PROVIDING INDIVIDUALIZED GUIDANCE AND FEEDBACK WITH WEB-BASED PROBLEM-SOLVING COACHES

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Research problem: Problem solving is a prominent feature of many physics courses. However, students often lack opportunities to receive individualized coaching to improve their problem-solving skills. Can computer coaches situated within a cognitive apprenticeship framework help students to become competent problem solvers?

Computer coaches

Theory

Cognitive apprenticeship

The teacher models a skill, making explicit the cognitive processes involved, coaches the student while the student practices, and fades the instructional scaffolding as the student becomes more proficient. (Collins, Brown & Newman, 1989)

Making thinking visible

Problem-solving framework	Needed cognitive functions
I. Focus the problem • Picture/Question/Approach II. Describe the physics • Diagram/Target quantity/Quant. relations III. Plan the solution • Algebraic manipulation/Check units IV. Execute the plan V. Evaluate the solution • Check statement, units, reasonableness	Decide Implement Assess

Instructional strategies

Reciprocal teaching

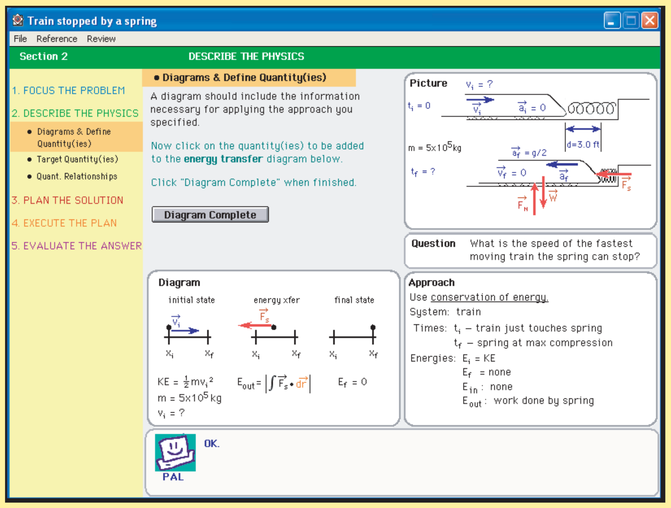
Student (S) and computer (C) take turns being the "coach." This pedagogy can help students develop not only desired skills, but also the ability to monitor their own performance of those skills. (Palincsar & Brown, 1984)

Learning from well-studied examples

Working attentively through a sequence of carefully structured examples can help students learn cognitive skills and be able to use them flexibly. (Zhu & Simon, 1987)

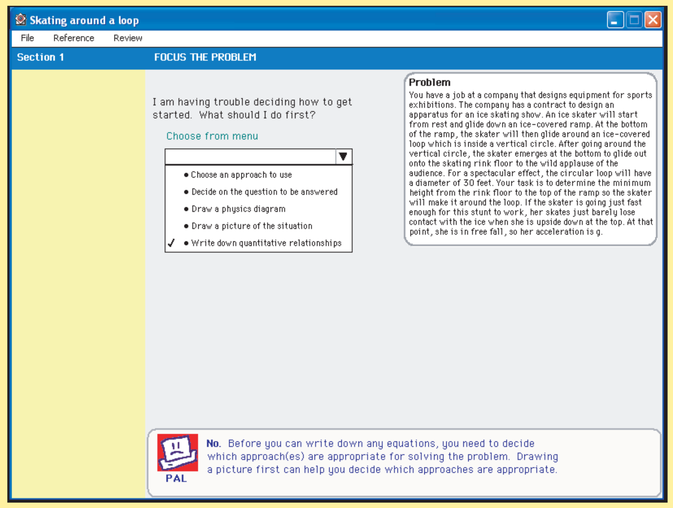
Context-rich (CR) problems

CR problems have a context and motivation that might be realistic to students and are used as instructional scaffolding. They are challenging enough that students must use an expert-like problem-solving framework and make good decisions to reach a solution. (Heller & Hollabaugh, 1992)



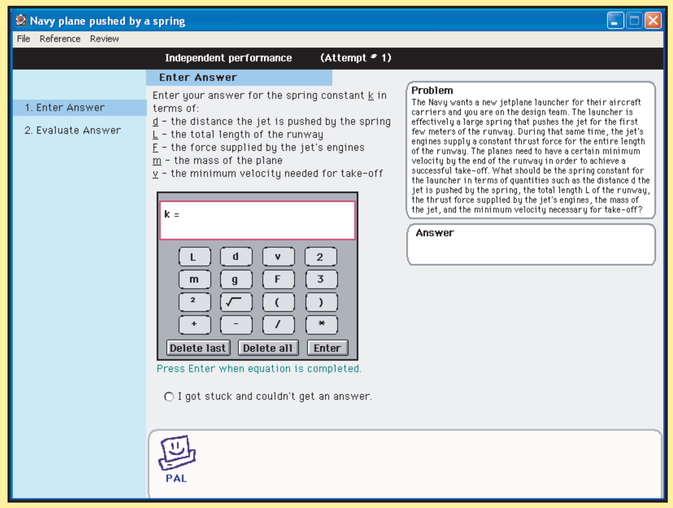
Implementation mode (modeling/coaching)

C decides, S implements, C assesses



Coaching mode (modeling/coaching)

S decides, C implements, S assesses



Performance mode (fading)

Scaffolding gradually withdrawn

Pilot study

45 students worked through 8 coached Conservation of Energy problems. Their performance on a subsequent class test was compared to that of a matched sample of students who did not use the web coaches.

Although no significant differences were found in the performance of the two groups, the students' feedback, as well as logs of their use of the coaches, will be used to improve the next version of the programs.

Differences from other systems

These coaches:

1. are based on a cognitive apprenticeship model of learning
2. provide students with detailed and intrusive individualized help that is anchored to an expert-like problem-solving framework
3. aim to achieve their effectiveness through good pedagogical design, rather than complex programming or artificial intelligence.
4. are customizable by individual instructors.

Acknowledgment: These computer coaches are based on an original concept by Fred Reif. (Reif & Scott, 1999)