ED04
Why Solve Problems? - Part 2: Different Views from Different Practices?*

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Interview Process

Goal of Study

- Understand faculty beliefs about learning and teaching of problem solving

Research Method

- Interviews conducted with 31 faculty

- Videotaped

- Transcribed (~30 pages of text / interview)

Can We Measure Anything?

Develop Analysis
based on interviews with two instructors that we know a lot about
"standard candles"

At minimum the analysis should:
• Find differences between instructors with different practices
• Elicit aspects of problem solving from:
    $\rightarrow$ Instructors familiar with PS research
    $\rightarrow$ Instructors not familiar with PS research

Analyze remainder of the interviews

Two Instructors - Two Practices

Both

- **Active research physicists**

- **Taught the same introductory calculus-based physics course within same departmental structure**

- **Won Teaching Awards**

TRaDitional (TRD)	**Explicit Problem Solving (EPS)**
• **Does not use Explicit Problem Solving Strategy**	• **Uses Explicit Problem Solving Strategy**
• **Not familiar with problem solving research**	• **Familiar with problem solving research**

Analysis Procedure

For Each Instructor*:
- Break the interview transcript into units
- Categorize the units
- Reconstruct
  1. Teaching Models
  2. Awareness of aspects of problem solving

Example from first part of interview (Instructor Solution II).

Q: "Take a look at each of these instructor solutions and describe how they are similar or different to your solutions."

TRD: "I worry about too much detail in a solution. I think it turns them [students] off in some ways. They kind of want the quick and dirty deal here."

*[Miles, M. & Huberman, A. (1994) *Qualitative Data Analysis*.]

Breaking Transcript into Units

Unit: The smallest piece of text that can be understood as describing an action or internal state of a student or instructor.

> **"I worry about too detailed of a solution. I think it turns them [students] off in some ways. They kind of want the quick and dirty deal here."** TRD interview

Units

1. **I don't like to give out solutions with too much detail**
2. **Students don't like solutions with too much detail**
3. **Students like quick and dirty solutions**

Reconstruction 1

- **Categorize the units from one set of thoughts (based on time sequence and internal references)**

	External	Internal	Unclear
Student		Students don't like solutions with too much detail, Students like quick and dirty solutions	
Instructor	I don't like to give out solutions with too much detail		

- **Construct teaching models**

TRD Instructor

	Initial State of Student	Instructor Action	Student Action	Final State of Student
Model 1		Provide structured solutions	Understand the structure of instructor solutions	Use this understanding when solving problems
Model 2	Don't like detailed solutions	Provide solutions without too much detail	Perceive problem as easy	
Model 3	Higher-level students can understand solution	I gear solutions to higher-level students		Higher-level students can use this when solving problems
	Lower-level students cannot understand solution	I don't gear solutions to lower-level students		Lower-level students get left behind

EPS Instructor

All Models from part 1: Instructor Solutions

	Initial State of Student	Instructor Action	Student Action	Final State of Student
Model 1	Students are not good at properly structuring their solutions	Provide structured solutions	Understand the structure of instructor solutions	Use this understanding when solving problems

- **EPS has 1 model**

- **TRD has 3, possibly incomplete, models**

Is Model 1 the same for both?

The Difference is in the Details

For Example:

Both emphasized "structured solutions" in Model 1

- TRD - Fewer external actions, sometimes vague
    - "Professional physicist strategy for problem solving"
    - "Draw pictures"
- EPS - More external actions, specific and detailed
    - "Explicitly state choices and decisions"
    - "Diagrams that include $\vec{v}$ and $\vec{a}$"

Reconstruction 2
Eliciting Aspects of Problem Solving

Procedure

- Categorize the units from different parts of the interview into the aspects of PS.

Results

- Each instructor mentioned similar aspects of problem solving.
- There were differences in emphasis within each aspect.

