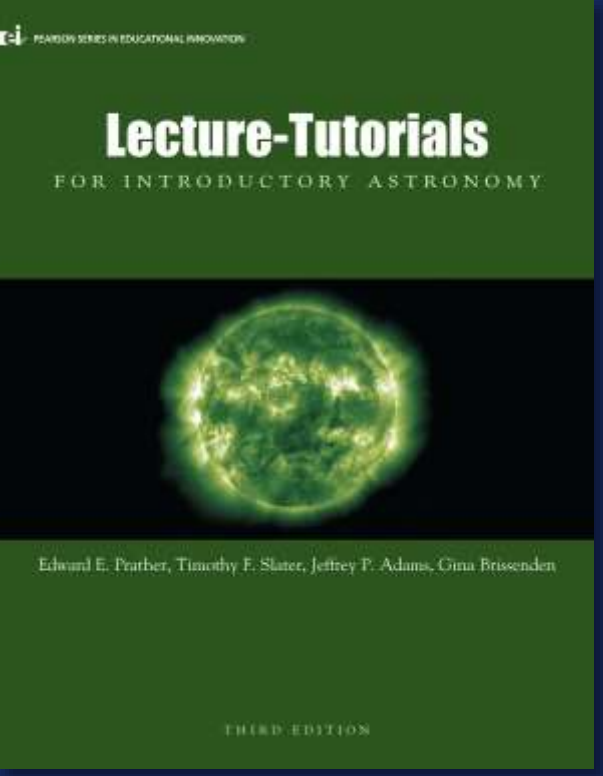
Getting Our “Challenges” on the Table

- Time, time, time!
- Department support
- Teaching resources
- Etc…

The REAL *challenge is* IMPLEMENTATION!!!!

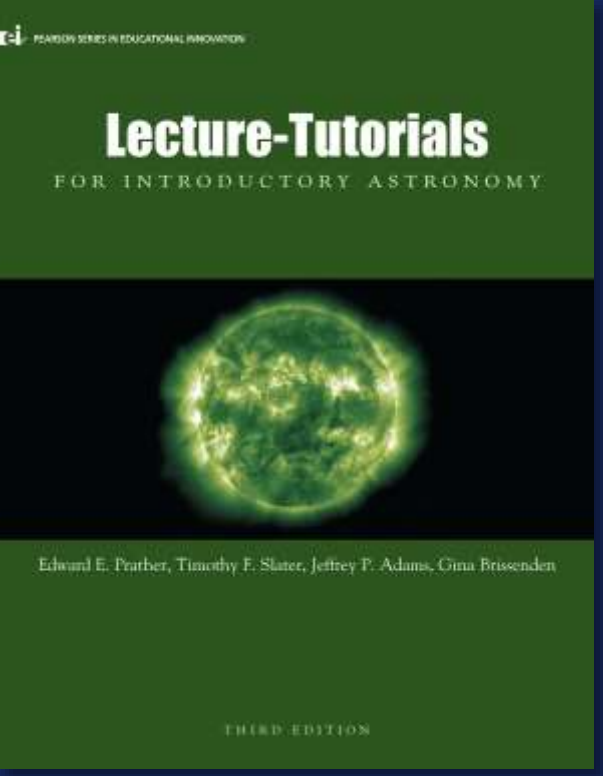
What Can I do Besides Lecture to Engage Students in their Learning?

- Ask students questions (not all questions are equal)
- In-class writing (with or without discussion)
  - Muddiest Point
  - Summary of Today's Main Points
  - Writing Reflections
- Use interactive videos, demonstrations, animations, and simulations
- Think-Pair-Share or PeerInstruction
- Small Group Interactions
  - Concept Maps
  - Case Studies
  - Sorting Tasks
  - Ranking Tasks
  - Lecture-Tutorials
- Student Debates (individual/group)
- Whole Class Discussions



Lecture-Tutorials

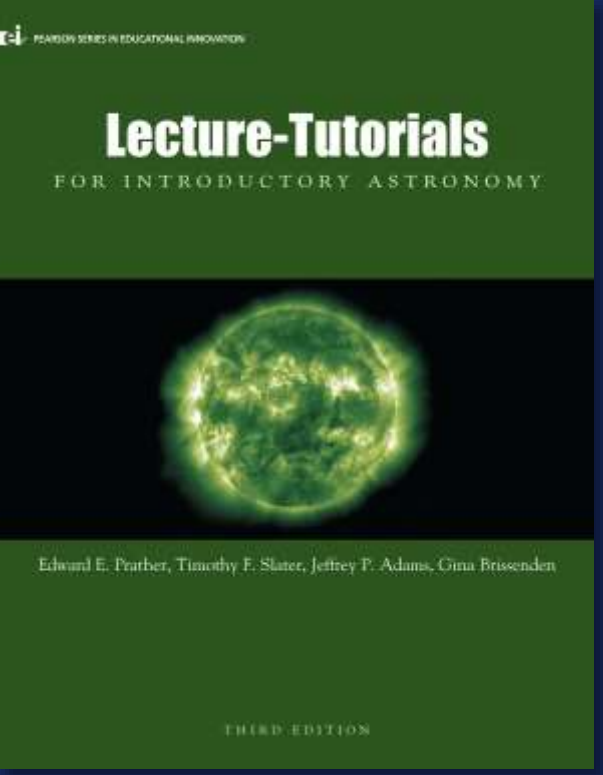
Instructional strategies designed to get your students thinking deeply about astronomy everyday ..and in almost any class setting.



