Project Title: PrairieLearn and Course Redesign for Core CEE Intro Sequence

What is this project about?

This SIIP project was conceptualized to serve the following goals:

1. Integration of coding with the content matter of the courses.
2. Shift to active learning.
3. Adoption of the Prairie Learn platform for assignment and practice problems and use of the Computer-Based Testing Facility (CBTF) for exams.
4. Improved student user experience when using the online platforms.

(This project has completed its 3-yr funded cycle.)

What are the participating courses?

This SIIP project focused on two required 2nd year courses:

- CEE 201 Engineering Economics
- CEE 202 Engineering Risk & Uncertainty

How does this project relate to CEE Educational Strategic Plan?

This CEE focused SIIP project aligns with the second thrust of CEE's Educational Strategic Plan for "of integrating and meaningfully infusing computation and data science content within the undergraduate and graduate curricula".

How was the project managed?

In each of a maximum of 3 SIIP funded years, the grant provided support for two 50% TAs. For each course, the instructors set one or more realistic goals per semester for their courses. Instructors are always in charge of their course. How a course is taught and managed is decided through the coordination among instructors who teach the same course. The broader project CoP act as motivator, a forum for idea generation and exchange, a venue for communication and as the technical supporter for new material development, always as planned by the course instructors.

What was accomplished?

In the first year of the project, we created infrastructure for the use of PrairieLearn (PL) and the Computer Based Testing Facility (CBTF). The main goals behind the adoption of these educational platforms were:

- support of the department-wide objective of introducing coding/computational skills throughout the CEE curriculum
- enabling sustainability of implementation of course updates through simplification of class management by using well-supported campus educational tools.

In the second year of the project, our focus was on:

- instructor and TA training for effective teaching and sustainability of course updates
- improvement in the materials created on PrairieLearn, during the previous year
- improvements in assessment of student outcomes

In the third year of the project, our efforts focused on:

- improvement of student in-depth learning through improvements in student user interfaces to stimulate and sustain student engagement throughout the semester, while reducing cognitive overload from continuous context switching in the on-line platforms.

Accomplishment examples

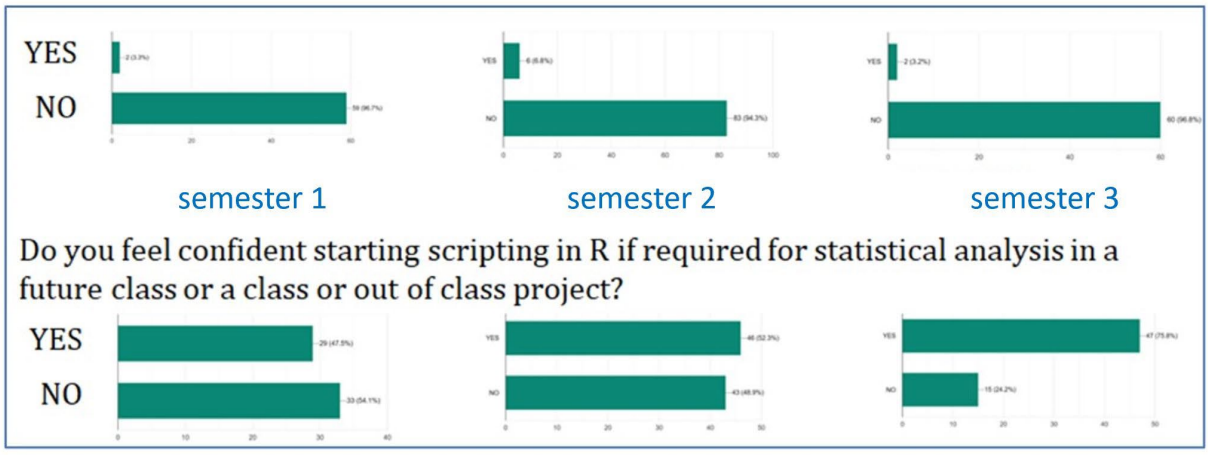

Figure 1. Top row: responses at beginning of semester. Bottom row: responses at the end of semester. Increased confidence in coding skills by end of semester, despite same baseline at beginning of semester.

