

# First-Year Engineering Students' Reflections: Plans and Actions for Meeting Course Learning Objectives

Kayla Ney & Dr. Heidi Diefes-Dux

Department of Biological Systems Engineering



## Background

- Reflection is a powerful tool for students because it can incite a metacognitive processes that can aid planning for the future and improved performance.<sup>1</sup>
- Standards-Based Grading (SBG) is an educational strategy that focuses on providing students with clear learning objectives (LO's) and feedback on these specific objectives.<sup>2</sup>
- Pairing reflection with SBG can help students use stated LO's and feedback to gage their level of understanding of the material.<sup>3</sup>
- The effects of reflection on student planning are not well-defined in the context of engineering education.

## Purpose

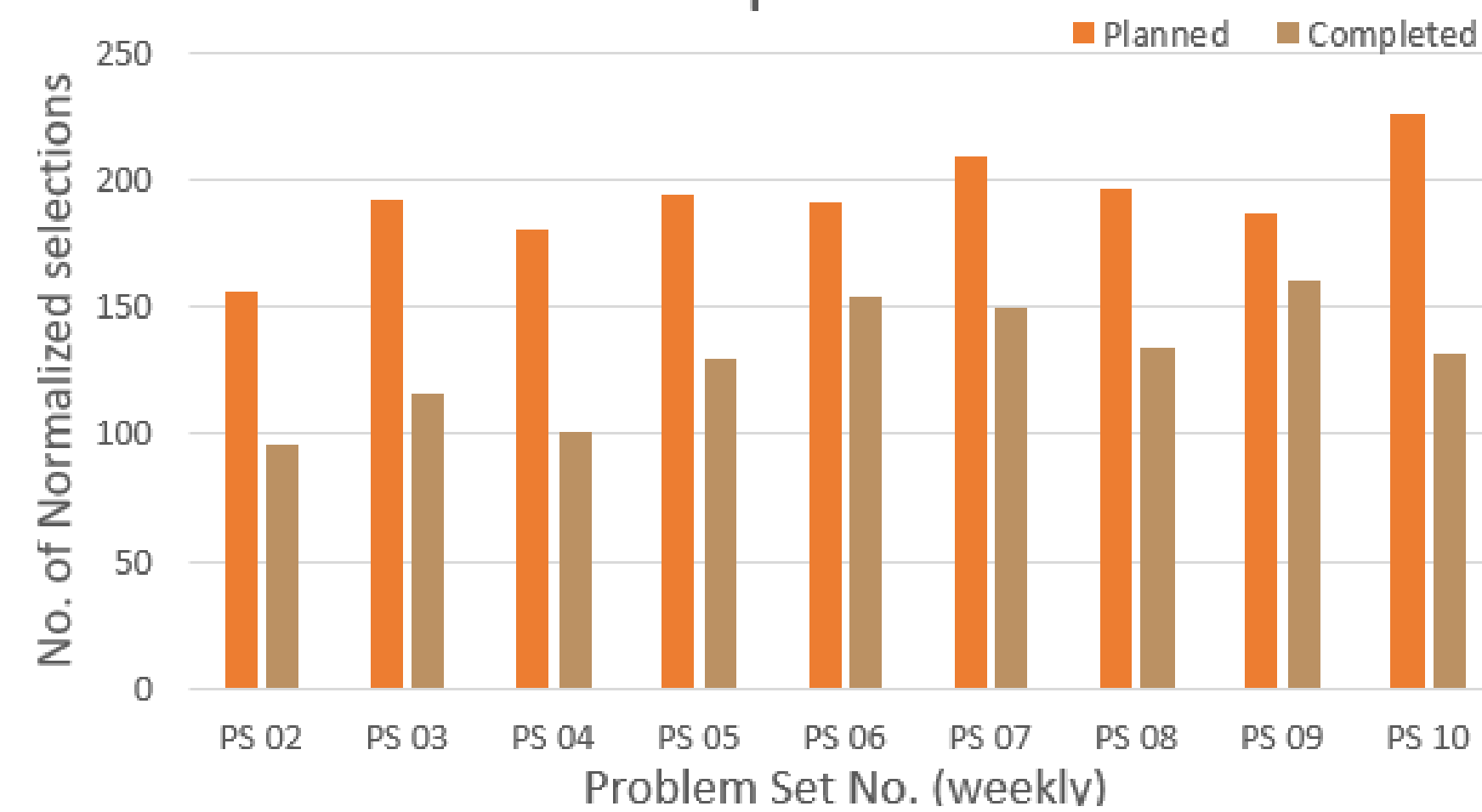
The purpose of this investigation was to explore the effects of reflection and SBG feedback on first-year engineering students' plans and actions for improving their learning regarding the stated Learning Objectives across the semester.

