

# Computer Coaches for General Problem Solving

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## Background

### Possible Advantages

- Provides individualized guidance and feedback while they practice solving problems outside class at their convenience
- Aim: Effectiveness through good design and pedagogy, vs. complex programming or artificial intelligence
- Customizable by individual instructors

### Theory

**Cognitive Apprenticeship**<sup>a</sup>

### Design

**Reciprocal teaching**<sup>b</sup>

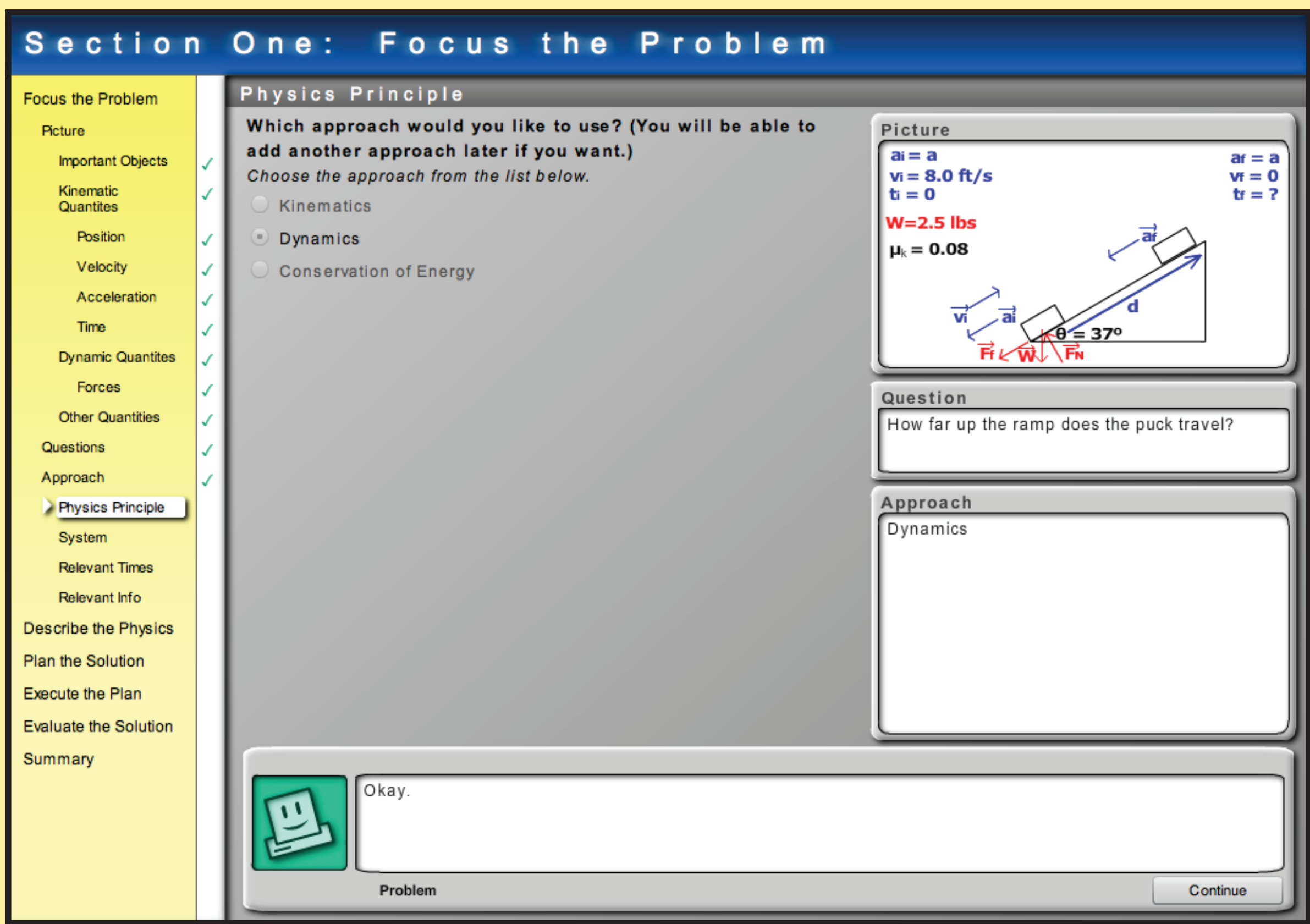
**Learning from well-studied examples**<sup>c</sup>

