

# **EVALUATING CRITICAL-THINKING AND WRITING SKILLS IN A WRITING-INTENSIVE COURSE**

**KATHRYN MILLER, PROFESSOR AND CHAIR  
BIOLOGY**

**DENISE LEONARD, HHMI POSTDOCTORAL RESEARCH  
ASSOCIATE  
BIOLOGY AND THE TEACHING CENTER**

**iTEACH SYMPOSIUM 2014**

# **THE COURSE: PURPOSE, GOALS, AND STRUCTURE**

# THE COURSE

- Biology 3191: Molecular Mechanisms in Development
  - Read primary literature (no textbook)
  - Discussion, not lecture
  - Writing-Intensive
    - Analytical essays
    - Long Literature Research paper

Foster understanding, organization, synthesis of ideas and information

# The writing process: 'think, then write' model


- Choose a topic
  - Narrow it
- Write a thesis
- Make an outline
  - Write a draft
    - Revise
    - Edit

# Why Writing Intensive?


- Bean 'Engaging Ideas' (2001), p. 29-31
  - “What.....students need to understand is that for expert writers, the actual act of writing causes further discovery, development, and modification of ideas.”
- Active rather than passive
- Understanding instead of facts
- Ask questions and engage in dialog, not acquire information

# Expert writer's process: unanswered questions and a dialog with the 'material'

1. Starting point: perception of a problem
2. Exploration
3. Incubation
4. First draft
5. Reformulation and revision
6. Editing



Recursive



Reformulate ideas

# Bean, Engaging Ideas

This description of the writing process emphasizes the fact that expert academic writers are driven by their engagement with questions or problems and by their need to see their writing as a contribution to an ongoing conversation. ....[T]his problem-driven model of the writing process has a distinct advantage... It allows ...[the]... link[ing of] the teaching of writing to ... teaching the modes of inquiry and discovery in the.... discipline. ....[S]tudents [get] personally engaged with the kinds of questions that propel writers through the writing process. Thus, the writing process itself becomes a powerful means of active learning.

# My goals for the course

Goal:

Why:

Developmental biology concepts and molecular mechanisms	Interesting area of Biology; many different aspects of biology encompassed within
Science discovery process	Knowledge construction in field, how is new knowledge created?
Relationship between evidence and ideas	Understanding not facts
Express ideas clearly, use empirical support	Understanding not facts; transferable skills



# Tools to assess student perceptions and progress towards goals

- **Analysis of essays**
  - Writing with reader in mind
  - Use of logical arguments and data to support thesis
  - Connecting different pieces of information to make an argument
- **CURE survey**
  - The Classroom Undergraduate Research Experience (CURE) survey
- **Views about writing survey**
- **Perceptions of usefulness of assignments and open ended questions**

# Assessing Learning Goals: scientific thinking, using evidence, and writing to communicate complex ideas effectively

- Developed rubric that reflects goals
- Train raters to use rubric
- Compare early essays to later ones to determine changes across each student and the class as a whole.
- Analysis just starting – no results yet!

# An Essay and the Rubric

- Short excerpt from NYT article: what do we do in class to promote learning goals?
  - Read first section
  - Draw a picture that represents what is described
- How does the rubric work?
  - Use first and last section of rubric to rate the introductory section of this article.

# Tools to assess student perceptions

- **Modified views survey**
  - **Attitudes about writing**
  - Assessment of usefulness of assignments
  - **Open ended questions**
- **CURE survey**
  - The Classroom Undergraduate Research Experience (CURE) survey
  - Demographics
  - Academic information
  - Goals
  - 21 items related to a summer undergraduate learning experience

# Tools to assess student perceptions

- **Modified Views about Writing Survey**
  - Attitudes about writing
  - Assessment of usefulness of assignments
  - Open ended questions

# Modified Views about Writing Survey

	a only	a>b	a=b	a<b	b only
Learning to write about science requires:					
a. serious effort	1	2	3	4	5
b. a special talent					
When I am given a writing assignment in a course:					
a. I look forward to putting my ideas on paper	1	2	3	4	5
b. I dread completing it					
When I experience difficulty writing:					
a. I immediately seek help or give up trying	1	2	3	4	5
b. I try hard to figure what to do on my own					
To me learning to write about science is an important source of:					
a. Factual information about the natural world	1	2	3	4	5
b. Ways of thinking about the natural world					
The first think I do when writing a paper is:					
a. I try to begin writing the whole essay	1	2	3	4	5
b. I try various ways to develop ideas					

