Assessing Online Computer Coaches for Problem Solving: Educational Impact

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Research Question

- Do the computer coaches improve students' problem-solving?

Version 1 Summary

- 3 sections of a university calculus-based introductory mechanics course
  - Fall 2011: One section of 221 students
    - Students could complete their homework using WebAssign or the coaches.
  - Spring 2013: Two sections of 148/103 students.
    - Although coaches were available to help with some problems, students were required to complete their homework using WebAssign.

Final exam scores Sp. 2013

Final Exam	Male	Female	Total
Low (0-20%) Coach Use (N=72)	70%±3%	71% ± 6%	**70% ± 3%**
Medium (40-60%) Coach Use (N=38)	65% ± 4%	68% ± 4%	**66% ± 3%**
Heavy (80-100%) Coach Use (N=49)	73% ± 2%	68% ± 4%	**71% ± 2%**

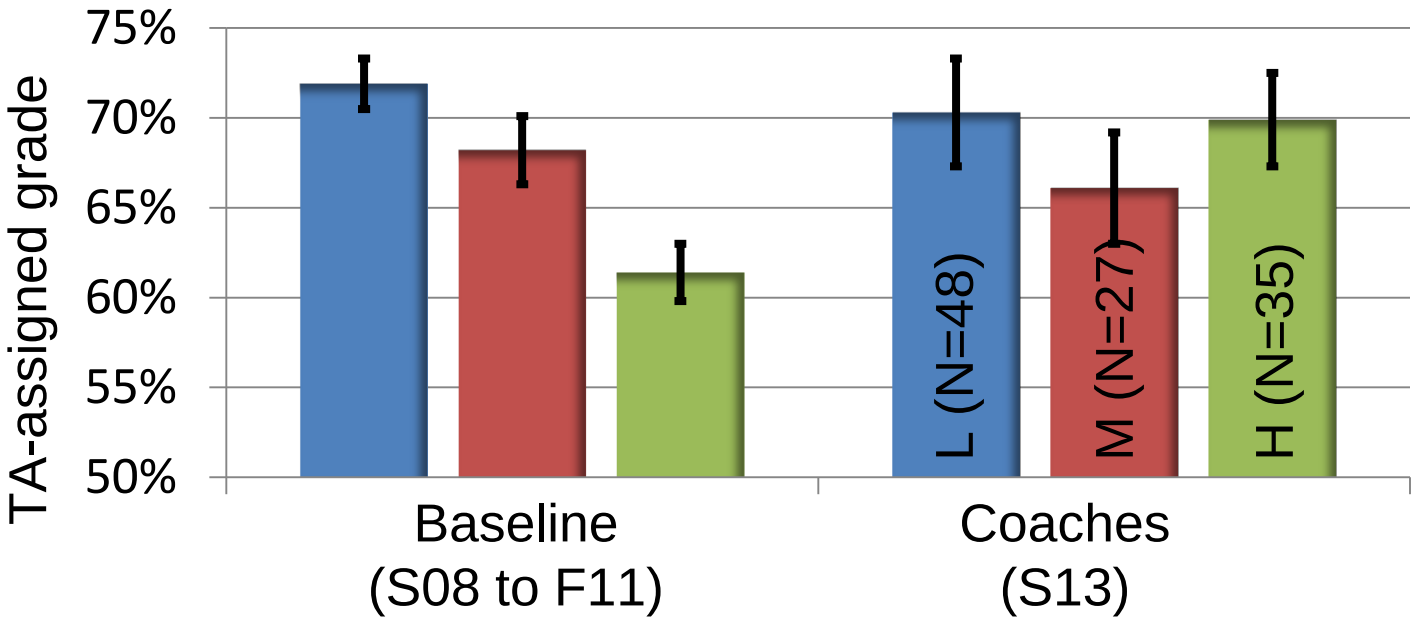
- Heavy users ≈ Light users in final exam
  - However, the confidence and FCI score of the students started lower as shown in previous talk.
  - Need to examine this closer.

Matching Historical Data

- 4 to 1 match of historical students to Sp2013 students.
  - Matched on pre-class FCI, gender, expected grade, and expected study time.
    - ~85% student perfect match. 3145 students from Spring 2008 to Fall 2011.