Lecture-Tutorials

Design Criteria:

- Post Lecture Activity
- Each LT should address a main topic commonly taught in Astro 101
- Require no equipment
- Require only about 10-15 minutes to complete
- Start with questions accessible to most students following a lecture
- Target students' conceptual and reasoning difficulties
- Use multiple representations to increase students' discipline fluency



Lecture-Tutorials

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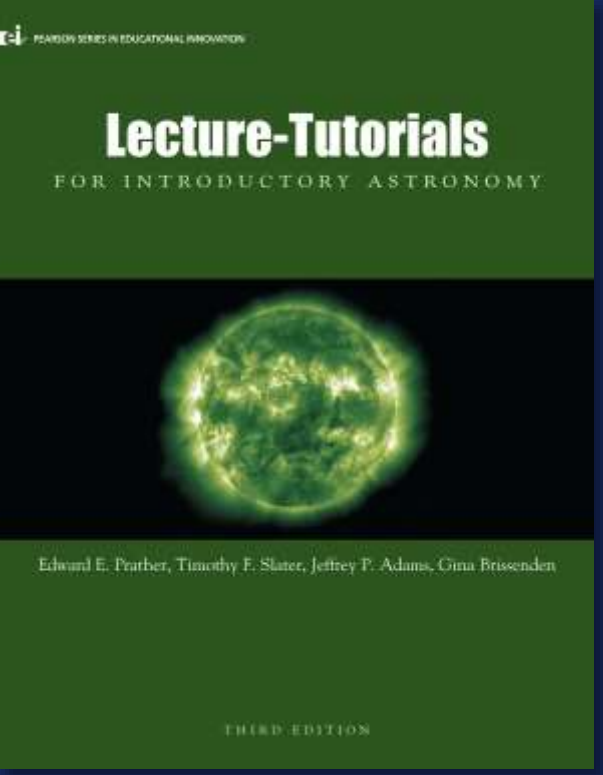


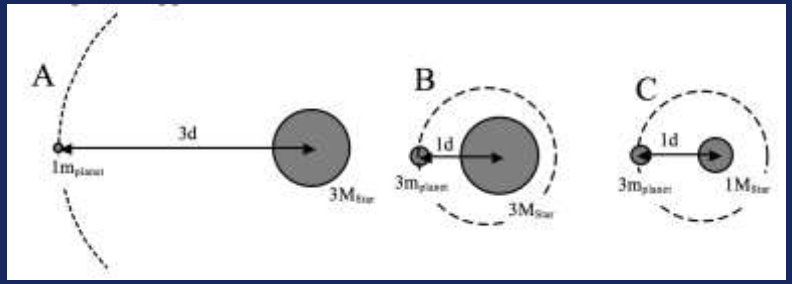
Lecture-Tutorials

Instructional Framing: Post-lecture, pencil and paper activities, that use a Socratic dialogue-driven, highly-structured collaborative learning methodology to help students elicit, confront and resolve their naïve beliefs and reasoning difficulties, and improve their critical thinking skills and develop scientifically robust conceptual models.

Research on a Lecture-Tutorial Approach to Teaching Introductory Astronomy for Non–Science Majors, Prather, E. E.; Slater, T. F.; Adams, J. P.; Bailey, J. M.; Jones, L. V.; Dostal, J. A., Astronomy Education Review, 3(2) 2005

Clickers as Data Gathering Tools and Students' Attitudes, Motivations, and Beliefs on Their Use in this Application, Prather, E. E., and Brissenden, G., Astronomy Education Review, 8(1), 2009.

STAR	Wavelength of Absorption line
A	649 nm
B	656 nm
C	658 nm
D	647 nm



Student 1: *The phase of the Moon depends on how the Moon, Sun, and Earth are aligned with one another. During some alignments only a small portion of the Moon's surface will receive light from the Sun, in which case we would see a crescent Moon.*

Student 2: *I disagree. The Moon would always get the same amount of sunlight; it's just that in some alignments Earth casts a larger shadow on the Moon. That's why the Moon isn't always a full Moon.*