**Context-rich (CR) problems**<sup>d</sup>

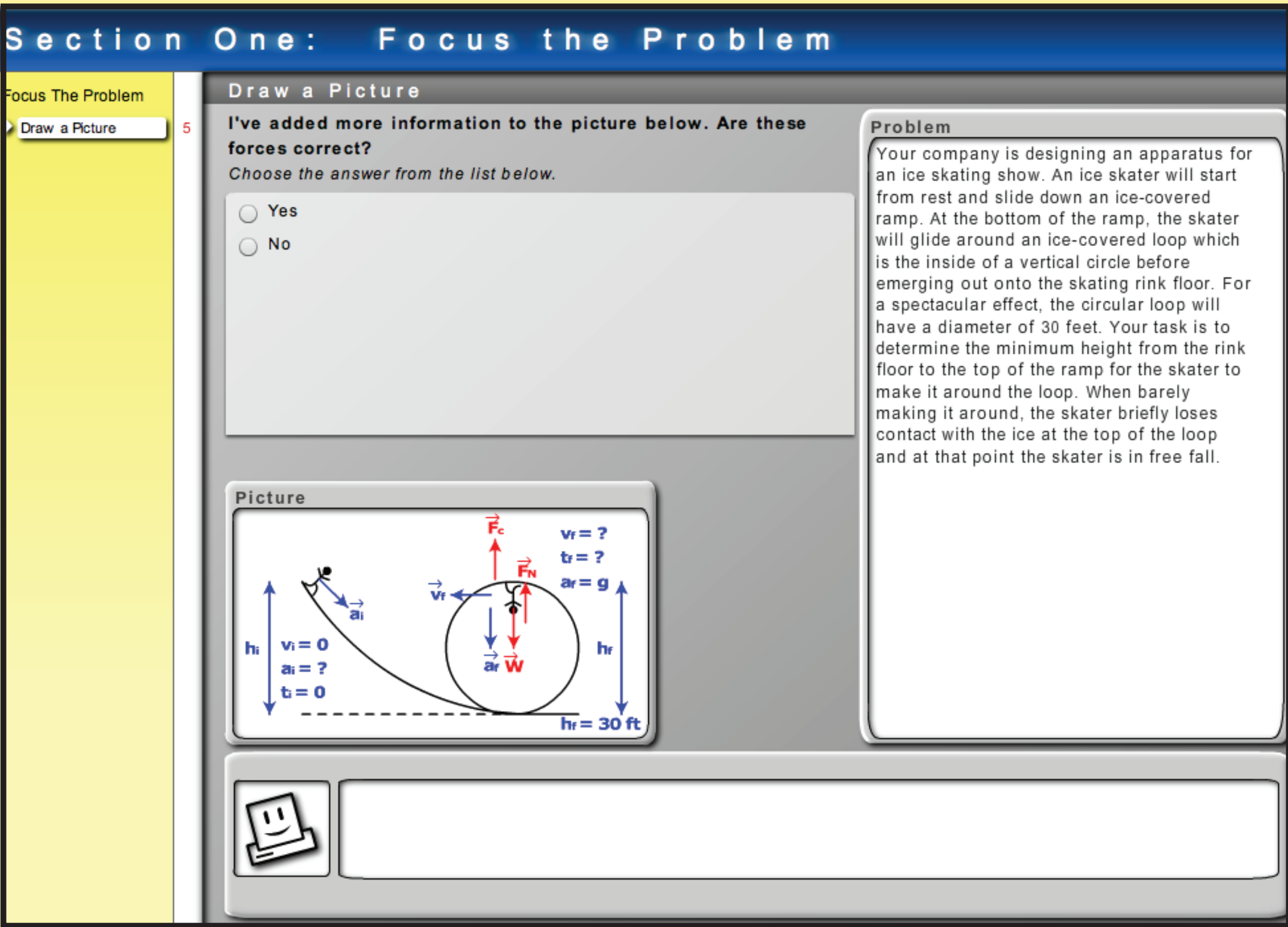
### References

- a. Collins, Brown, & Newman, 1989
- b. Palincsar & Brown, 1984
- c. Zhu & Simon, 1987
- d. Heller & Hollabaugh, 1992
- e. Docktor, 2009; Docktor & Heller, 2009

