Group Learning Interviews to Facilitate Case-Reuse Strategies in Problem Solving

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Goal
Facilitate the development of ‘conceptual schema’ during problem solving using ‘case reuse’ strategies.

Conceptual schema – a mental map of concepts and their relationships.

Outline
I. Treatment
   I. Group Learning Interviews
II. Assessment
   I. In-class examinations

What is ‘Case Reuse’?
Appropriate use of conceptual knowledge learned through a previous case (solved example) to assist in solving an unsolved problem

Treatment
Research Questions
• How do students determine whether a given example is useful for solving a different problem?
• How might we refocus student’s emphasis on the similarities and differences between problems to include emphasis on deep-structure differences?

Previous Research
Expert vs. Novice
Chi (1981)
• Novices focus on surface features of the problem for categorization.
• Experts focus on physics principles applicable to approaching and solving a problem.

Hardiman (1989)
• Surface similarity between problems could interfere with experts’ classification of problems.
Research Design

Timeline

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Group Learning Interviews

1. 2-D Kinematics
2. Force
3. Rotational Motion
4. Work-Energy
5. Rotational Motion
6. Pressure in Fluids
7. Simple Harmonic Motion
8. Standing Waves & Resonance

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Group Learning Interview #1

Method

For each problem, students were individually asked to:
1. Identify and interpret the principles involved in problem.
2. Represent problem using a picture (e.g. Free body diagram)
3. Specify if problem has sufficient, missing, irrelevant info.
4. Use principles and equations to solve problem.

Group Learning Interview #2

Similar to Int. # 1, but introduced ‘stopping points’.

Method

1. Explain your solution to your partner.
2. Discuss similarities and differences with partner’s problem.
3. Signal “Stop” if you have completed tasks 1-5.
4. Discuss any similarities and differences that your problem has with your partner’s problem.
5. Signal “Stop” if you have completed task 6.
6. Work together with your partner to create a new problem which incorporates elements of both problems previously discussed.
**Group Learning Interview #3**

**Method**

More **procedural scaffolding** provided to shift focus from procedure to concepts.

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**Group Learning Interview #4**

**Prob. C** was solved for the students by moderator before they were given either Prob. A or Prob. B.

**Problem A**

A 0.10 kg arrow is fired from a bow. The bow is pulled back a distance of 0.8 m so that the arrow is released with a speed of 30 m/s as it leaves the bow. The arrow travels 21.6 m before hitting its target. What is the average force exerted on the arrow by the bowstring?

**Problem B**

A 0.65 kg batter hits a 0.14 kg, baseball sending it off into left field, 400 m away from the batter’s box. The baseball lands in a backyard’s glove, starting an average force of 300 N, moving the glove backward 0.25 m before coming to rest. What is the speed of the ball just before it is caught?

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**Group Learning Interview #5 through #8**

Same protocol as **Group Learning Interview #4**

**Except**

Students are asked to read through the solution to Prob. C and moderators addressed questions that students asked.

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**Summary of Group Learning Interviews**

**General Observations**

- **Similarities**
  - Focus on deep structure
  - Surface features rank lower than deep structure
- **Differences**
  - Focus on surface features
  - Usefulness
  - ‘Mathematical trickery’ lessens usefulness ratings every time

Still focus on procedure more than concepts

**What we Learned**

- Difficulty level of problems must be carefully adjusted
  - Too difficult: focus on solving problem, not on reflection
- We need to provide scaffolding in the form of:
  - solved example before unsolved problems
  - questions asking them to enunciate principles
  - structure for reflecting on similarities/differences