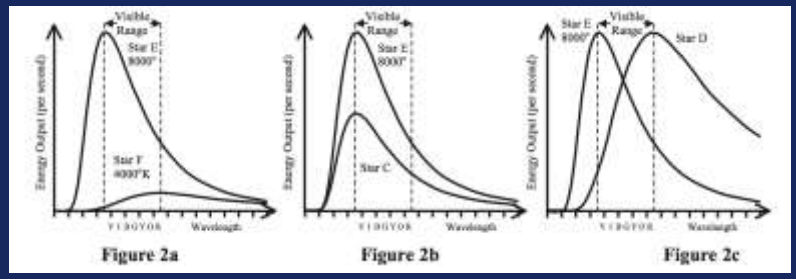
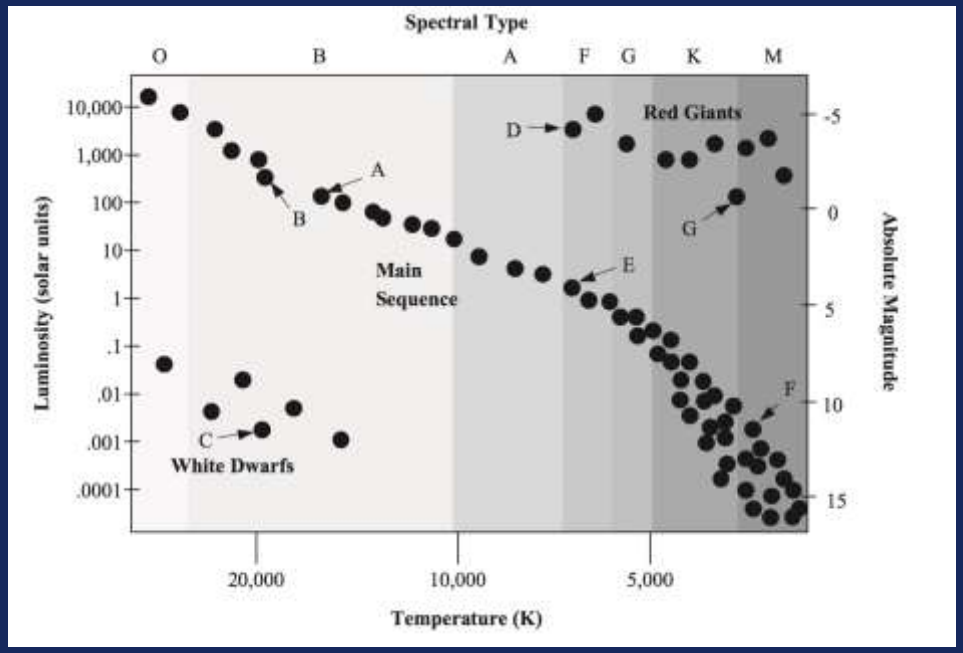
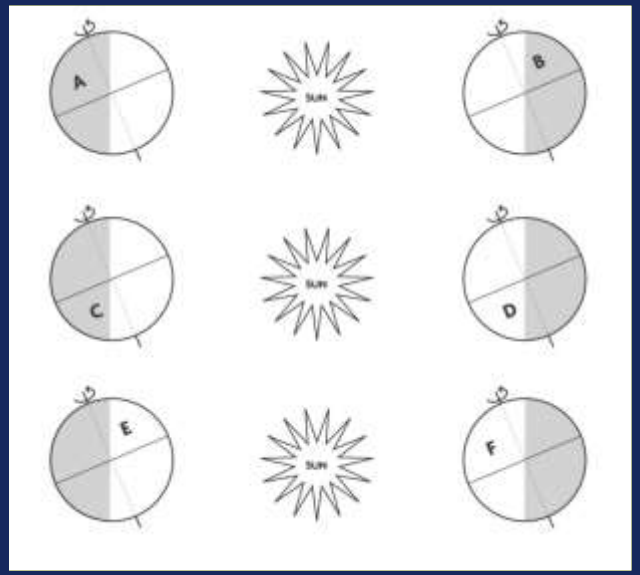
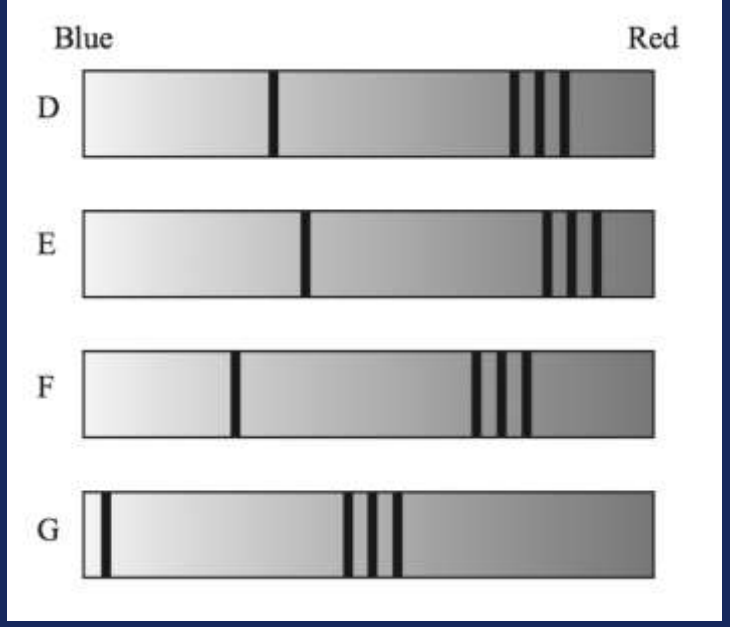