**What are the student attitudes  
toward writing before and after  
the course?**

# QUESTION 1

**HOW WELL I DO ON PAPERS IN COURSES DEPENDS  
ON:**

**(a) If I write what  
the instructor wants**

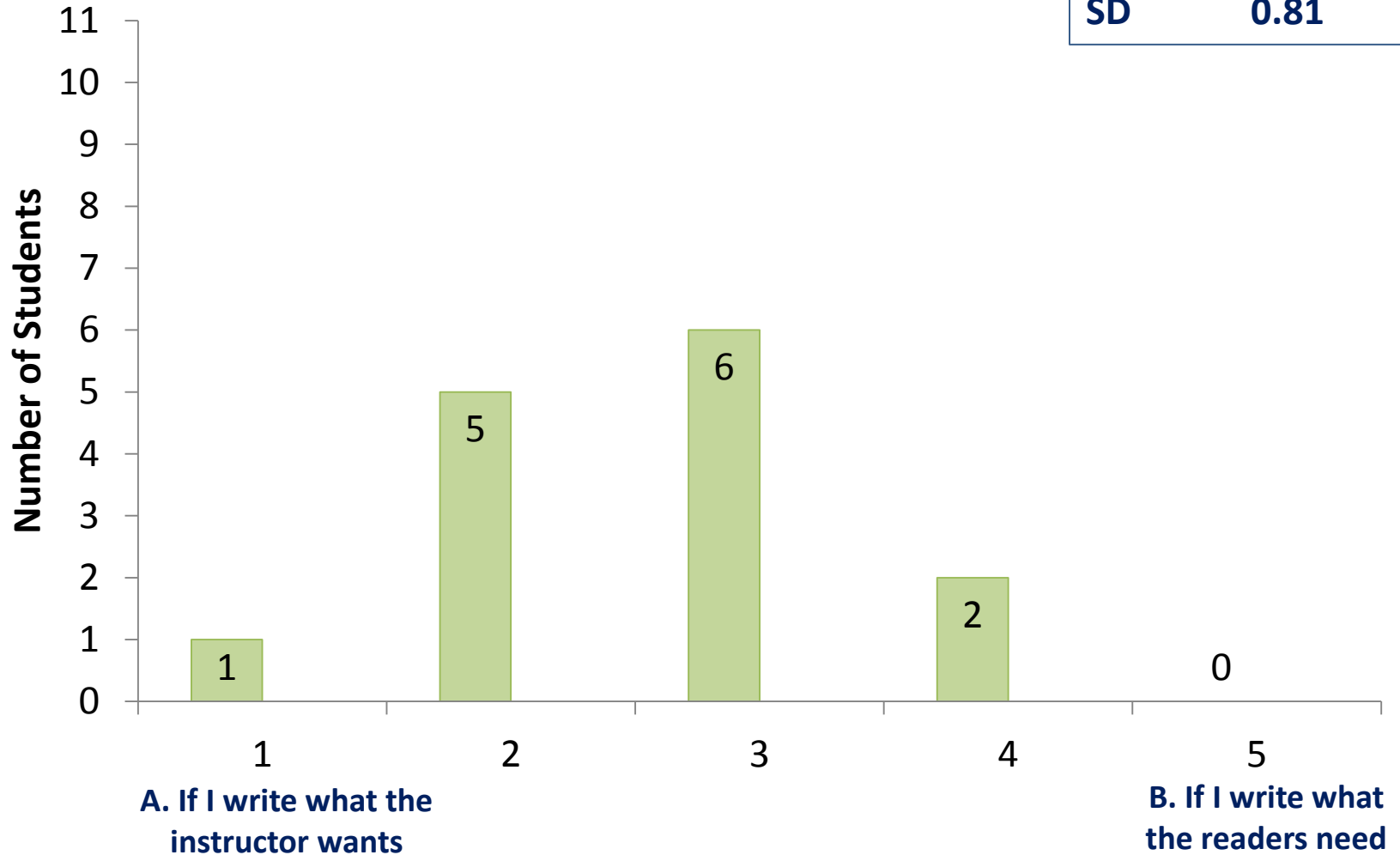
**(b) If I write what  
the readers need**