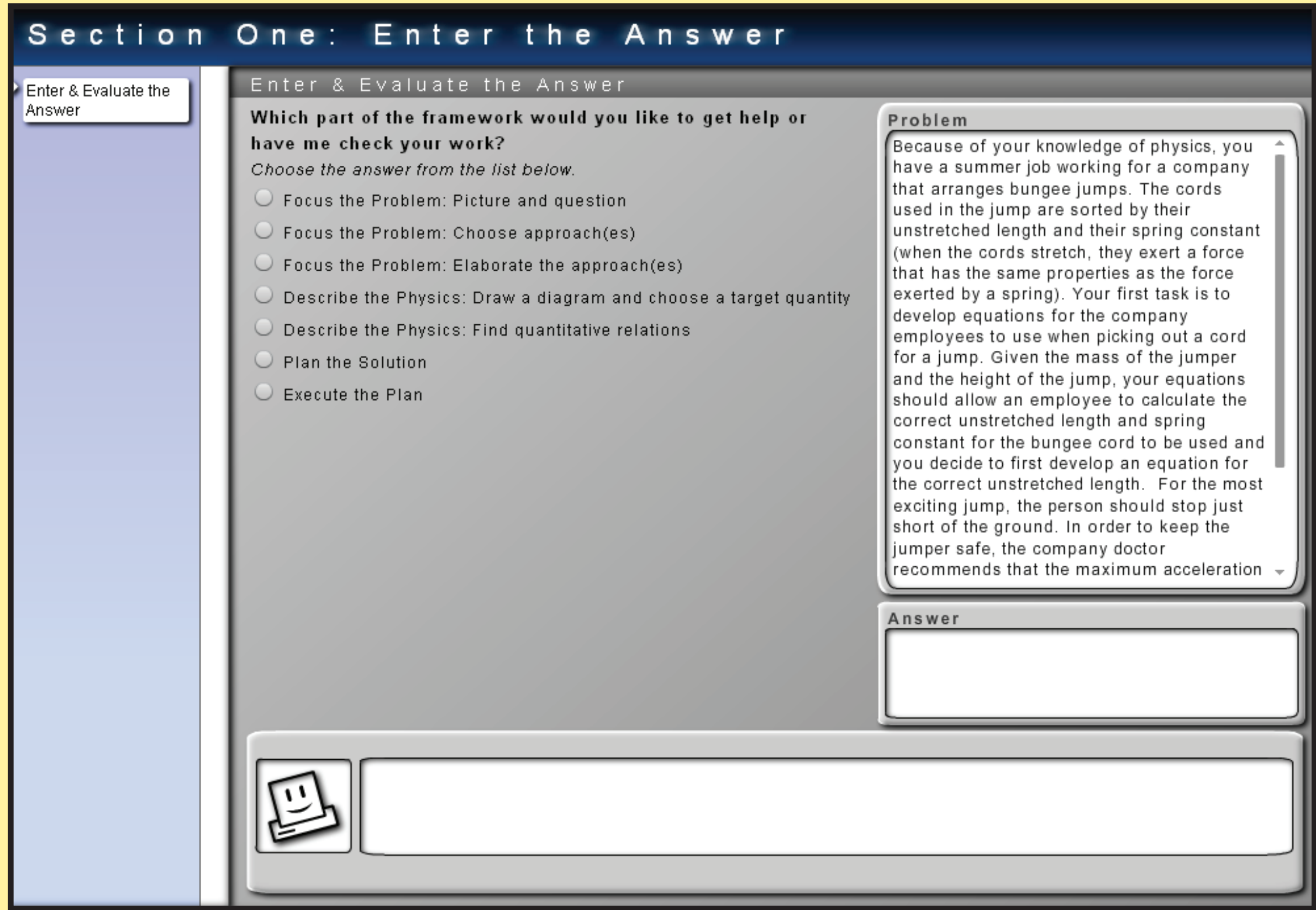
## Experimental plans



Interaction mode 1 – Implementation  
C decides, S implements, C assesses



Interaction mode 2 – Coaching  