Figure 2a Figure 2b Figure 2c







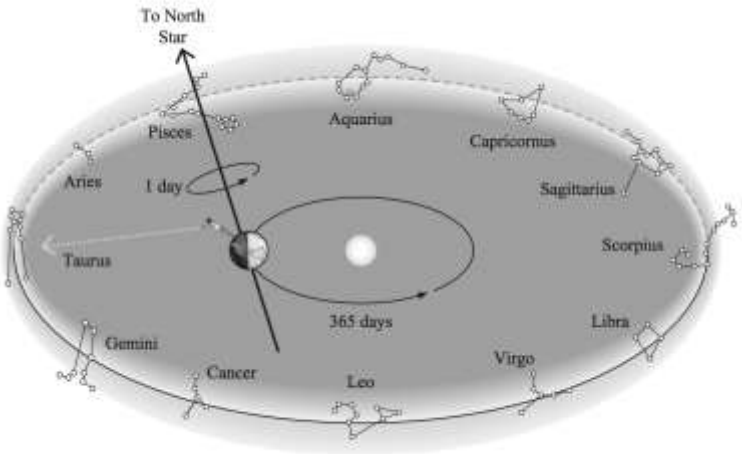


Figure 1

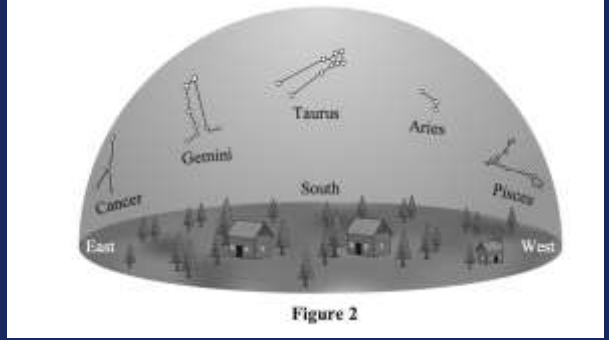
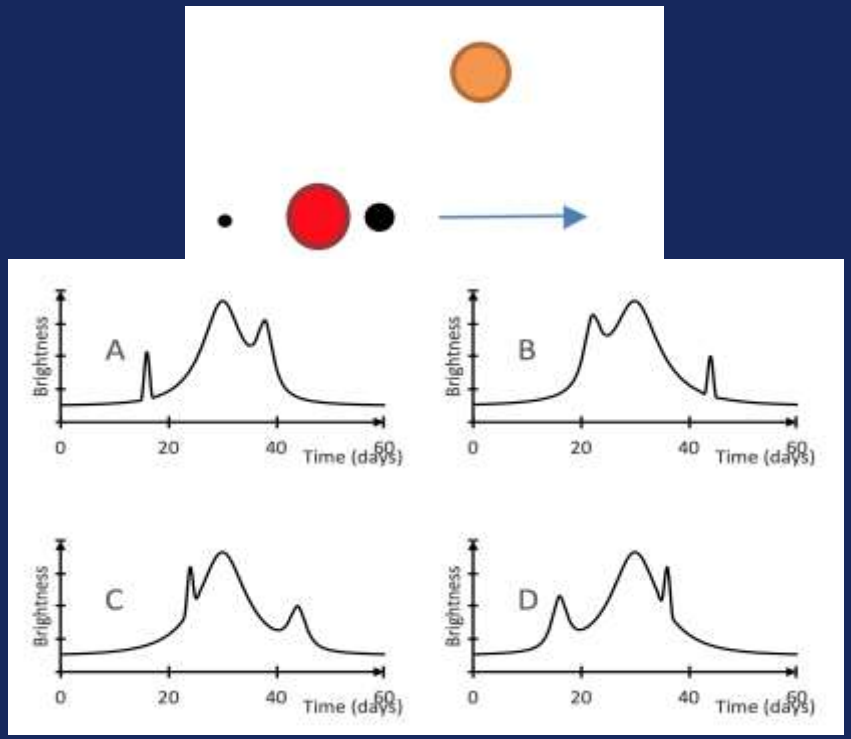
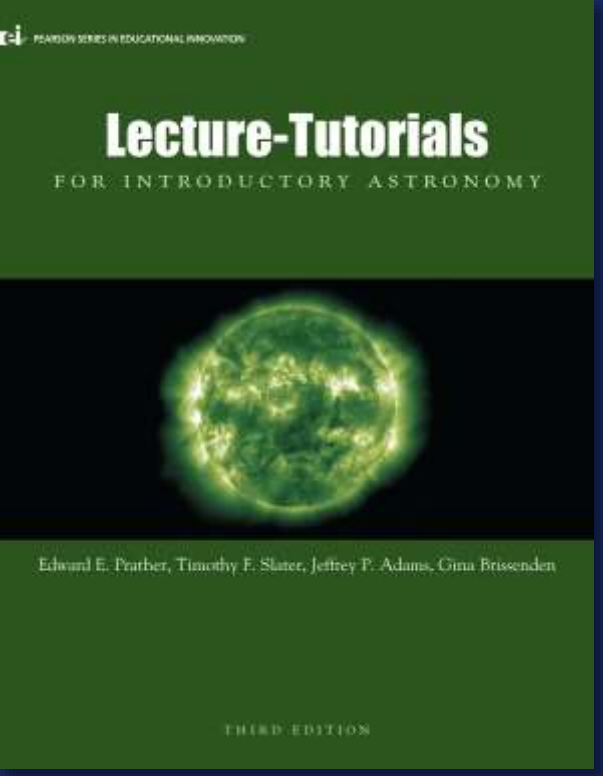


Figure 2



Idealized Classroom Implementation

- Professor lectures for approximately 20 minutes on core ideas of the topic to prepare students for working on the activity learning activity.
- Students are posed conceptually challenging questions on the presented lecture material to set the stage for the collaborative learning activity to come.
- Class is divided into pairs or small groups and instructed to work collaboratively and reach consensus on the questions presented during the activity.
- Instructor circulates through the room listening to student conversations and works with student groups only if hands are raised.



Lecture-Tutorials

Lets Do One!!

Idealized Classroom Implementation

- Instructor provides time-stamps approximately every 5-8 minutes to maintain overall class progress.
- When approximately 70% of students are on last part/page of the activity, instructor asks students to raise their hand if they are on the last part/page or done, then says “You’ve got a few more minutes.”
- Instructor “debriefs” the activity interactively, working with the students to highlight the difficulties in reasoning and common errors.
- Instructor returns to lecture mode on next course topic.

The Devil is in the Implementation!

- How do you motivate students to do in-class activities - at the beginning of your course and throughout the semester?
- Why does it matter if the students talk to each other and come to consensus?
- What do you need to do, prior to creating your lecture, so that you create an effective PRE-activity lecture? What should your lecture include? What should your lecture not include?
- What do you do while your students are doing the in-class activity?
- How do you manage and communicate time limits while students are doing your in-class activities
- How do you estimate how long the activity will take?