  For example, under General Decision Making

  → Both mentioned evaluating progress and results

  → TRD emphasized exploration (trial and revision)

  → EPS emphasized weighing choices in making decisions

Preliminary Conclusions

This type of analysis seems meaningful:

- **Our analysis allows us to find differences between the two instructors with different practices**
    - → Both mentioned similar aspects of problem solving, but with differences in attributes and in external manifestations
    - → TRD did not have "complete" teaching models, EPS did
    - → TRD had more general descriptions, EPS more specific
    - → TRD had 3 competing models, EPS had 1 model

Preliminary Conclusions

- **The differences correspond with their practices**

  → **Competing models result in inconsistent actions *:**

  → **External observer and self-reporting**

    → **TRD: No consistent approach (to problem solving)**

    → **EPS: Consistent use of strategy (for problem solving)**

  → **Self-reporting (from TRD)**

    → **"I want to see their reasoning."**

    → **"I am not particularly in favor of knocking people off … if they see an answer and go right to it."**

Many teachers have competing models*

[Calderhead (1996), Schoenfeld (1998)]

Preliminary Conclusions

This type of analysis seems fruitful:

- If we can get similar information from the other 29 interviews we will be able to:
  - **Clarify language used by instructors**
    - "Structured Solutions"
  - **Match curricular design to instructors concerns**
    - Need to address student likes/dislikes
  - **Determine possible professional development**
    - No need to develop awareness of aspects of problem solving
    - Develop awareness of competing teaching models

Refine our analysis (suggestions invited)

Reconstruction 1b
Triangulation based on Explicit Reasons

Using explicit reasons given by each instructor in different parts

TRD mentioned three prominent types of reasoning used when planning instruction:
- Student learning
- Perceived student likes/dislikes
- Belief that some students cannot be helped

EPS only mentioned reasons based on considerations of student learning when planning instruction.

Reconstruction 2
Based on problem solving content

- **Categorize the units from all parts of the interview**

	External	Internal Cognitive	Internal Affective	Unclear
Student				
Instructor				

Knowledge Organization
Knowledge Type
Analysis Type
General Decision Making Processes
Other Problem Solving Aspect

- **Examine aspects of problem solving**
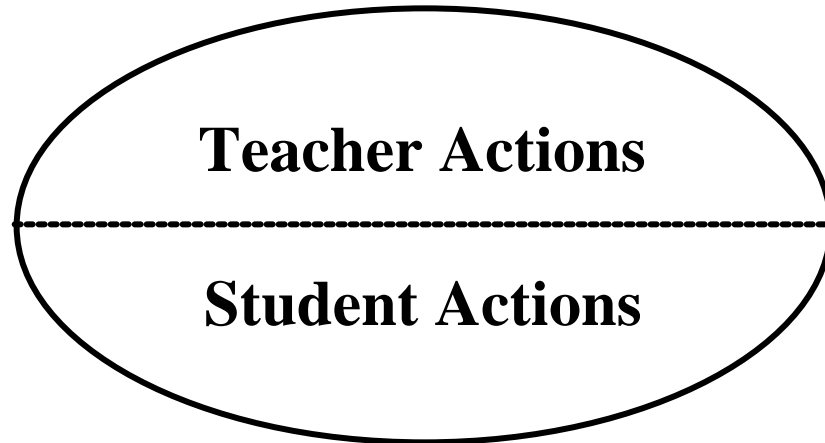- **Examine relationships between internal and external actions**

Reconstruction 2
Based on problem solving content

	TRD	EPS
Knowledge Organization	Principles, Surface Features	
	Concept covered recently	
Knowledge Type	Procedural (summing forces, math, etc.), Conceptual	
	Declarative (knowing the facts)	
Analysis Type	Diagram (few specific details)	Translating problem to physics representation (typically through a diagram – many specific details)
General Decision Making Processes	Evaluating progress and results	
	Exploration (trial and revision)	Weigh choices to making decisions, Realize what you understand
Other	Understanding of the problem solving process	
	Believing you can solve the problem	

Teaching Model

Initial State of Student

Teacher Actions

Student Actions

Final State of Student