S decides, C implements, S assesses



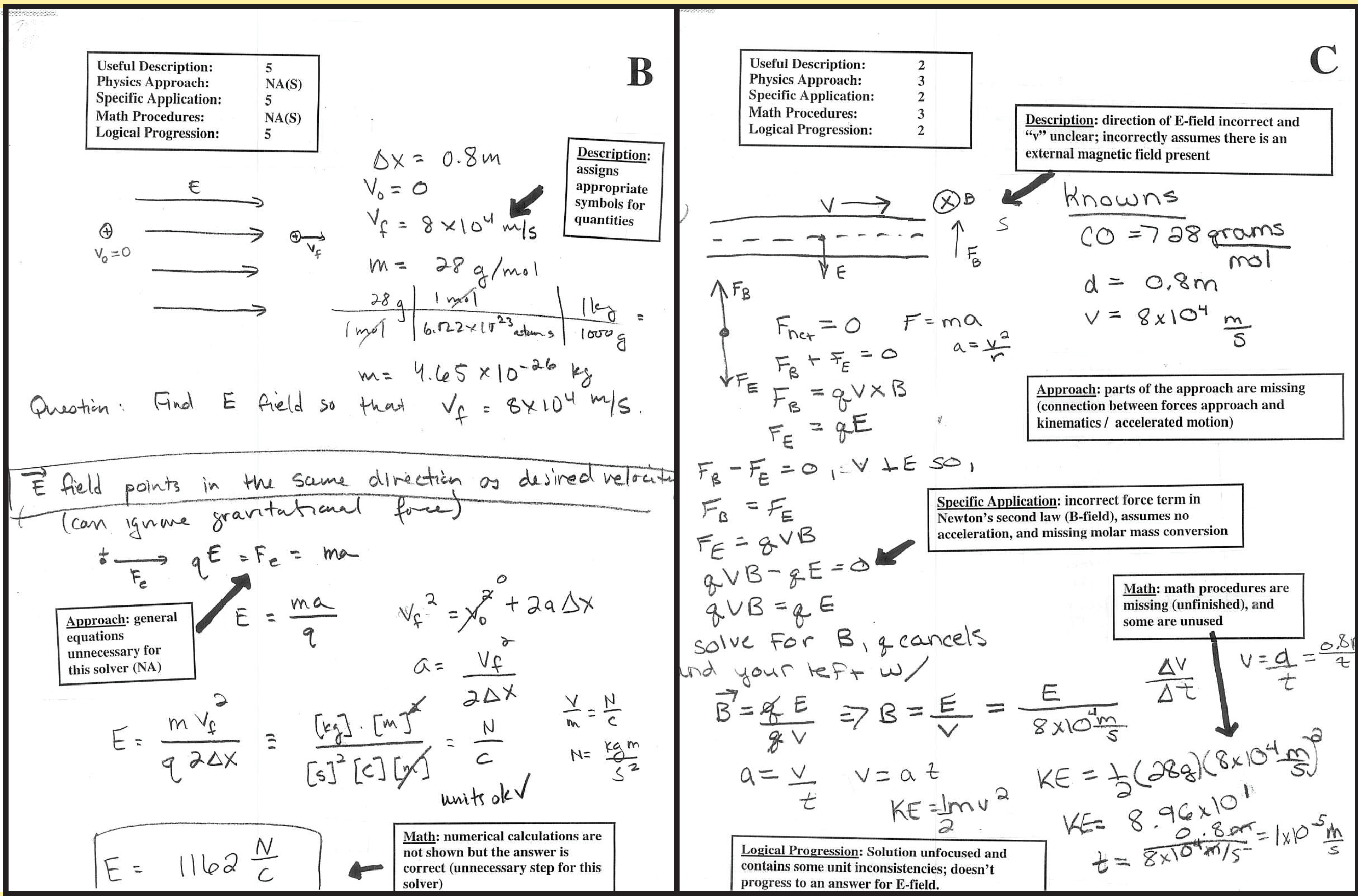
Interaction mode 3 – Independent practice  
Scaffolding gradually withdrawn