- Normalize the exam scores.
  - Exam differences absorbed by equating the exam averages.
  - Retained the exam distributions.
- Avoided unintended selection bias or specific class bias into the results by using varied selection rules.

Final Exam Problem-Solving Grade



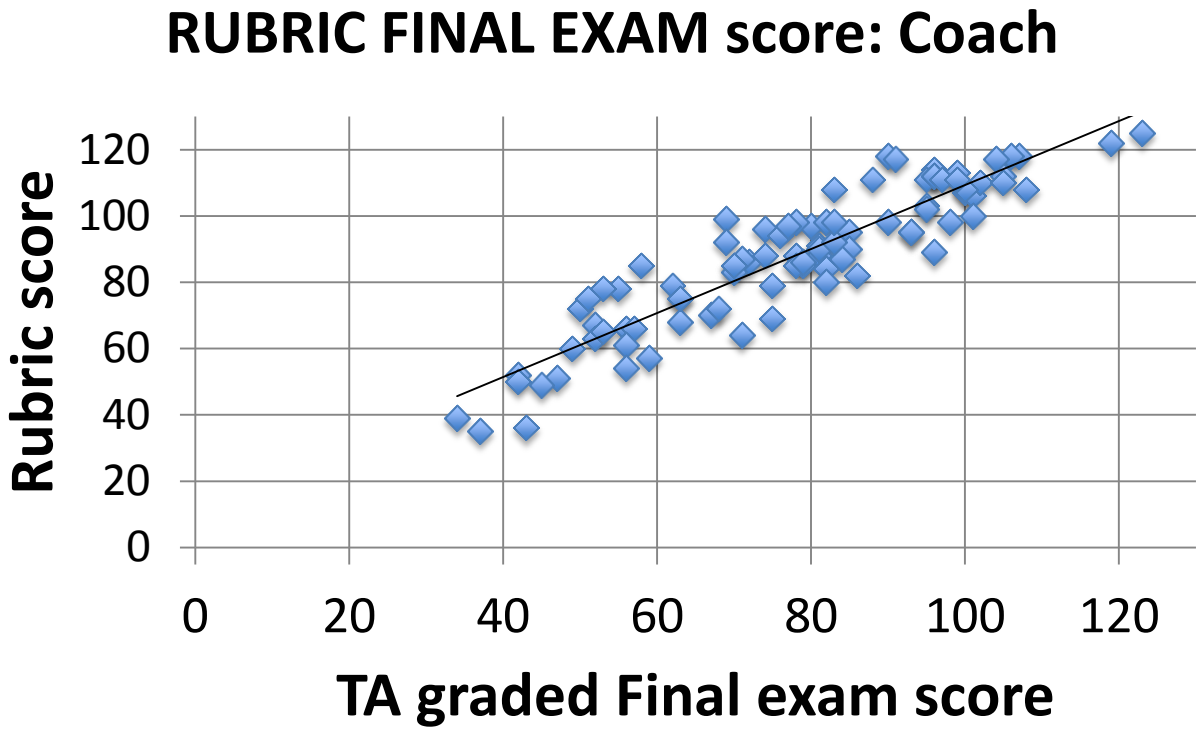
- Low-use characterized students in historical match predict there should be a significant difference (11%±2%) as compared to the high-user characterized students.
- Coached group shows no significant difference (0%±4%) between heavy and low user groups in coached class from Sp2013.

How to assess the impact of the coaches?

- Other tools to assess student problem-solving?

