

Students' Perceptions of Research-Based Problem Solving Strategies in Physics

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Research Questions

- What are students' perceptions of research-based strategies implemented in algebra-based physics?
- How do these strategies compare with traditional strategies already used by the students?

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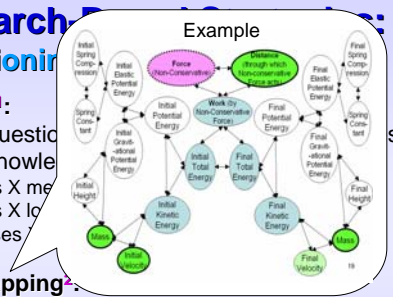
Research Questioning

Questioning¹:

- Generate questions based on knowledge
 - What does X mean?
 - What does X look like?
 - What causes X?

Structure Mapping²:

- Provide a visual representation which expresses functional relations between concepts and quantities.



¹(Otero & Graesser, 2001)

²(Novak, 1983)

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Participants

- 'Descriptive Physics'
 - Algebra-based introductory physics
 - Course Text: *Physics: Principles with Applications*, Giancoli 6th Ed.
- About 80% Architecture majors
- Spring 2007
- N=150

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Research Design

- **Quantitative Study Result**
 - **No significant difference** in homework or exam scores between treatment and control groups
- **Qualitative:** (N = 8) **Semi-Structured Interviews**
 - What are students' perceptions of these strategies?
 - Participants from both treatment groups & control group
 - About 1 month after quantitative study
 - Two, 50-minute individual interviews

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Qualitative Semi-Structured Interviews

- **Interview 1**
 - Described how they work through a problem
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- A ball of mass 2kg is held against a spring compressed by 1 m with a spring constant of $k = 3 \times 10^4 \text{ N/m}$, and sits at the bottom of a ramp 50 m high. The ramp is inclined at an angle of 60° . When the ball is released, assuming a frictionless ramp and no wind resistance, the ball will hit a pit of sand. The depth the ball sinks into the sand is 1 m.
- (a) At what speed will the ball leave the ramp?
 (b) What is the average force on the ball by the sand?
 (c) Is there any information provided in the problem that you did not need in (a) and (b)? If so, what information?
 (d) If 'x' is reduced, what happens to the depth the ball sinks into the sand?

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Qualitative Results

Perceptions of Questioning Strategy

- Purpose of strategy:
 - Helps in visualizing and focusing (4 of 4 students)
"...to help us visualize the problem, to ... think of what we should take into account, ... of what shouldn't be taken into account..."
- Comparison with own strategy:
 - Mimics question asking, similar to own (4 of 4)

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Qualitative Results

Perceptions of Questioning Strategy

- Using the questioning strategy:
 - Used equations to answer questions (3 of 4)
"...I usually try to find the equation I'm using from what I'm given ... and .. see if there is something ... I need."
- Pairing of problems:
 - Recognized pairing (4 of 4)
 - Reason for pairing: Use same equation (3 of 4)
- Performance on interview problem:
 - Completed at least one part of interview problem (1 of 4)

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Qualitative Results

Perceptions of Structure Mapping

- Purpose of strategy:
 - Map presented problem information (3 of 4 students)
 - Map made relationships apparent (4 of 4)
"... when you figure out ... what it gives you and then how to figure out what equation to use from the arrows, helps, ... it tells you what you need in order to figure out how to get the answer."
- Comparison with own strategy:
 - Not comparable (4 of 4)

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Qualitative Results

Perceptions of Structure Mapping

- Using the structure mapping strategy:
 - No difficulties (4 of 4)
 - Not likely to use it unless given the map (4 of 4)
- Pairing of problems:
 - Recognized pairing (1 of 4)
 - Reason for pairing: Space saving (3 of 4)
- Performance on interview problem:
 - Completed at least one part of interview problem (4 of 4)

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Conclusions

- Neither questioning nor structure mapping appears to be effective as measured by homework and exam performance – *perhaps longer study needed.*
- Students report that both strategies are user friendly – but *more structure mapping students completed interview problem* vs. *fewer questioning students.*
- Problems with strategies:
 - Questioning strategy: Tendency to answer questions using equations.
 - Structure mapping strategy: Inability to see value of paired problems.

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Current Work

- **One Strategy at a Time**
 - Clearer focus for research project
 - Start with structure mapping
- **Long Term Study**
 - Learn how problem solving skills develop over the long term.

Currently adapting and implementing structure mapping in algebra based General Physics.

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Thank You!

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