Using Similarity Rating Tasks to Assess Case Reuse in Problem Solving

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1. BACKGROUND

Facilitate the development of conceptual schema using case reuse.

- Conducted semester long treatment in algebra-based physics.
- Two individual interviews conducted at mid- and end-points of semester.
  - Asked to rate problem pairs of varying similarity

2. QUESTIONS

- To what extent do students focus on principle similarities and differences?
- Given problem pairs, how do students' similarity ratings of the pairs change after the group learning interviews?
- How do student ratings compare with faculty ratings?

3. THEORY

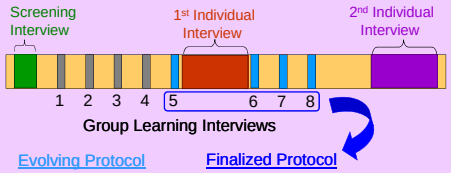
[1]Surface and Principle Differences

- Surface different problems: Multiple contexts can be associated with a principle.
- Principle different problems: Problems are not associated by the same principles.
- Principles are basic rules or assumptions.

4. METHODOLOGY

- N=10 Students
  - Enrolled in algebra-based physics
  - Participating in weekly Group Learning Interviews

Research Design



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

- Method:
  - Two Individual Interviews
    - 50 minutes each
    - 1st Individual Interview at mid-point of semester
    - 2nd Individual Interview at end of semester
- Students rate similarities between problem pairs

REFERENCES

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2. M.T.H. Chi, P.J. Feltovich, and R. Glaser, Cognitive Science **5** (2), 121-152 (1981).
3. L. Hsu, et al., *American Journal of Physics* **72** (9), 1147-1156 (2004).
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5. D. Gentner, Cognitive Science **7** (2), 155-170 (1983).

4. METHODOLOGY (continued)

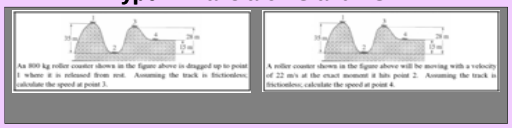
Four Categories of Pairing

- Principle Similarity (PS)
- Facial Similarity (FS)
- Principle Difference (PD)
- Facial Difference (FD)

	FS	FD
PS	A	B
PD	C	D

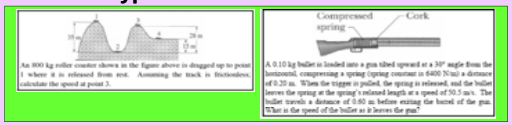
- Students are given 8 problem pairs in the order of A,A,B,B,C,C,D,D

Type A: Pairs are FS and PS



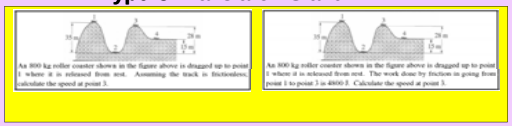
- Facial Similarity (FS) : both roller coasters
- Principle Similarity (PS) : both no friction

Type B: Pairs are FD and PS



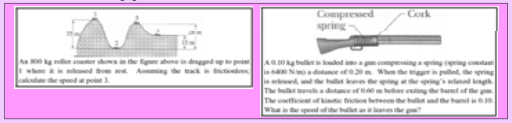
- Facial Difference (FD) : roller coaster vs. gun
- Principle Similarity (PS) : both no friction

Type C: Pairs are FS and PD



- Facial Similarity (FS) : both roller coasters
- Principle Difference (PD) : friction vs. no friction

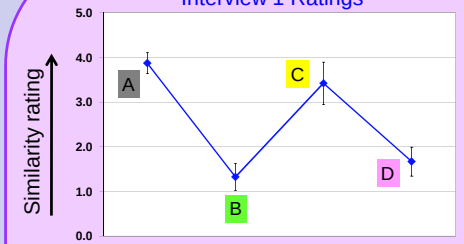
Type D: Pairs are FD and PD



- Facial Difference (FD) : roller coaster vs. gun
- Principle Difference (PD) : friction vs. no friction

5. RESULTS

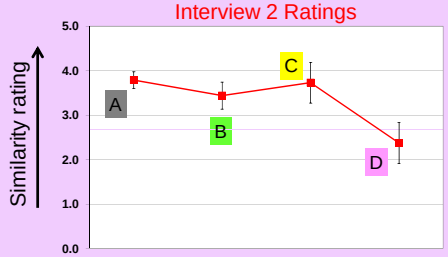
Interview 1 Ratings



Significant Differences:

A > B (p-value 0.000)
B < C (p-value 0.003)
C > D (p-value 0.008)

Interview 2 Ratings

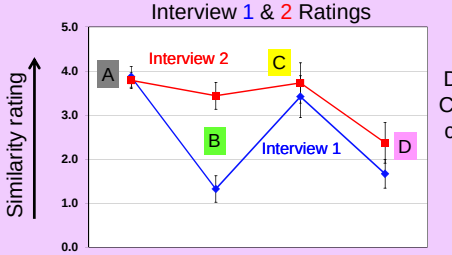


Differences between A & B, B & C are no longer significant

Significant Difference:

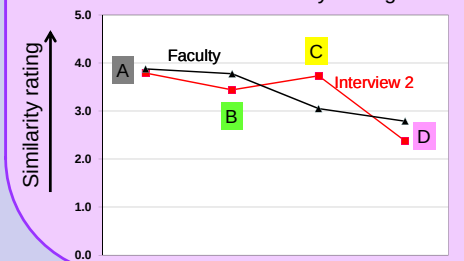
C > D (p-value 0.014)

Interview 1 & 2 Ratings



Differences between B & C in Interview 2 negligible compared to Differences between B & C in Interview 1

Interview 2 & Faculty Ratings



Students' end-semester ratings for three of the four problem types are similar to four volunteer faculty ratings.

6. Summary

- Given problem pairs with facial differences:
  - Students are seemingly unfocused on Principle Similarities during 1st interview.
  - Students begin to focus on Principle Similarities during 2nd interview.
- Student rating of problem Type B (Surface Different and Principle Similar) increases significantly.
- Student rating of problem Type B looks more expert-like.

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