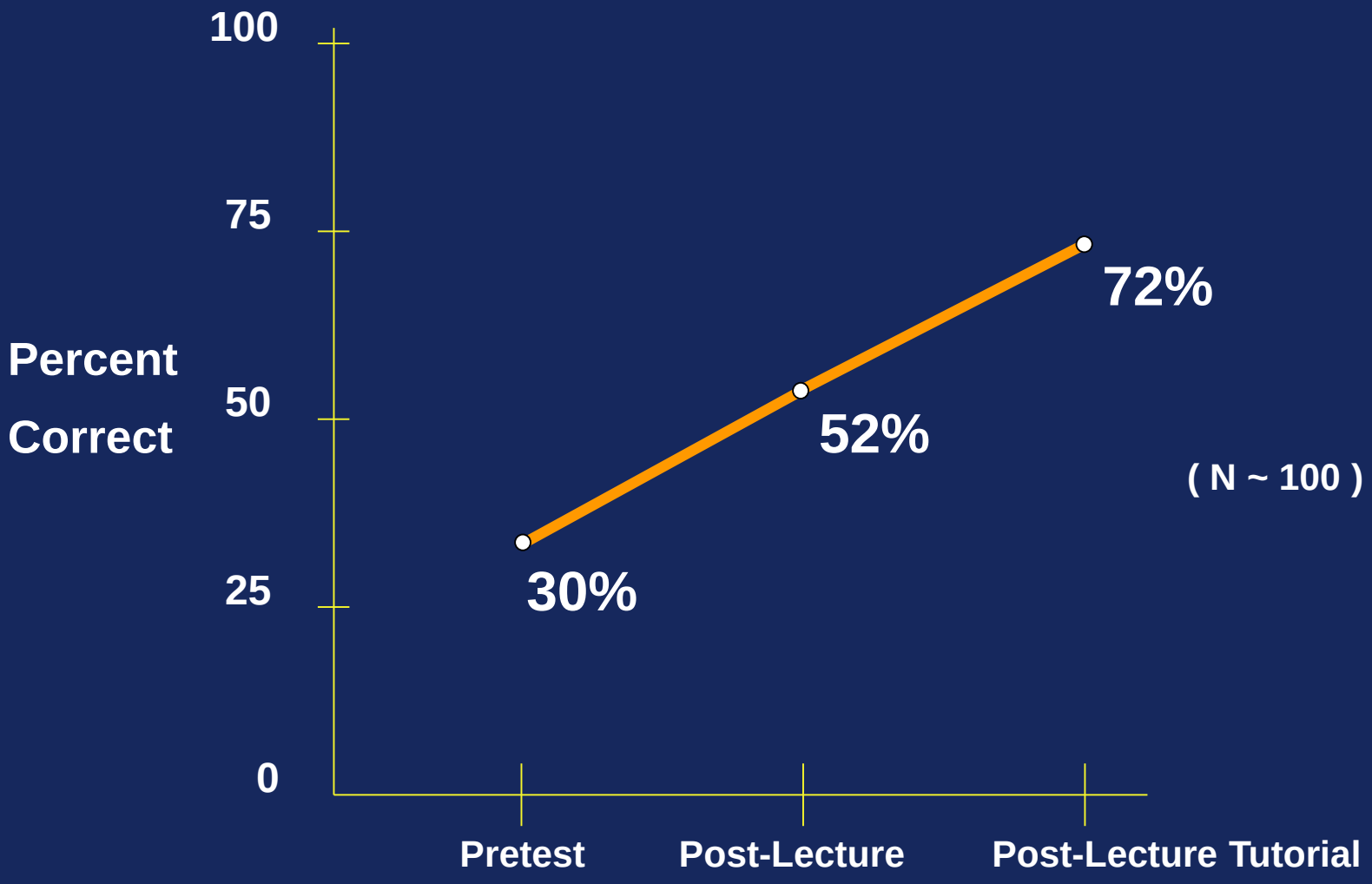
The Devil is in the Implementation!

- When/Why should you ask a group member to read the question they are working on aloud to you?
- When/Why should you answer a group's question with another question?
- When/Why should you ask one member of a group what the other student in their group wrote or what they were thinking when they wrote their answer?
- When/Why should you pause the entire class to discuss a particular question?
- When/Why should you ask your students to work with a different partner?
- What do you do with a group that is clearly not working together?
- What do you do with a group of students that is not even working?

The Devil is in the Implementation!

- Is it okay to end the in-class activities even if everyone is not done?
- What are effective and in-effective ways to debrief in-class activities?
- How do you make your students realize what activity content they are accountable for on the exam and whether or not they need to do some more studying?
- When or why should you, or should you not, provide solutions to in-class activities?

The Results from our Research to Validate the Effectiveness of Lecture-Tutorials.



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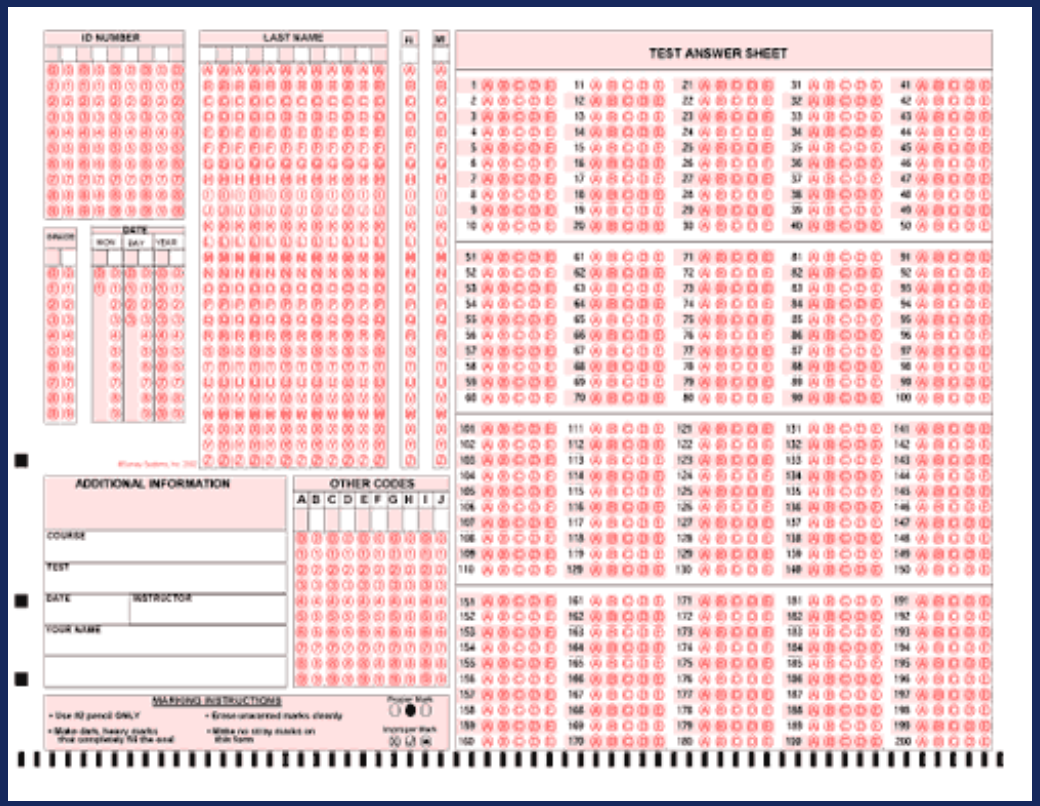

