

# INTERNET COACHES FOR PROBLEM SOLVING IN INTRODUCTORY PHYSICS: USAGE & USABILITY STUDIES



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## Background

### Goals

- Test the usage and usability of computer programs designed to provide students with individualized coaching while solving problems to direct future development of these coaches
- Coaching programs are designed within the framework of cognitive apprenticeship and provide scaffolding in conjunction with the processes of modeling, coaching, and fading.
- Coaching programs emphasize the process of decision-making in solving problems.

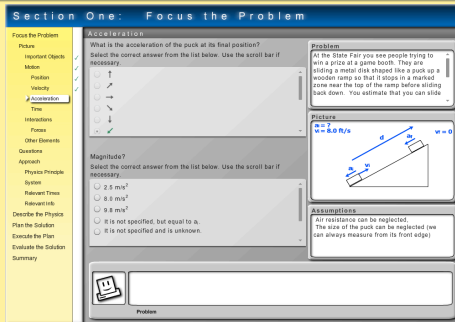
### Design Process Cycle



### Study

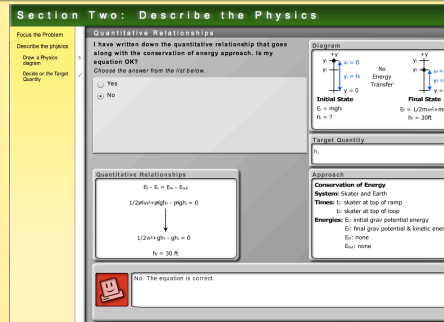
- What are the characteristics of students who use the coaches?
- Do they perceive the coaches as useful?
- How do the students use the coaches?
- How to use these information to direct future improvement on the design of the coaches?
- Computer coaches for 35 problems were incorporated into 2 sections of a calculus-based introductory mechanics course (148/103 students) in Spring 2013
- Students were required to complete their homework using WebAssign (coaches were available to help with some problems)
- Data collected included: Students keystrokes when using the coaches, Standard pre/post assessments (FCI/Math/CLASS) and mid and end of semester surveys about the coaches

## Computer Coaches (version 1.0)



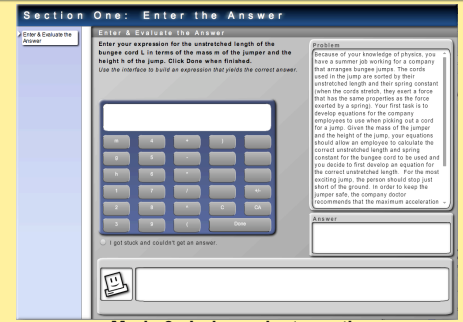
### Mode 1 – Guidance

C guides, S decides, C assesses



### Mode 2 – Debugging

C decides or asks for help, S assesses, C responds



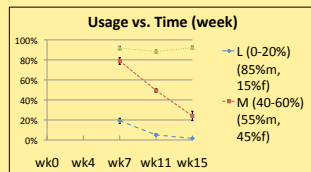
### Mode 3– Independent practice

S solves or asks for help, C questions, S responds, C assesses

## Usage and Usability

### What are the characteristics of students who use the coaches?

- L group (Light/Non user) : 0-20% (of the coached problems)
- M group (medium user) : 40-60% (of the coached problems)
- H group (high user): 80-100% (of the coached problems)



m: male, f: female  
L group: N=72  
M group: N=38  
H group: N=49

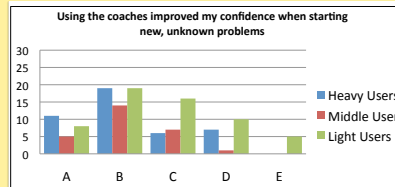
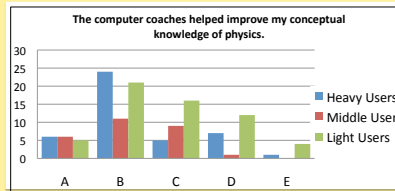
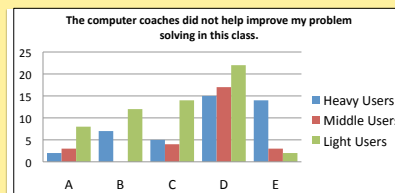
	N	Weekly study time (hrs)			Expected grade	
		≤5	6-10	≥10	A	B
L	48	25%	46%	29%	71%	29%
M	27	4%	59%	37%	70%	30%
H	35	8%	63%	29%	40%	60%

Test	L (N=48)		M (N=27)		H (N=35)	
	male	female	male	female	male	female
FCI	58%±5%	59%±12%	53%±7%	42%±7%	46%±5%	31%±4%
MATH	58%±5%	66%±8%	53%±6%	61%±9%	54%±15%	45%±4%
CLASS	62%±4%	55%±7%	66%±5%	66%±4%	65%±4%	56%±4%

- Females are underrepresented in the L group (15%) compared to that of the class as a whole (30%)
- A higher FCI pre-test score is correlated with lower usage
- Students in the L group expect to spend less time studying and earn a high grade
- Students in the H group expect to spend more time studying and are less confident of their success

### Do students perceive the coaches as useful?

- Students were asked to rate several statements about computer coaches on a 5 point Likert scale.  
A: Strongly disagree B: Agree C: Neither D: Disagree E: Strongly disagree



- Students were asked to rank the class components from the most useful(10) to least useful (1).

	Light	Medium	High
Lectures	8.3 ± 0.3	7.5 ± 0.9	7.2 ± 0.7
Doing the homework	6.8 ± 0.5	7.2 ± 0.6	8.1 ± 0.4
Computer coaches	4.9 ± 0.5	7.2 ± 0.5	7.0 ± 0.5
Tutor room	4.2 ± 0.6	3.8 ± 0.8	4.3 ± 0.6

### How do students use the coaches?

- Way to approach homework: Students in the H group seem to depend on the coaches for their homework
- M group shows a dramatic decrease in their coach usage

Statement	L	M	H
I tried to solve the problems on my own and used the computer coaches for help if I got stuck	48%	70%	42%
I worked through the computer coaches before trying to solve the problems on my own	3%	4%	37%
Others	49%	26%	22%

- Some mechanism is necessary to wean the H user group from the detailed help provided by the coaches

- Have adjustable grain sizes to better serve the M group

- For development of the coach version 2.0, please see PST2C10

- For more information, please visit our website: <http://groups.physics.umn.edu/physed>