# Q1--HOW WELL I DO ON PAPERS IN COURSES DEPENDS

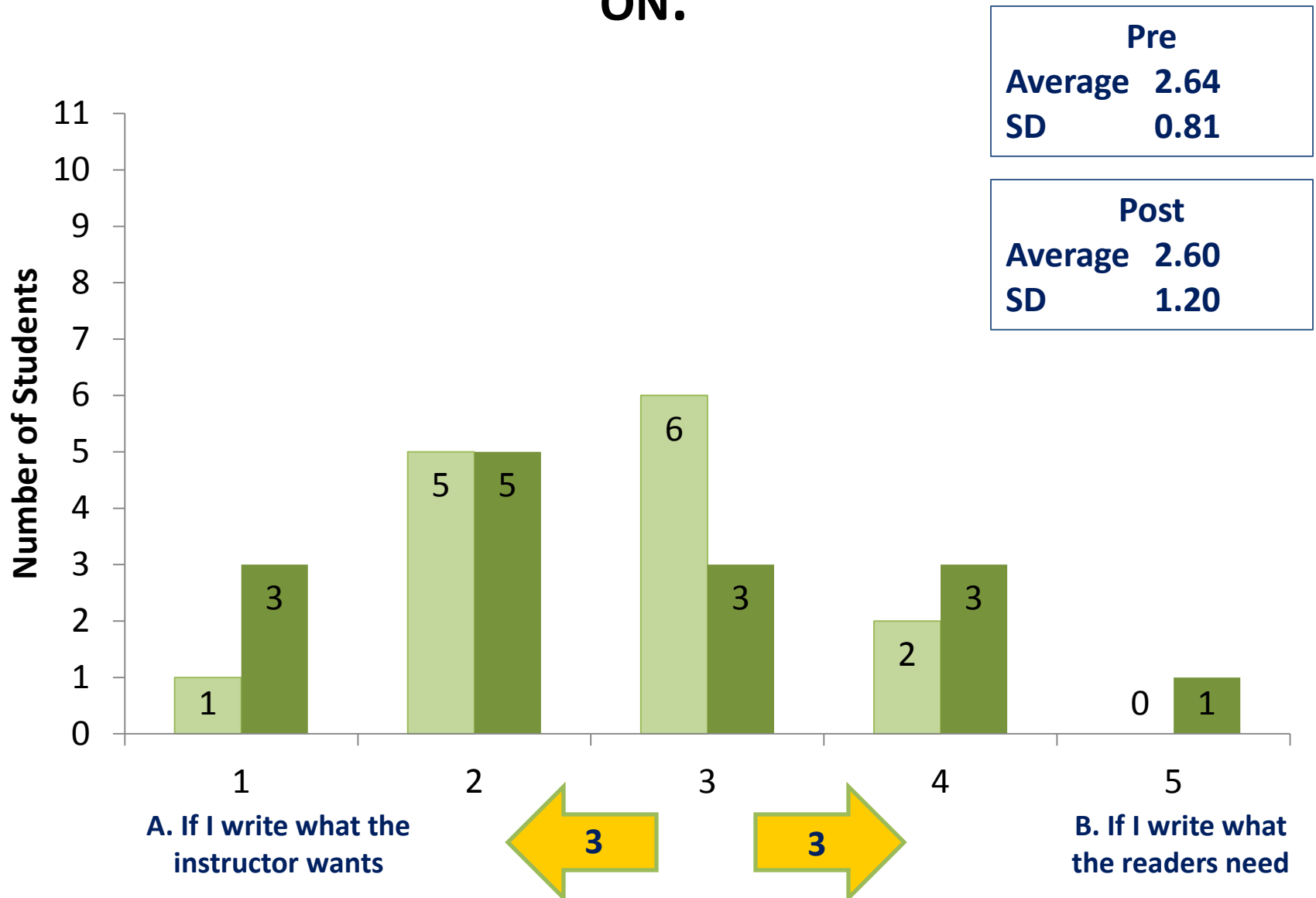
ON:

	Pre
Average	2.64
SD	0.81



# Q1--HOW WELL I DO ON PAPERS IN COURSES DEPENDS

ON:



## **QUESTION 2**

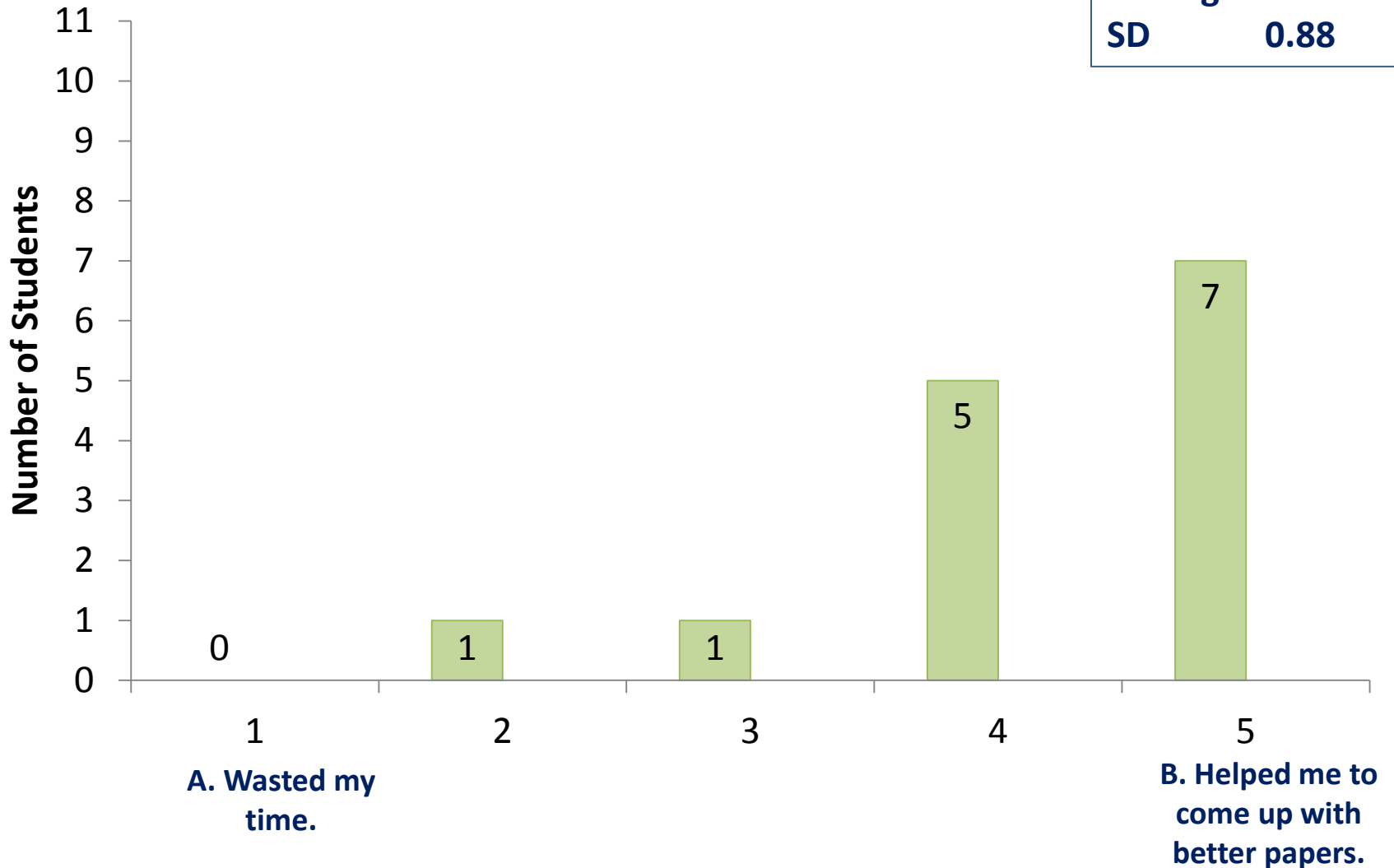
**FOR ME, TIME SPENT REVISING PAPERS IN THIS  
COURSE:**

**(a) Wasted my  
time.**

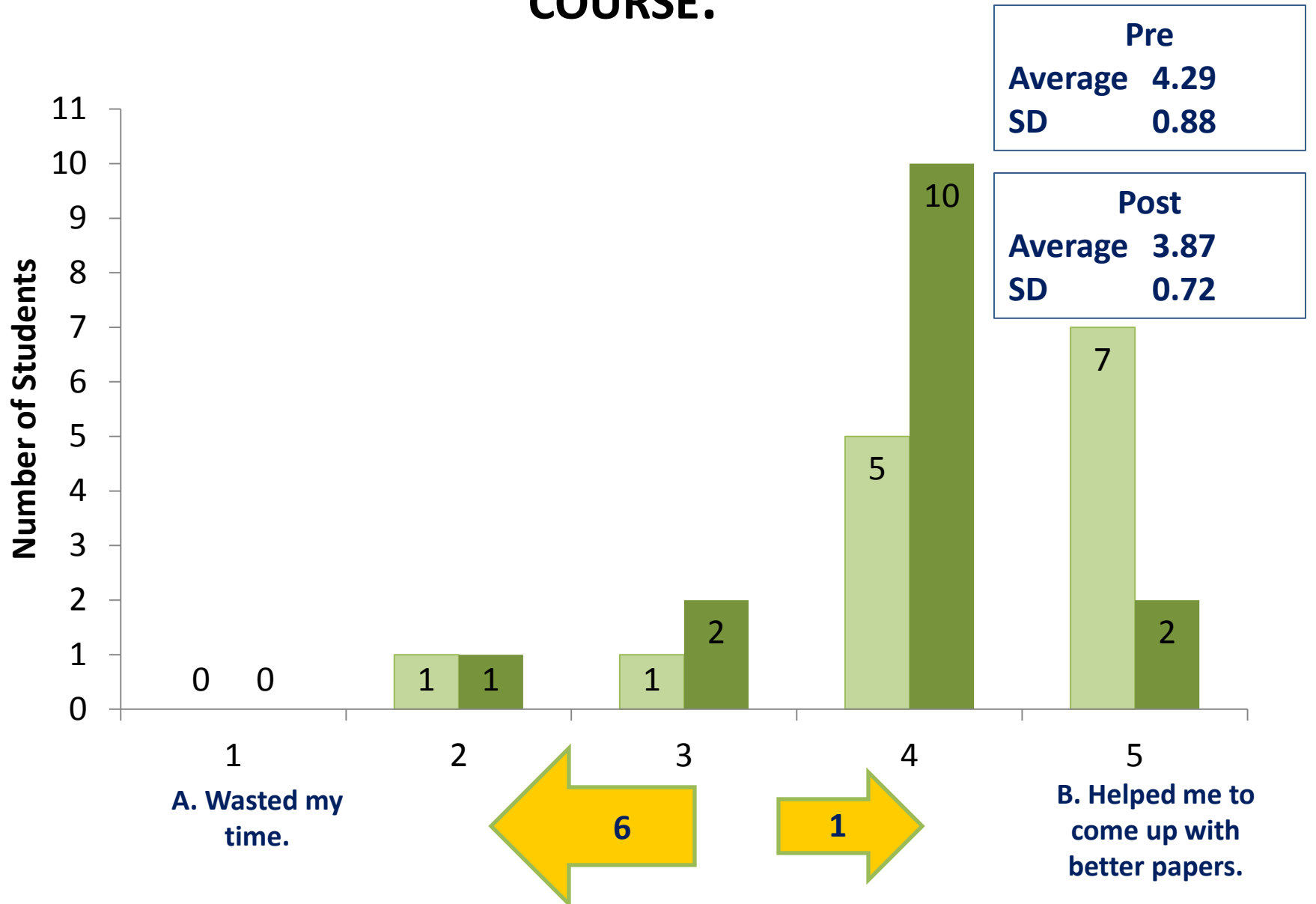
**(b) Helped me to  
come up with  
better papers.**