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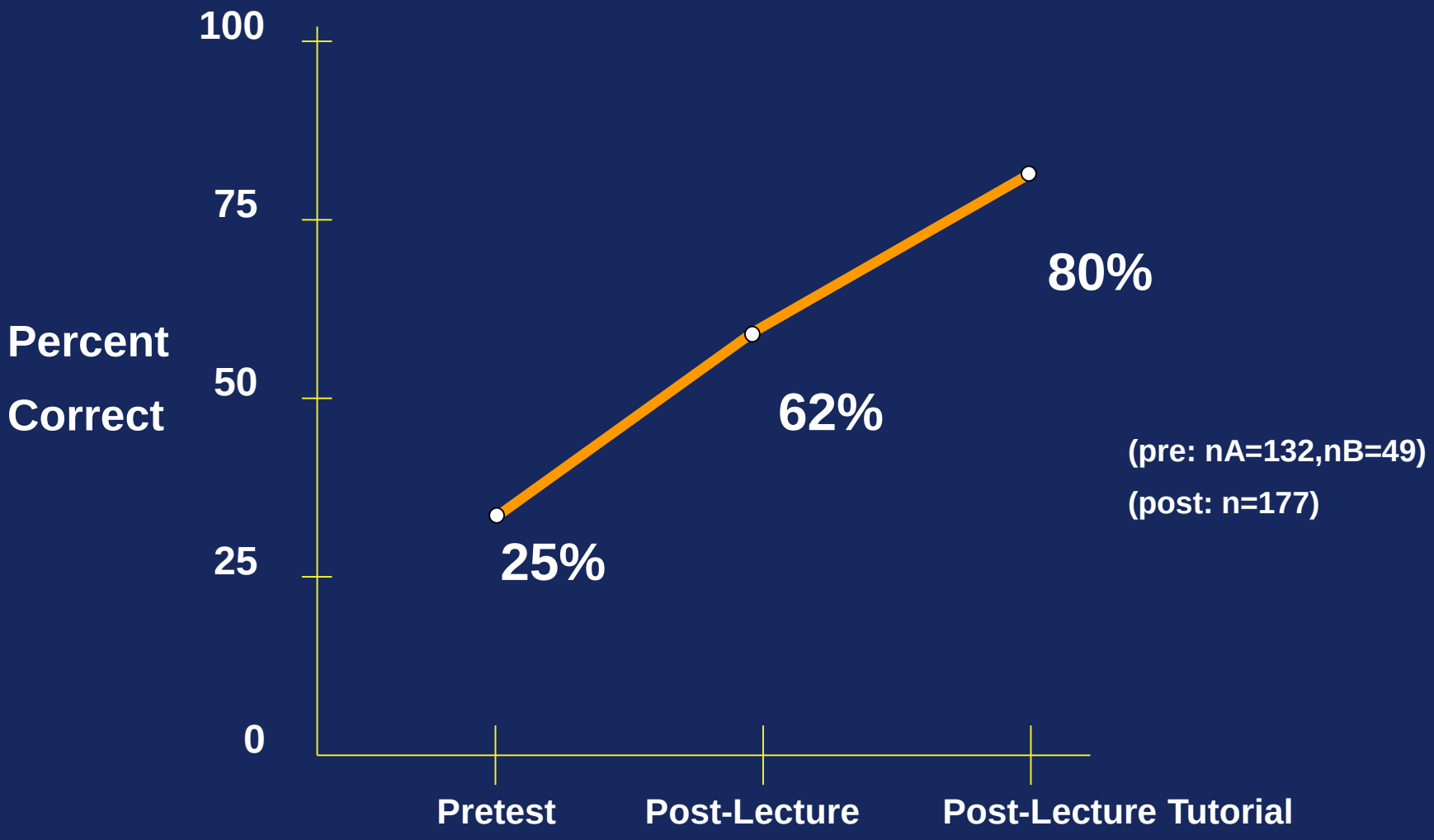
Dedicated to improving teaching and learning in Astronomy 101

The Results from our Research to Validate the Effectiveness of Lecture-Tutorials: Using Clickers.



