What do students learn from example problem solutions?

Instructors’ Beliefs*

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Outline

• Details of the study

• Focus of the talks

• Analysis Procedure

• Instructors’ beliefs on how Example Problem Solutions aid student learning

Disclaimer: “Student Learning” really means “instructors’ beliefs about student learning”
Focus of Our Group

Learning of physics through problem solving

in this study ...

Instructors’ beliefs and values about the teaching and learning of problem solving in physics

why instructors? the questions is ...

Can we determine what these beliefs and values are?
To understand instructors’ beliefs and values with respect to problem solving

We have developed and administered a 1½ hour open-ended interview to physics faculty guided by instructional artifacts:

1st) 3 Instructor solutions: varied in the details of their explanation, physics approach, and presentation structure
General & Specific Questions

2nd) 5 Student solutions

3rd) 4 Problem types

All artifacts were based on one problem -- instructors were given the problem and asked to solve it on their own before the interview.
Sample

Physics faculty in state of Minnesota:

taught introductory calculus-based physics course in the last 5 years (~107 possible).

Randomly Selected 30

Roughly evenly divided among:
1) Community College (CC) N = 7
2) Private College (PC) N = 9
3) Research University (RU) N = 6
4) State University (SU) N=8

Plan

Phase I: Develop hypotheses about the range and nature of faculty conceptions based on 6 Research University Faculty.

Phase II: Refine and test hypotheses with remaining 24 interviews.

Phase III: Determine the distribution of conceptions among faculty using a larger national sample.
In these 2 talks …

about why instructors give EPS

We have developed a method to get at these beliefs

Talk 1: procedure on finding out what instructors think students get out of example problem solutions – learning from EPS

Talk 2: how do instructors choose to use example problem solutions – teaching using EPS
Analysis

Procedure

Concept Maps allow for:
the reduction of complex data into visual representations
explicit connections to be made between ideas that can then be tested

Video- & audiotapes of 6 interviews (~9 hrs)

Interview transcripts (~180 pages)

Statements (~2400)

Concept Maps (15 x 6 = 90)

Combined Concept Map (15)
Main Concept Map – Learning of Problem Solving
Main Concept Map – Learning of Problem Solving

Working and Comparing
Example Problem Solution – Working and Comparing

Engage in Learning Activities

of
working

Appropriate Problems

on

Appropriate Knowledge

by trying problems on their own (1, 2, 3, 4, 5, 6)

must be substantial effort (1, 3)

students can’t get much from just making sense of EPS – they must do the process themselves (1)

by focusing on the structure (3)

by analyzing mistakes and compare with my solution (1, 2, 4, 6)

most students don’t do this (1, 2, 3)

by

Approaching A Problem (1, 3, 4)

which is

Understanding Physics Concepts (1, 4)

feedback
to
get

then using

before using

because

then using

of

trying problems on their own (1, 2, 3, 4, 5, 6)

by

which is

which is

by

by

by

by

by
Main Concept Map – Learning of Problem Solving

Working and Comparing
Main Concept Map – Learning of Problem Solving

Looking
Example Problem Solution – Looking

Engage in Learning Activities

Looking / Listening

Example Problem Solutions / Lectures

Get

Appropriate Knowledge

if having trouble, looking at EPS in other textbooks to get a different viewpoint (2)

which is traditional studying (6)

can be helpful, but not as good as trying it yourself (1)

think about what is going on (6)

Approaching A Problem (1, 3, 5, 6)

Perform Specific Techniques (1, 5)

Understanding Physics Concepts (6)

read the book, look at problems that others have solved, etc. (6)
Preliminary Hypotheses
with respect to the usefulness of Example Problem Solutions

• Instructors believe that students can learn from EPS if: (these should not be surprising)
  1. Students work on problems and then compare their solutions to the EPS

    many faculty don’t think that students typically do this comparison

  2. Students look at solutions from example problems that the instructor solves during lecture

    faculty rarely mention the types of thought processes that students should engage in while watching the solutions
Preliminary Hypotheses
with respect to the usefulness of Example Problem Solutions

• Instructors believe that students can learn these 3 things from EPS: (again, these should not be surprising)

1. Approaching problems
   • e.g. Recognize what is relevant and what is not

2. Understanding physics concepts
   • e.g. Identify the physics that underlie the problem

3. Performing specific techniques
   • e.g. Free Body Diagrams
What have we learned?

• Concept maps:
  – **Reduced** complex data into visual representations
  – **Identified** beliefs and values of the instructors
  – **Made** explicit connections between ideas from various parts of the interview, and can thus be tested
  – **Identified** areas / ideas that need further exploration
The end ...
Thank You!

For more information, visit our web site at:

http://www.physics.umn.edu/groups/physed/