## Methods

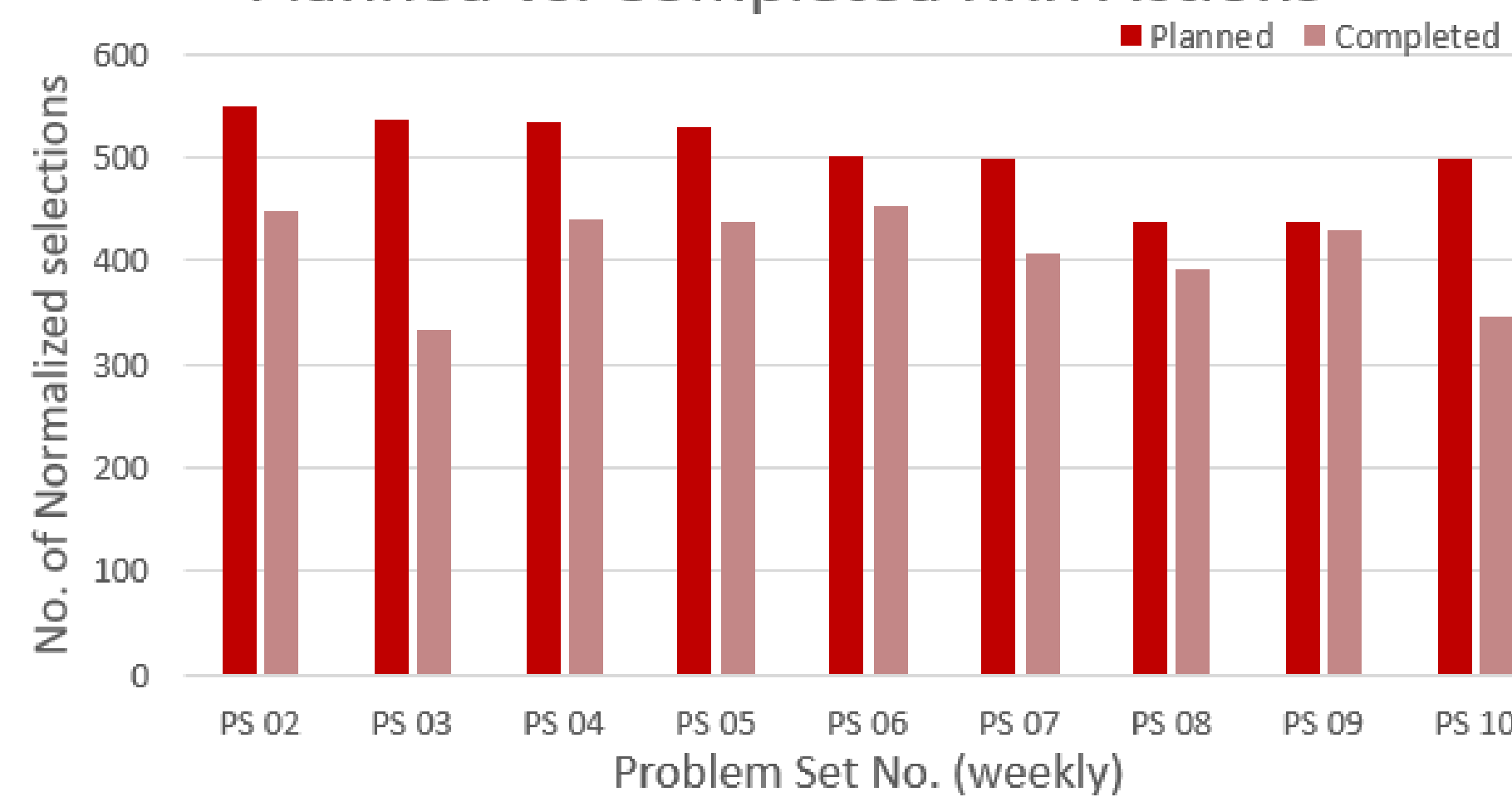
- Six sections of a first-year engineering spring-semester course (N=670 all sections, n=108 section AAA) were given reflections to complete in class immediately after they turned in an assignment from the previous week and before they were given a new assignment.
- Reflections included multiple-choice items that asked students what actions they took to understand the LO's when completing the previous week's assignment and what actions they planned to take to improve their understanding of the LO's over the next week. Possible responses to these questions consisted of 14 options in three categories:
  - **Ask (ASK)** (classmates, the instructional team, office hours)
  - **Research & Review (RRR)** (review performance, LO's, solutions, or online modules, and research via Google or MATLAB's help function)
  - **Practicing & Checking (P&C)** (use feedback and practice using old problems and Exploration Activities)
- Reflections were gathered online nine times over the semester.
- The number of planned and self-reported actions selected from each category were visually compared over time to look for changes in type and amount of actions and plans selected.

