PROBLEM SOLVING IN BIOCHEMISTRY: ASSESSMENT, LEARNING STRATEGIES, AND PRECONCEPTIONS

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University of New Mexico
April 23, 2013
OBJECTIVES:

1. Summarize a DBER dissertation.
2. Identify its implications for the community.
COLLECTIVE VISION FOR CHANGE

V&C Core Competency
Apply the process of science

ASBMB Core Concept
Discovery requires:
• objective measurement
• quantitative analysis
• clear communication

DEFINING SCIENTIFIC PROBLEM SOLVING

Hypothesize

Reflect

Integrate

Evaluate

Investigate

INDIVIDUAL PROBLEM SOLVING ASSESSMENT (IPSA)

- Electronic, computer-based
- Progressive reveal format
- 1 Short essay per domain
- 45-75 minutes total

Scoring rubrics

- Exemplary
- Satisfactory
- Unsatisfactory

**Diverse DBER Perspectives**

**IPSA**
- Problem Solving
  - Hypothesize
  - Investigate
  - Evaluate
  - Integrate
  - Reflect

**CAT**
- Critical Thinking
  - Evaluating Information
  - Creative Thinking
  - Learning & Problem Solving
  - Effective Communication

**CLASS-Bio**
- Learning Attitudes about Science
  - Real World Connection
  - Enjoyment
  - Conceptual Connections
  - Problem Solving

- Reasoning
- Synthesis & Application
- Strategies
- Effort

**DIVERSE DBER PERSPECTIVES**

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A DBER DISSERTATION

Majors
Cohort 1A (N = 14)
Cohort 1B (N ≥ 20)

All Students
Cohort 2 (N ≥ 50)

Descriptive Statistics  \rightarrow \text{Describe Performance}

Inferential Statistics  \rightarrow \text{Explain Performance}

Fit Current Views
A DBER DISSERTATION

Majors
Cohort 1A (N = 14)
Cohort 1B (N ≥ 20)

Content
IPSA

All Students
Cohort 2 (N ≥ 50)

Content
IPSA
CAT
CLASS-Bio

Fall | Spring | Fall | Spring
--- | --- | --- | ---
Biochem I | Biochem II | Electives

Descriptive Statistics → Describe Performance
Inferential Statistics → Explain Performance

Fit Current Views
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Content
IPSA

Fit Current Views

Describe Performance

Explain Performance
## A DBER Dissertations

### Majors

- **Cohort 1A (N = 14)**
  - Content
  - IPSA

- **Cohort 1B (N ≥ 20)**
  - Content
  - IPSA

### All Students

- **Cohort 2 (N ≥ 50)**
  - Content
  - IPSA
  - CAT
  - CLASS-Bio

### Course Registration

<table>
<thead>
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<th></th>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
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<td>Biochem I</td>
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### Analytical Approaches

- **Descriptive Statistics**: Describe Performance
- **Inferential Statistics**: Explain Performance

### Fit Current Views
A DBER DISSERTATION

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Fit Current Views
LONGITUDINAL IPSA PERFORMANCE

N = 14
A SINGLE PREDICTOR OF SCIENTIFIC ACUMEN?

Hypothesize – Given vague problem, list top 4 hypotheses

Investigate – Given hypothesis, design an experiment

Evaluate – Given data, describe results

Integrate – Given results, interpret in the broader context

Reflect – Given interpretation, evaluate your performance
Do you identify with one domain as a simple correlate to becoming a successful scientist, and what is your stake in measuring problem solving?
“Problem solving is…”

**DIVERSE STUDENT PERSPECTIVES**

- Individual Problem Solving Inventory (IPSI)
  - Student preconceptions

- Individual Problem Solving Assessment (IPSA)
  - Student performance
“Problem solving is...”

- **Process Steps**
  - Observe
  - Question
  - Search
  - Hypothesize
  - Investigate
  - Evaluate
  - Integrate
  - Reflect

- **Big Ideas**
  - Process
  - Reasoning
  - Community
  - Validity
  - Novelty
  - Solution
  - Cyclical

- **Pie Chart**
  - 21% No Emphasis
  - 45% ≥ 3 Big Ideas
  - 16% ≥ 4 Steps
  - 18% Both

N = 76
SUMMARY

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Explain Performance

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Describe Performance
Explain Performance
Fit Current Views

Future IPSI

- 21% No Emphasis
- 45% ≥ 3 Big Ideas
- 18% Both
- 16% ≥ 4 Steps

N = 74
**SUMMARY**

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- Describe Performance
  - Explain Performance

**DBER Evidence**

- Future Translation

**Pedagogical Practice**

**Future IPSI**

**Fit Current Views**

- 45% ≥ 3 Big Ideas
- 16% ≥ 4 Steps
- 18% Both
- 21% No Emphasis

N = 74
ACKNOWLEDGMENTS

Advisor and Committee Members

Marcy Osgood, PhD
University of New Mexico

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University of New Mexico

significant Others

Ellis Bell, PhD
University of Richmond

ASBMB

Tennessee Technological Univ.
Univ. of Colorado at Boulder
Exit IPSA Pilot Testers
UNM HSC HRRC
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