- TA grading vs. rubric assessment
  - Rubric from Jennifer Docktor (2009)
    - J Docktor et al, PERC proceedings (2009) AIP
    - Built upon previous work: P. Heller et al, Vol 60 #7, AJP (1992)
  - 5 categories assessed on scale 0-5
    - Useful Description, Physics Approach, Specific Application, Mathematical Procedures, Logical Progression

TA grading vs. Rubric

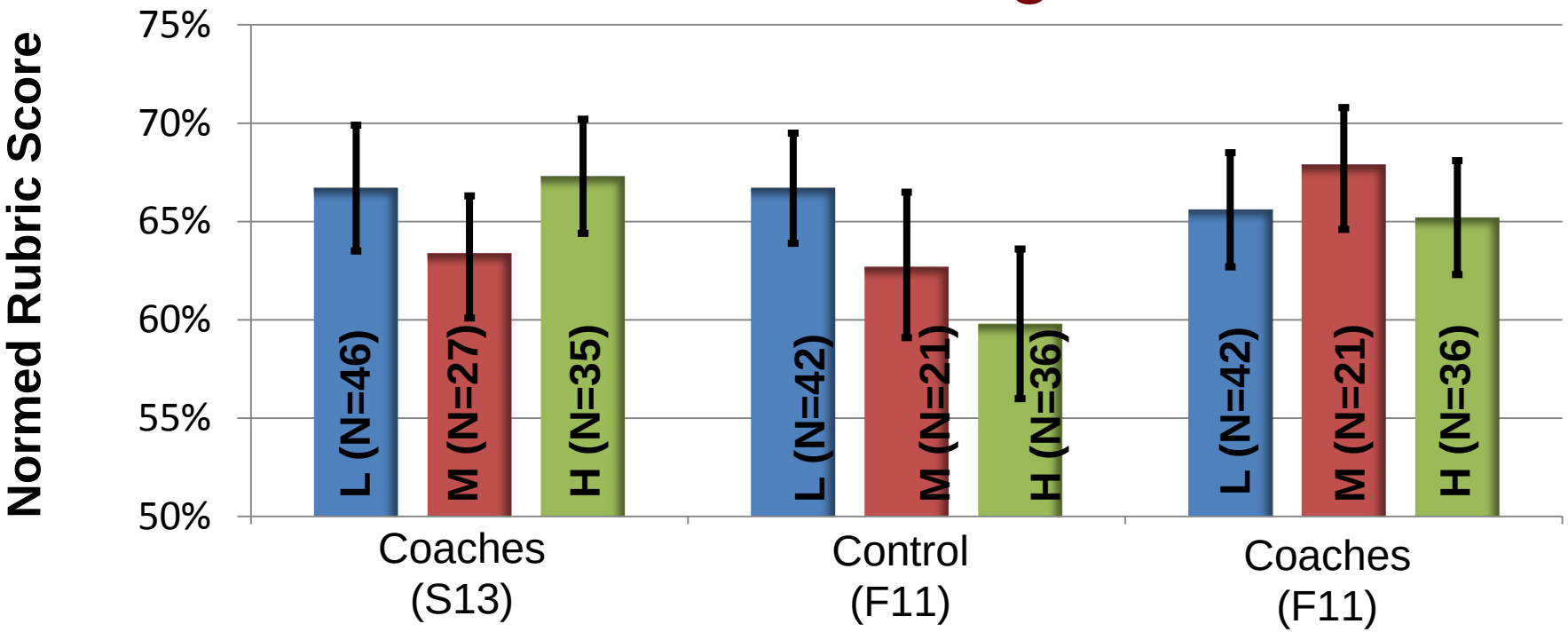


Fall 2011,
Combined 5 Final exam problems:
C=0.91 coach;
C=0.88 control;

Individual problems:
C=0.79 ~ 0.85

- The TA grades are highly correlated with independently assessed rubric scores.
  - Note: Our TAs have gone through TA training in the Minnesota model but not the rubric assessment.

Final Exam Problem-Solving Rubric Score



- Test differences controlled through a match of low users from Spring 2013 to the Fall 2011 control class low user characterization.
- No perceived difference in low user characterization students.
- The difference in heavy use characterization still present in Fall 2011.

Summary

- Coaches improved problem solving scores
  - Near full letter grade difference
  - Less prepared, less self confident student characteristics
  - More female than the rest of the class (about 1/3 of the class)
  - 70% ± 3% Coached heavy users; 61% ± 2% Non-coached matched

- For TAs with our TA support, grading is a good indication of problem solving skills.
  - High correlation between TA grading and Rubric assessment

- For more information see:
  - Talks: GC09/10, FD08/09 (Wednesday)
  - Posters: PST2C13/14/15 (Tuesday)