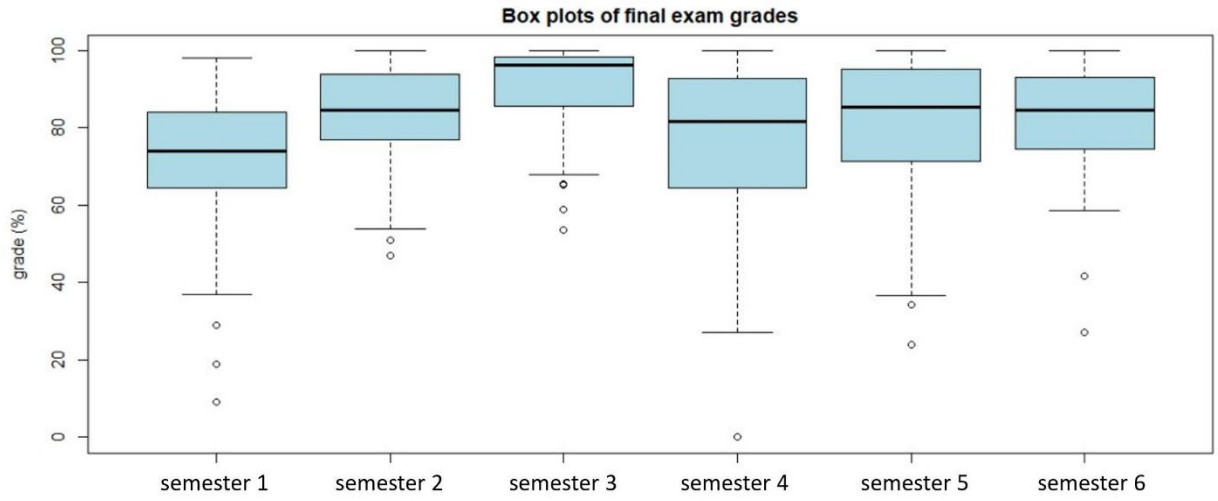

Figure 2. Statistically significant upward trend in final exam grades (baseline semester 1).

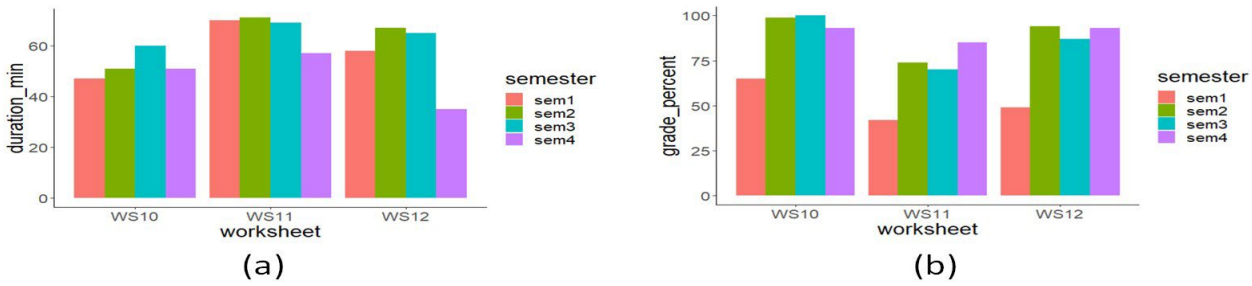

Figure 3. Indication of improvements in reducing cognitive overload by streamlining in-class workflows that reduce continuous context switching among learning platforms during class (see, semester 4). Indicators we use here are duration until completion of a worksheet and grade achieved.

Publicity

The following papers have been presented to the ASEE annual conference:

- S. Koloutsou-Vakakis, E. Kontou, C. W. Tessum, L. Zhao, and H. Meidani, "Cloud technologies for scalable engagement and learning in flipped classrooms". Accepted, 2022 ASEE Annual Conference, Minneapolis, MN.
- S. Koloutsou-Vakakis, E. Kontou, C. W. Tessum, L. Zhao, and H. Meidani, "Educational Technology Platforms and Shift in Pedagogical Approach to Support Computing Integration Into Two Sophomore Civil and Environmental Engineering Courses". 2021 ASEE Annual Conference (virtual).
- S. Koloutsou-Vakakis (on behalf of this SIIP team) presented in the AE3 Spring 2022 Lightning Symposium, Feb 24, 2022, "Integrating computational thinking in CEE sophomore courses."

- H. Meidani and S. Koloutsou-Vakakis, on behalf of the SIIP team, presented "Integrating computing and implementing student-centered learning in CEE 201 and 202" to the Fall 2020 CEE Faculty retreat.
- Initial project award was publicized in the department webpage: https://cee.illinois.edu/news/student-coding-skills-be-strengthened-through-active-learning-thanks-siip-grant.

Project co-PIs: Sotiria Koloutsou-Vakakis, Eleftheria Kontou, Hadi Meidani, Chris Tessum, Lei Zhao.

EIF Liaisons for the project to date: Craig Zilles (CS), Chris Schmitz (ECE), and Matt West (MECHSE)