## Results

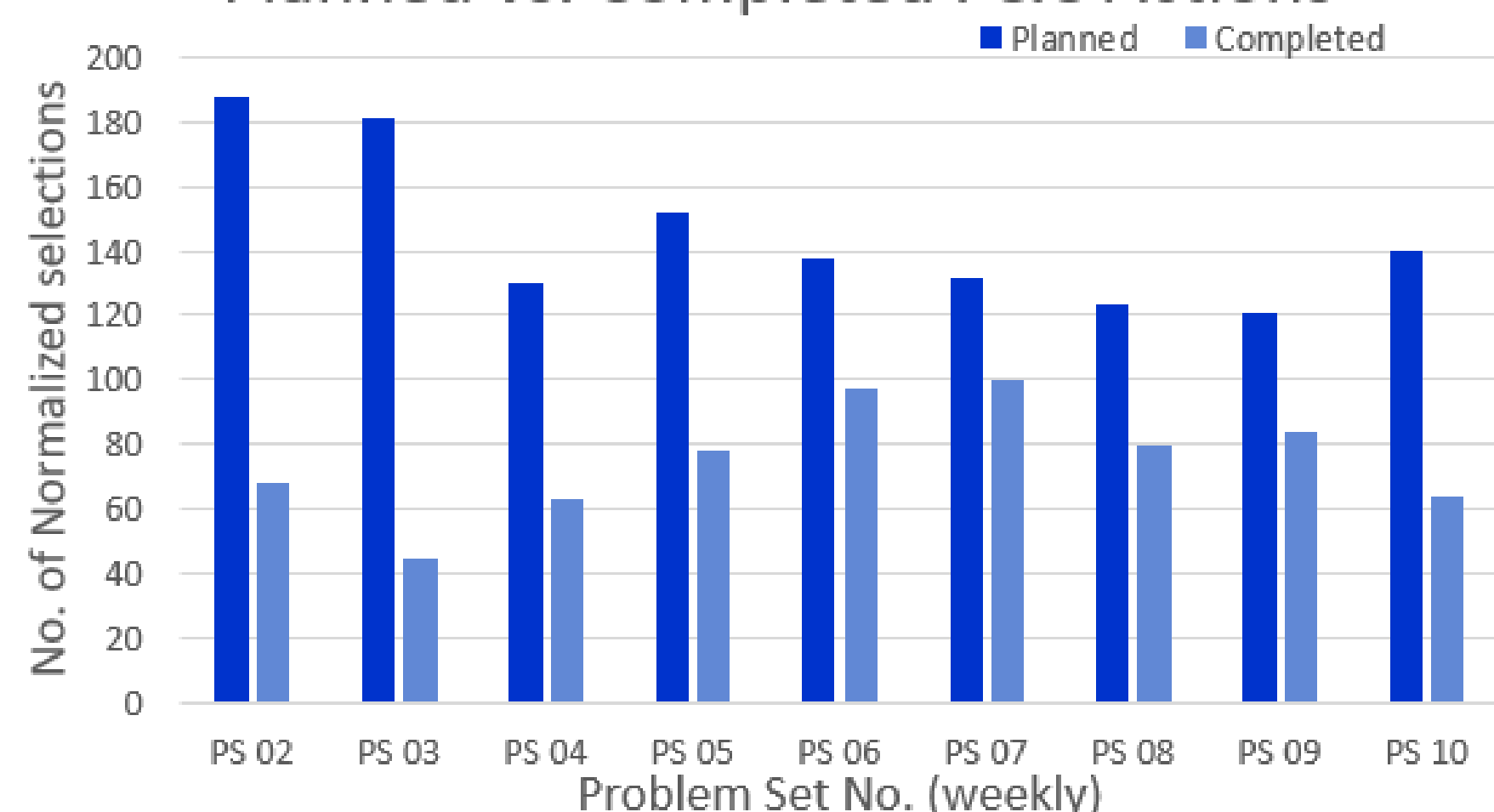
Planned vs. Completed ASK Actions



Planned vs. Completed RRR Actions



Planned vs. Completed P&C Actions



## Discussion

- Using a chi-squared test, the p-values for each category over time were: ASK  $p < 0.0001$ , RRR  $p < 0.0001$ , PC  $p = 0.0008$ , indicating a significance
- Planned actions were always greater than completed actions
- Planned and Completed actions generally start with a large gap, then approach an equal amount, then the gap reopens at the end of the semester
  - Gap closure could be due to refinement of study actions
  - Gap reopening could be due to finals week
- Ask:
  - Smallest gap: Problem Set 9
  - Largest gap: Problem Set 10 (3,4)
  - Overall both completed and planned actions increased over the semester
- Research & Review
  - Smallest gap: Problem Set 9
  - Largest gap: Problem Set 3 (10)
  - Planned actions decreased over the semester, completed actions decreased slightly
- Practice & Check
  - Smallest gap: Problem Set 7
  - Largest gap: Problem Set 3
  - Planned actions decrease over the semester, completed actions increase slightly

## Conclusions & Future Work

- Student study action selections do change significantly over time
- Within each category, evaluate the frequency of actions selected and how it changes between planned and completed actions and over time
- Look at individual planned action choices versus the choices they completed to see which individual actions were complete/incomplete and if there were preferences
- Evaluate individual choices to see which actions may have been necessary to turn in the homework versus which actions helped the students learn
- Evaluate class section variability to investigate if instructor had a significant effect on actions
- Compare this data to a similar study where reflections were hand-written, not guided to investigate the method of data collection

## References

1. Quinton S., & Smallbone, T. (2010). Feeding forward: using feedback to promote student reflection and learning – a teaching model. *Innovations in Education and Teaching International*, 47(1), 125-135.
2. Guskey, T. R. (2001). Helping standards make the grade. *Educational Leadership*, 59(1), 20-27.
3. Diefes-Dux, H. A., & Carberry, A. R. (2019). Student reflections on proficiency with learning objectives: Early semester actions and plans. *Proceedings of the Research in Engineering Education Symposium 2019, Cape Town, South Africa.*

## Acknowledgements

- This work was made possible by a grant from the National Science Foundation (NSF DUE 1503794 and NSF IIS 1552288). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.
- Summer Nebraska Engineering Research Program (SNERP), University of Nebraska- Lincoln, College of Engineering