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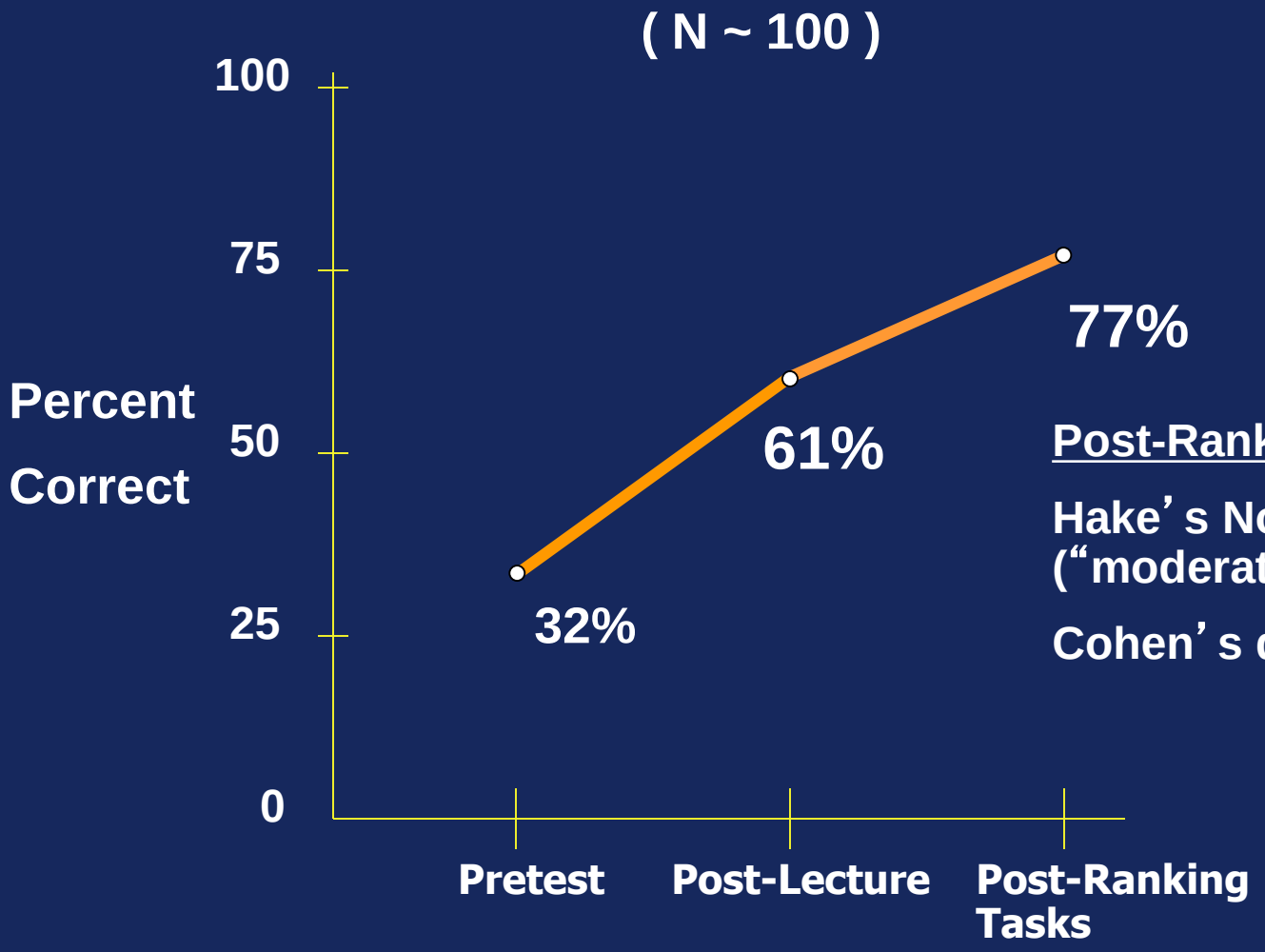
The Results from our Research to Validate the Effectiveness of Ranking Tasks



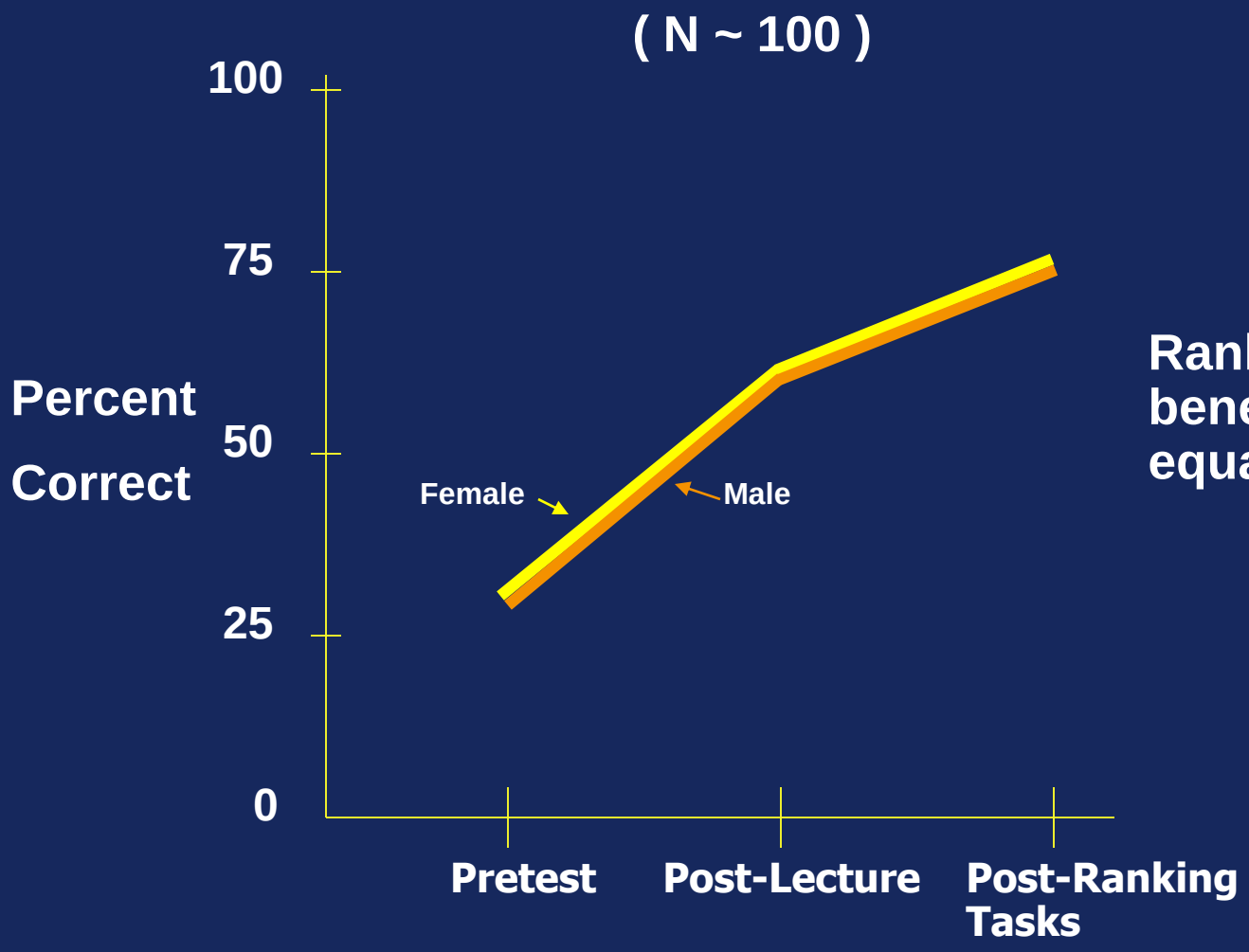
Post-Ranking Task:

Hake's Normalized Gain = 0.41 ("moderately large effect")

Cohen's d = 0.62 ("Large effect")

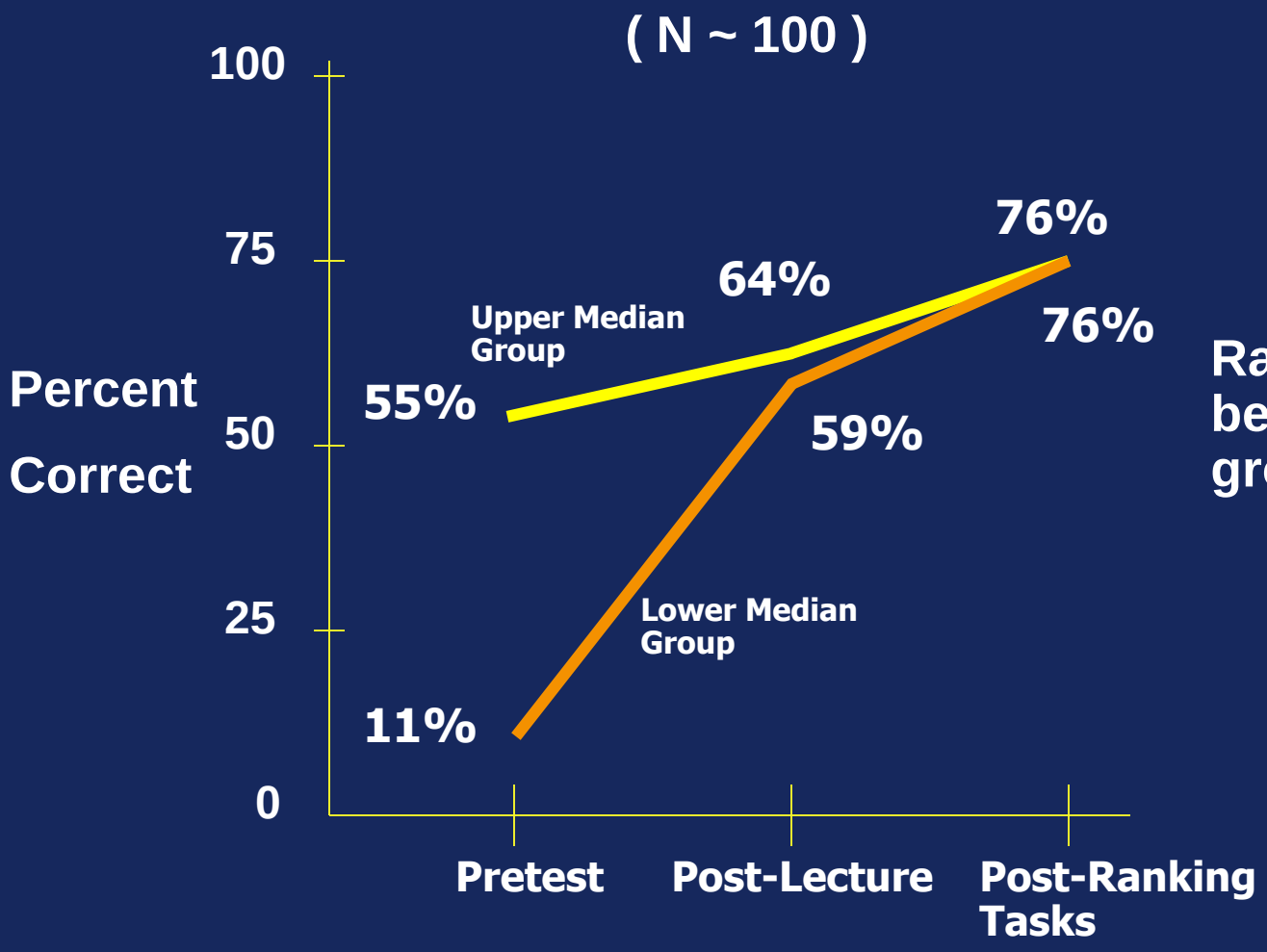
Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts, Hudgins, D. W., Prather. E. E., Grayson, D.J. and Smits, D. P. Astronomy Education Review, 5(1), 2006

Ranking Tasks: Gender Effect?



Ranking Tasks benefited both groups equally.

Ranking Tasks: High vs. Low Pretests Groups?



Ranking Tasks benefited both groups equally.