# Q2--FOR ME, TIME SPENT REVISING PAPERS IN THIS COURSE:

	<b>Pre</b>
<b>Average</b>	<b>4.29</b>
<b>SD</b>	<b>0.88</b>



# Q2--FOR ME, TIME SPENT REVISING PAPERS IN THIS COURSE:



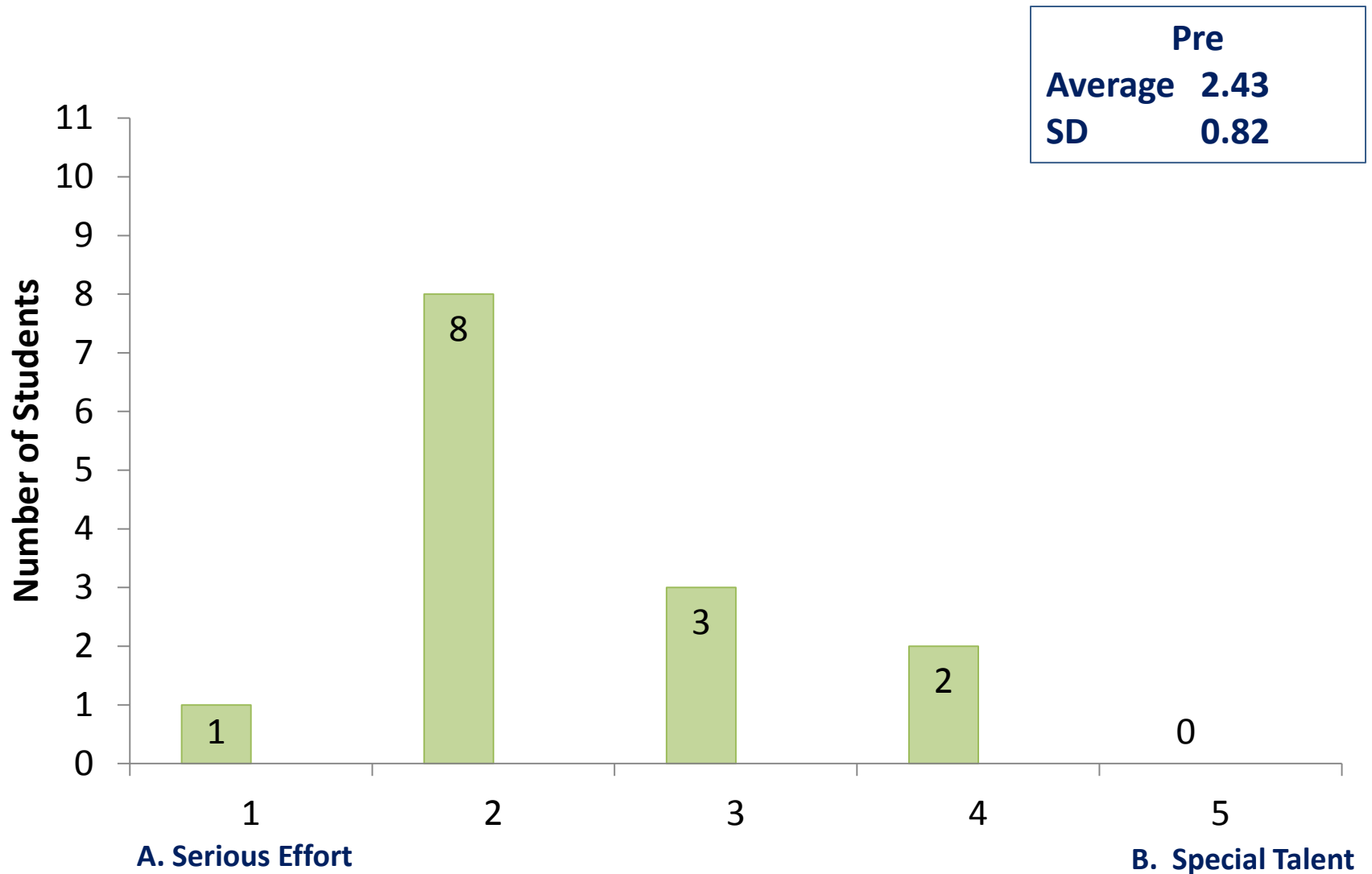