### Current status

- Test effectiveness of currently finished computer tutors on introductory physics students (Fall 2010)
- Examine net gain of student performance on quizzes, final exam vs. control group
- using scoring rubric developed for problem solving<sup>e</sup> (see below)

	5	4	3	2	1	0	NA(Problem)	NA(Solver)
USEFUL DESCRIPTION	The description is useful, appropriate, and complete.	The description is useful but contains minor omissions or errors.	Parts of the description are not useful, missing, and/or contain errors.	Most of the description is not useful, missing, and/or contains errors.	The entire description is not useful, missing, and/or contains errors.	The solution does not indicate an approach, and it is necessary for this problem/solver.	A description is not necessary for this problem. (i.e., it is given in the problem statement)	A description is not necessary for this solver.
PHYSICS APPROACH	The physics approach is appropriate and complete.	The physics approach is appropriate but contains minor omissions or errors.	Some concepts and principles of the physics approach are missing and/or inappropriate.	Most of the physics approach is missing and/or inappropriate.	All of the chosen concepts and principles are inappropriate.	The solution does not indicate an approach, and it is necessary for this problem/solver.	An explicit physics approach is not necessary for this problem. (i.e., it is given in the problem)	An explicit physics approach is not necessary for this solver.
SPECIFIC APPLICATION OF PHYSICS	The specific application of physics is appropriate and complete.	The specific application of physics contains minor omissions or errors.	Parts of the specific application of physics are missing and/or contain errors.	Most of the specific application of physics is missing and/or contain errors.	The entire specific application of physics is inappropriate and/or contains errors.	The solution does not indicate an application of physics and it is necessary.	Specific application of physics is not necessary for this problem.	Specific application of physics is not necessary for this solver.
MATHEMATICAL PROCEDURES	The mathematical procedures are appropriate and complete.	Appropriate mathematical procedures are used with minor omissions or errors.	Parts of the mathematical procedures are missing and/or contain errors.	Most of the mathematical procedures are missing and/or contain errors.	All mathematical procedures are inappropriate and/or contain errors.	There is no evidence of mathematical procedures, and they are very simple.	Mathematical procedures are not necessary for this problem.	Mathematical procedures are not necessary for this solver.
LOGICAL PROGRESSION	The entire problem solution is clear, focused, and logically connected.	The solution is clear and focused with minor inconsistencies.	Parts of the solution are unclear, unfocused, and/or inconsistent.	Most of the solution parts are unclear, unfocused, and/or inconsistent.	The entire solution is unclear, unfocused, and/or inconsistent.	There is no evidence of logical progression, and it is necessary.	Logical progression is not necessary for this problem. (i.e., one-step)	Logical progression is not necessary for this solver.

### Sample students - scoring with rubric<sup>e</sup>



### Goal for setup

- Limited number of tutors finished, more by fall semester.
- Baseline set of student exams collected
- same introductory class (spring 2010)
- two raters (established inter-rater reliability) score baseline for future comparison
- Goal: 40 tutors (8 for each of 5 topics), larger-scale study (~spring 2011)