Problem Solving Coaches For Physics Tutoring

Part III : ASSESSMENT DESIGN

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PLAN FOR 1st (SMALL-SCALE) STUDY

- ~30 students, 1 lecture session of intro calculus-based class
- Assign into 2 statistically matched groups (~15 for each group)
  - Variables for matching: background information, e.g. HS physics & math level, FCI/CLASS/math pretests
- Subset of tutors available – energy, momentum (4 weeks)
- Treatment and Control
  - Treatment- computer coaching (on Web, outside of class), 4 problems per week
  - Control– normal class setting
- Data collection
  - Written solutions on quizzes & final exam
  - 2×4+5=13 for each student

PLAN FOR 2nd (LARGE-SCALE) STUDY

- ~90 students, 1 lecture session of intro calculus-based class
- Assign into 2 statistically matched groups (~45 for each group)
  - Variables for matching: background information, e.g. HS physics & math level, FCI/CLASS/math pretests
- All tutors available (kinematics, dynamics, energy, momentum, rotational motion)
- Treatment and Control
  - Treatment- computer coaching (on Web, outside of class), 4 problems per week
  - Control– normal class setting
- Data collection
  - Written solutions on quizzes & final exam
  - 2×4+5=13 for each student

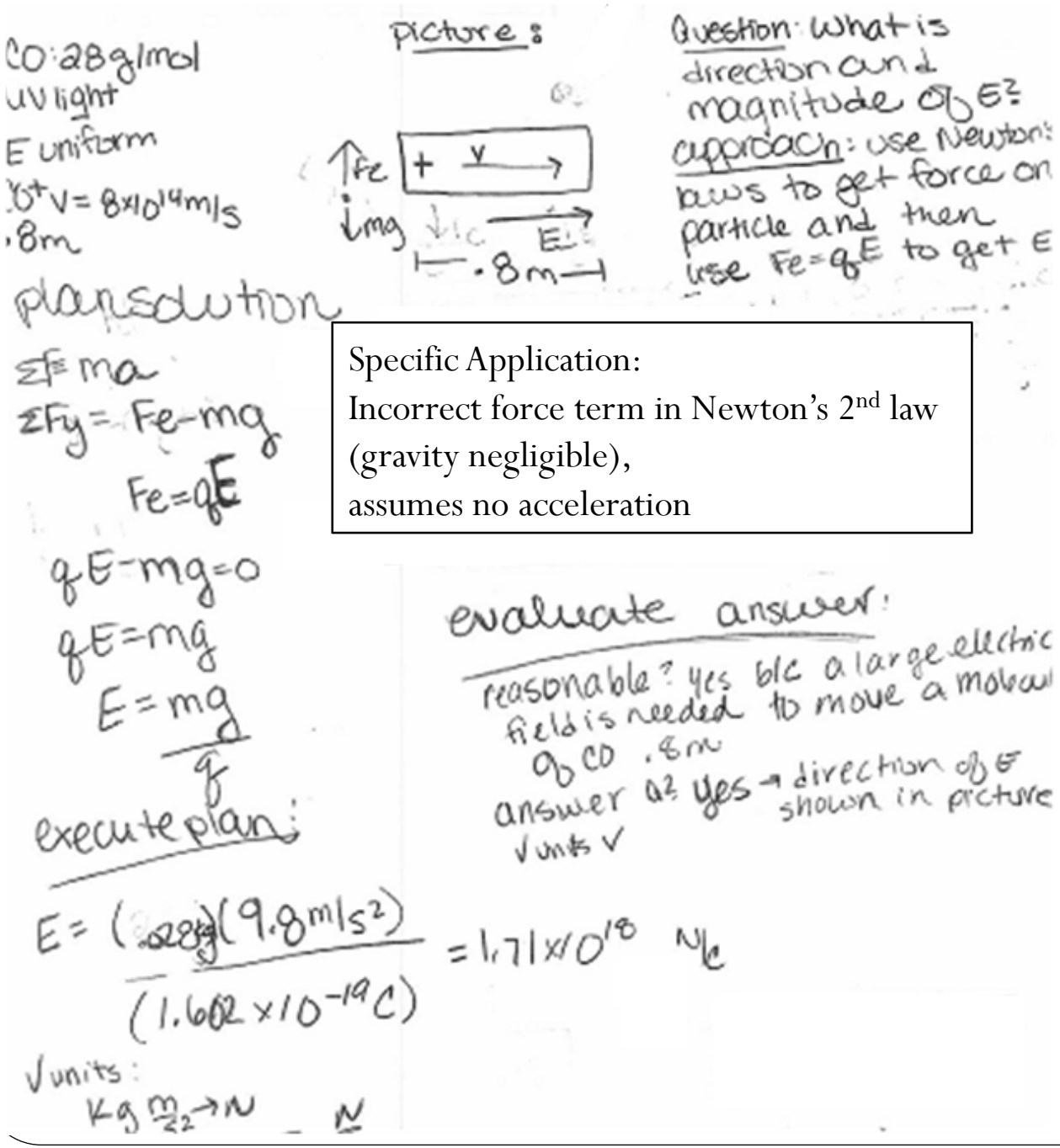
EVALUATING PROBLEM-SOLVING[1]

- Rubric developed to evaluate student problem solutions
  - Validity, reliability have been tested
- Five rubric categories (established by past research)
  - Useful Description
  - Physics Approach
  - Specific Application of Physics
  - Mathematical Procedures
  - Logical Progression

- [1]Docktor 2009; Docktor and Heller 2009

	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 and/or contains errors.	The solution does not include a description 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 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 an contains error	The entire specific applicati			
MATHE-MATICAL 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 mathem procedur inapprop and/or co errors.			
LOGICAL PROGRESSIO N	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 entir solution i unclear, unfocuse and/or inconsiste			

Most of the specific application of physics is missing and/or contains errors.



Specific Application:
Incorrect force term in Newton's 2nd law (gravity negligible),
assumes no acceleration

Summary:

Useful Description: 3

Physics Approach: 4

Specific Application of Physics: 2

Mathematical Principles: 5

Logical Progression: 4

QUESTIONS TO BE ADDRESSED

- Will students use them?
- How will students use them? (keystroke function)
- Do they improve students' problem solving skills?

- Are they adaptable to be used in teaching other physics courses?
- Can this software be modified by faculty to fit their problem solving preferences?

- Interested in seeing how tutor works? Come see us after this session, or at poster session (PST2B17, tonight, 9:20-10:50 pm)
- Website:
  - http://groups.physics.umn.edu/physed/

THANK YOU!

Sample professor, sorting exercise

Category	UD	PA	SAP	MP	LP
Caution					
Problem Solving Techniques					
Understand Basic Definitions					
Basic Principles					
Global Aspect					

Sample professor, sorting exercise

Category	UD	PA	SAP	MP	LP	N/A
Caution					X	
Problem Solving Techniques		X	X			
Understand Basic Definitions	X					
Basic Principles		X				
Global Aspect						X