## **QUESTION 3**

**LEARNING TO WRITE ABOUT SCIENCE REQUIRES:**

**(a) Serious Effort**

**(b) Special Talent**

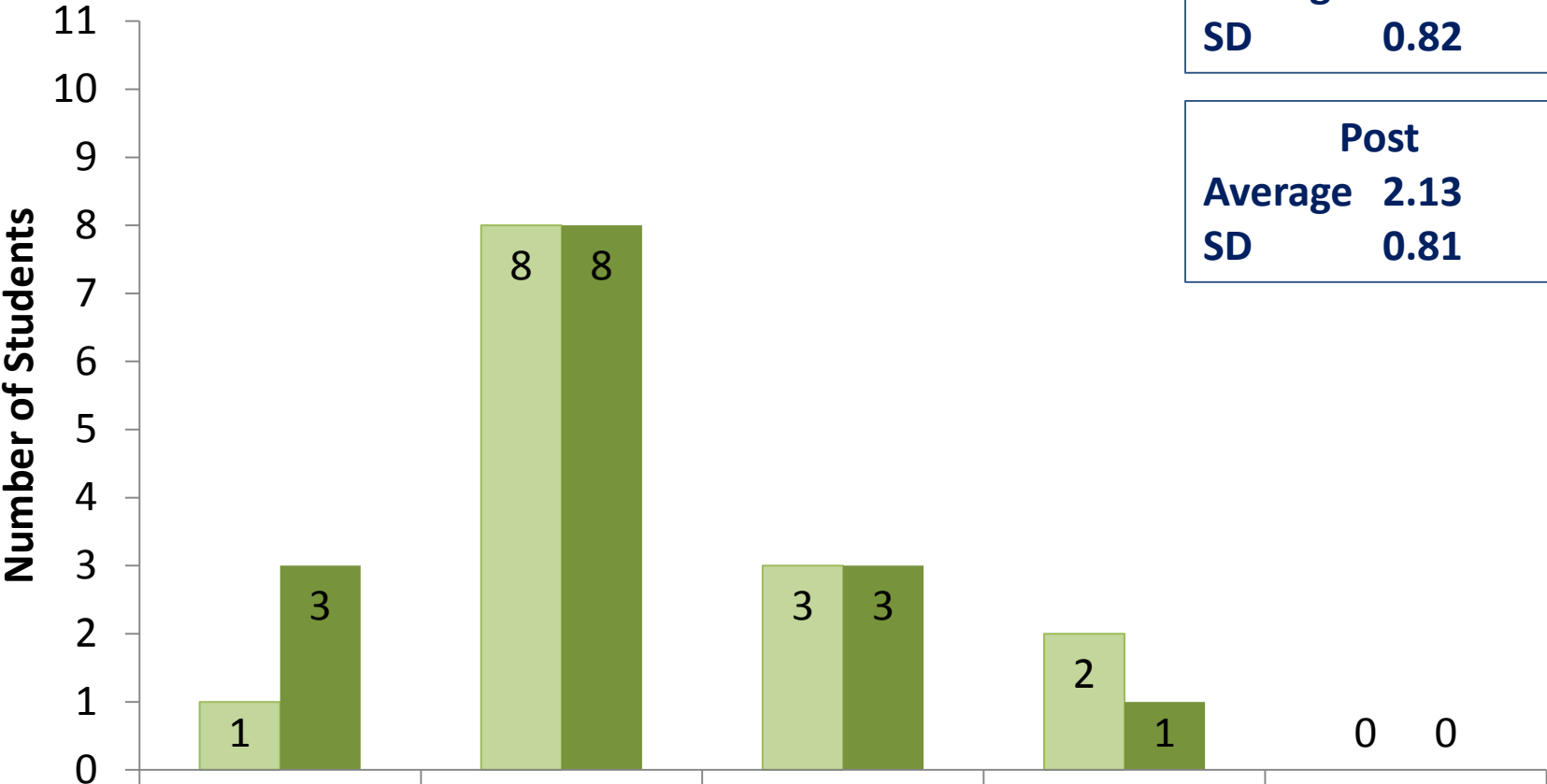
# Q3--LEARNING TO WRITE ABOUT SCIENCE REQUIRES:



# Q3--LEARNING TO WRITE ABOUT SCIENCE REQUIRES:

<b>Pre</b>	
<b>Average</b>	<b>2.43</b>
<b>SD</b>	<b>0.82</b>

<b>Post</b>	
<b>Average</b>	<b>2.13</b>
<b>SD</b>	<b>0.81</b>



**1**  
**A. Serious Effort**

**2**  
**6**

**3**  
**3**

**4**  
**B. Special Talent**

**5**



# Open Responses by Students

- **Most Useful:**

- “Learning how to structure essay”
- “Distilling primary literature”
- “Group discussions”
- “Reviewing figures”
- “Using the tablets”
- “Provided a new way of thinking”

- **Least Useful:**

- “Amount of writing could be cut down”
- “Too much time discussing articles”
- “Using the tablets”

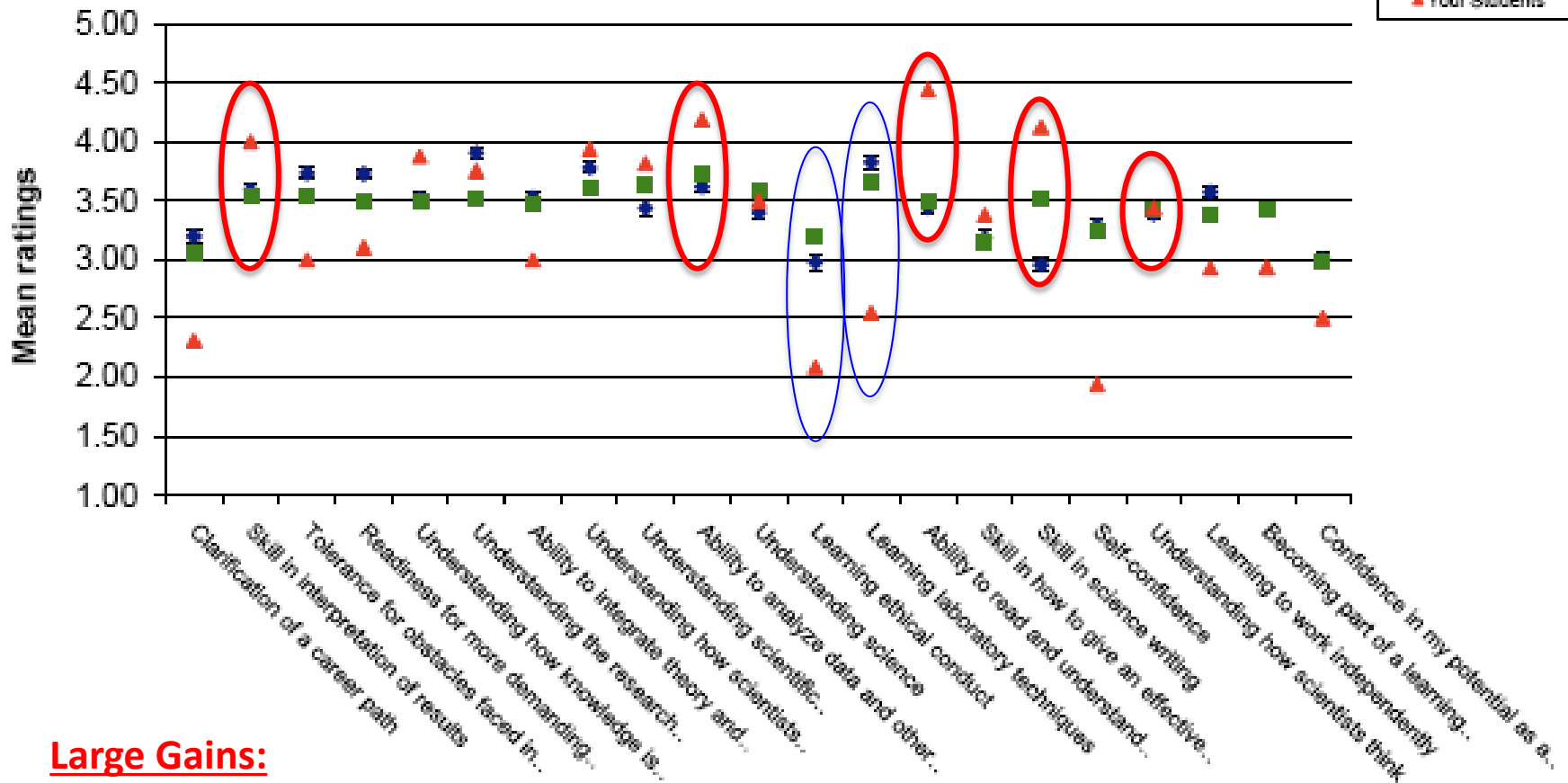
# Pre and Post-Semester Perceptions

- Lack of clarity on the direction of writing????
  - Reader is the instructor and vice versa
- Revision process may have been less helpful
  - The term of “revision” is a bit nebulous; connected to the grade versus the process
- Despite the challenges of writing, students, post-semester, view writing with a growth mindset rather than a fixed mindset.
- Provoked a new way of developing their scientific ideas and understanding the process

