Facilitating Case Reuse During Problem Solving

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Case Reuse

Traditional Problem Solving in Descriptive Physics:
Students are given 1 problem of a particular “structure” followed with a “transfer problem”
(The transfer problem is generally another problem on the same homework assignment)

Case-Based Reasoning:
• Retrieve similar case or cases
• Reuse information and knowledge in similar case to solve the problem
• Revise proposed solution
• Retain parts of experience useful for future problem solving

Facilitating Case Reuse in Descriptive Physics:
• Retrieve similar cases (a pair structurally similar problems)
• Students use information in similar cases to solve transfer problem
• Structural characteristics more important than some less important characteristics (facial) students tend to analyze.

Literature

“An important skill in mathematical problem solving is recognizing that the problem one is working on (target problem) can be solved using the same method as a problem one already knows (source problem).” (Quilici et al, 2002)

Audience

• Phys 115 - Descriptive Physics
• “about 80% architecture students” yields homogeneous population
• Course is taught spring semester of the year
• Study in mind with utilize 2 treatments and a control group

Concept Maps, Schema...

External representations through objects and/or symbols in an effort to illustrate a learner’s knowledge can facilitate the process of solving a problem. (Jonassen et al, 1997)
**Research Design**

**TREATMENT GROUP I (Questioning Strategy)**
- THREE PAIRS of contrasting cases
- EACH PAIR of problems have same underlying schema (structure) and different surface features
- EACH PAIR followed by a series of M.C. questions geared to help the learner focus on:
  - Difference between the two problems
  - Causal Reasoning
- THREE TRANSFER problems; one for each pair of contrasting cases.

**TREATMENT GROUP II (Structure Map Strategy)**
- Students led through an example in which they learn how to interpret the schema at different layers.
- Explicitly given elements
- Implicitly given elements
- Differentiate necessary and unnecessary elements
- THREE PAIRS of contrasting cases
- EACH PROBLEM is followed by the structure map. Students are asked to identify all elements of each problem by mapping them to the schema (map).
- EACH PAIR followed by M.C. questions geared to help the learner focus on:
  - Differences in schema
  - Causal Reasoning
- THREE TRANSFER problems; one for each pair of contrasting cases.

**CONTROL GROUP**
- THREE regular homework problems from end of chapter (Their main purpose is to balance the time on task with the Treatment Groups)
- THREE TRANSFER problems (Same as those in the treatment groups).

**Training Problem Pairs**
(Problem #s are from Giancoli, 6th Ed.)

**TYPE 1 : Work & Kinetic Energy**
- Problem # 6-19
- Problem # 6-23

**TYPE 2 : Potential Energy**
- Problem # 6-29 (Modified)
- Problem # 6-32

**TYPE 3 : Conservation of Energy**
- Problem # 6-61 (Giambattista 2nd. Ed.)
- Problem # 6-38 (Modified)
### Generic Structure Map or Schema

- **Force** (Non-Conservative)
- **Distance** (through which Non-conservative Force acts)
- **Work** by Non-Conservative Force
- **Initial Total Energy**
- **Final Total Energy**
- **Initial Potential Energy**
- **Initial Kinetic Energy**
- **Initial Elastic Potential Energy**
- **Initial Gravitational Potential Energy**
- **Initial Spring Compression**
- **Spring Constant**
- **Mass**
- **Initial Velocity**
- **Final Velocity**
- **Final Height**
- **Initial Height**
- **Initial Spring Compression**
- **Spring Constant**
- **Force** (Non-Conservative)
- **Distance** (through which Non-conservative Force acts)
- **Work** by Non-Conservative Force
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- **Initial Kinetic Energy**
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- **Initial Spring Compression**
- **Spring Constant**
- **Mass**
- **Initial Velocity**
- **Final Velocity**
- **Final Height**
- **Initial Height**

(Treatment II)

### Treatment I: Questions

- **Questions 1-5:** What do you know about problem A?
  - 1. General principle, theory, may be applied
  - 2. Direct quantities given in problem
  - 3. Physical quantities that change while solving problem
  - 4. Identify non-conservative forces
  - 5. Information not required to solve problem

- **Question 6:** Complicate problem A and ask students for additional information required to solve for the new anomaly.

- **Questions 7:** OPEN ENDED: Ask students to create a (part II) to problem A such that the problem resembles problem B

- **Question 8:** Manipulate one of the values given and ask students to identify the general trend of manipulation on the system

### Seminar Feedback:

- Time on task not fair between control, treatment 1, and treatment 2
- General questions about validation:
  - how were pairs validated?
  - how was the schema validated?
  - how were the questions validated?
- During treatment 2, must be very careful not to give extra instruction
- Note what feedback will be given to students ahead of time. Don’t want to do so individually as necessary
- Non-conservative not necessary in problem 6-19 as could be taken as conservative and can’t tell reasoning from M.C.
- Unfair grading ~ [Grades will be normalized at end]

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**PLAYTIME!**

You will be given:
- Treatment II (Structure Map)
- Paired Questions
- Treatment II Questions

Answer Questions, use structure map, and be expressive!

Any feedback given could prove useful for modification of materials
References