**What does the CURE survey tell  
us?**

# CURE 2009

## Learning Gains



### Large Gains:

Skills in interpretation of results

Ability to analyze data

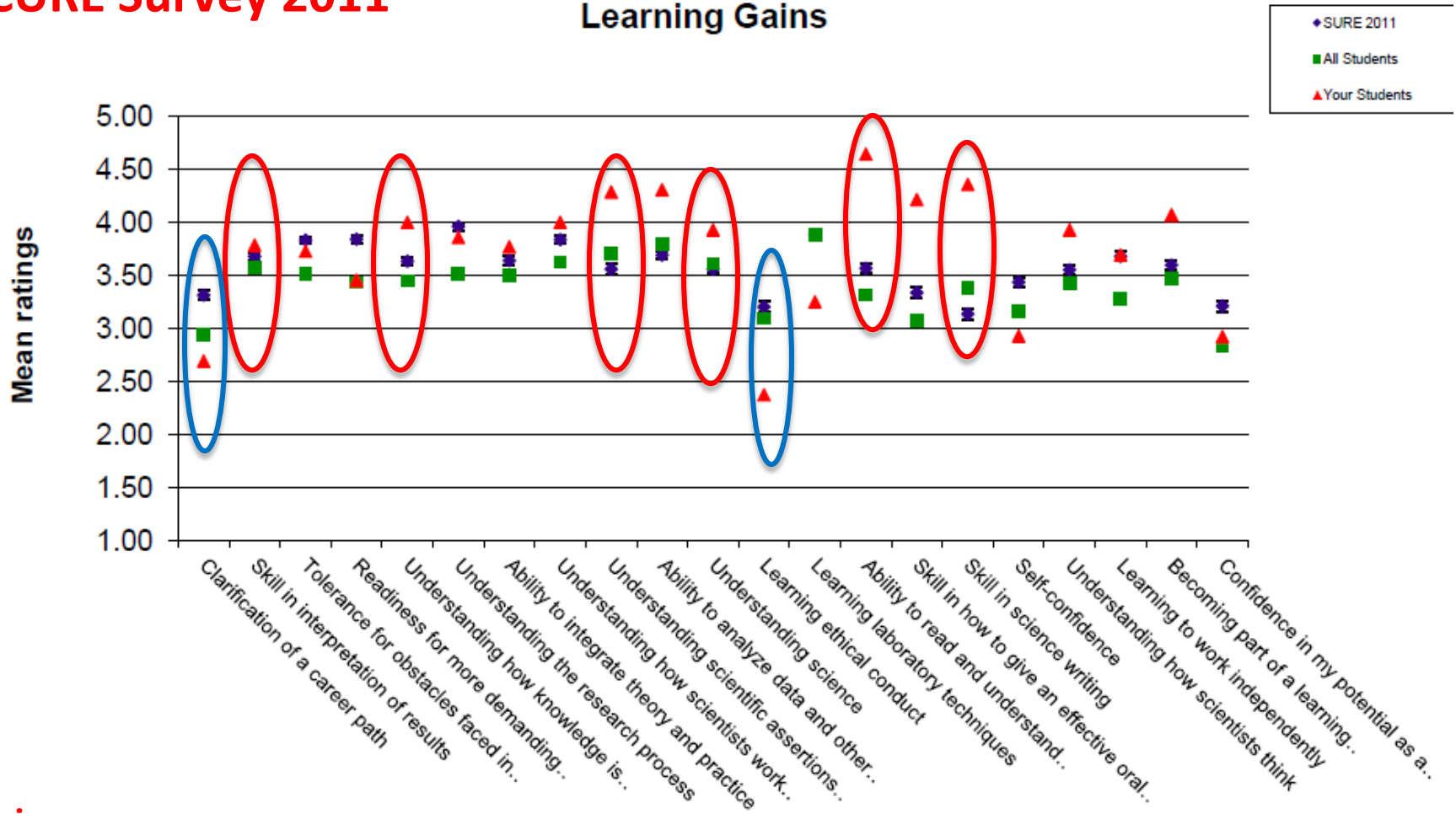
Ability to read and understand primary literature

Skill in scientific writing

Understanding how scientists think

# CURE Survey 2011

## Learning Gains



### Gains:

Skills in interpretation of results

Understanding how knowledge is constructed

Understanding the scientific assertions require supporting evidence

Ability to analyze data

Ability to read and understand primary literature

Understanding how scientists think

# Conclusions and future prospects

- Write a paper on student progress in meeting course learning goals by combining data from all these different measures
  - independent scoring of the writing using the rubric
  - Attitudes about writing
  - Self perceived skills development
  - Usefulness of assignments/free responses about the course.

**Questions or Comments?**