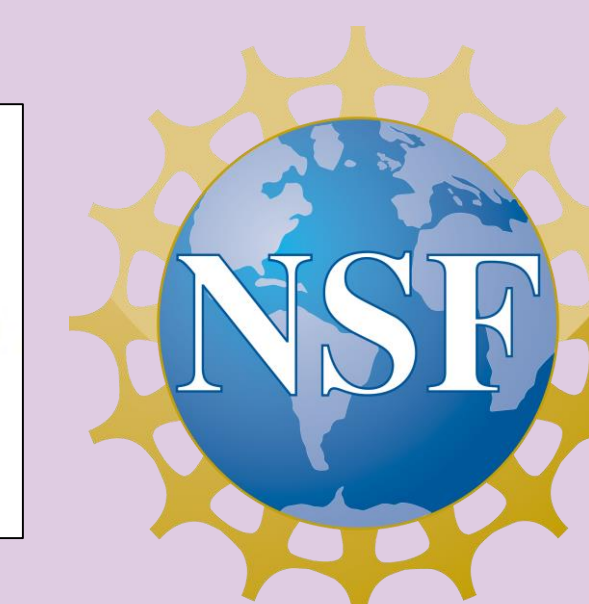


# Promoting Inclusive Engineering Identities in First-Year Engineering Courses

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## PROJECT GOAL

Change engineering culture to support robust learning in degree programs, more effective professional practice, and efforts to retain diverse students and professionals.

## PROJECT OBJECTIVES

- Broaden perceptions of ALL students about who can identify as engineers
- Kindle awareness and appreciation for how diversity strengthens engineering practice
- Cultivate inclusive classrooms for ALL instead of targeting underrepresented populations
- Develop inclusive engineering identities

## WHAT ARE INCLUSIVE ENGINEERS?

- They possess engineering knowledge and the ability to apply it in problem-solving practice
- They approach teamwork with an inclusive attitude that values diversity of thoughts and identities
- They embrace the social responsibility of engineering to serve ALL populations
- They acknowledge the potential impact of implicit and explicit biases
- They recognize the need to participate in life-long learning practices related to engineering and diversity

## OUR APPROACH

- Cultural change must address what happens in the classroom and in the curricula, not just co-curricular activities
- We study changes to the curriculum of two first-year courses
  - CIVE 102 Introduction to Civil and Environmental Engineering
  - ENGR 101 Grand Challenges in Engineering (open option)
- Assess how curriculum changes impact student appreciation for diversity and emerging engineering identities using mixed methods

## REFERENCES

- [1] Barker, L.C., O'Neill, M., & Kazim, N. (2014). Framing classroom climate for student learning and retention in computer science. SIGCSE '14 Proceedings of the 45th ACM Technical Symposium on Computer Science Education, 319-324.
- [2] Bennett, J.E., & Sekaquaptewa, D. (2014). Setting an egalitarian social norm in the classroom: Improving attitudes toward diversity among male engineering students. Social Psychology Education, 17, 343-355.
- [3] Finelli, C., & Kendall-Brown, M. (2009). Using an interactive theater sketch to improve students' perceptions about and ability to function on diverse teams. American Society for Engineering Education. Austin, TX.

Any opinions, findings, conclusions, or recommendations herein are those of the authors and do not necessarily reflect views of NSF.

## CURRICULUM CHANGES IN FALL 2015

### Student Trading Cards

- Inspired by Barker, O'Neill, & Kazim [1]
- Instructors for each course received a set of cards with each student's name
- During class discussions, instructors used cards to call on students
- Goal is for students to recognize that all perspectives are valuable and every person can make important contributions

### Welcome Presentation by the Dean

- Inspired by Bennett and Sekaquaptewa [2]
- Dean visited students in first-year engineering courses and welcomed them to the college. As part of the welcome, he emphasized engineers must develop strong communication skills and how overtly sexist, racist, and other biased behaviors can harm communication.

### Panel of Professional Engineers

- Arranged to demonstrate the diversity in engineering career paths
- Panel members displayed visible differences in social identity (race, gender, age)
- Questions explicitly included the importance of working on teams with non-engineers
- After the panel, students completed a reflective writing assignment to encourage sense-making and engineering identity building.

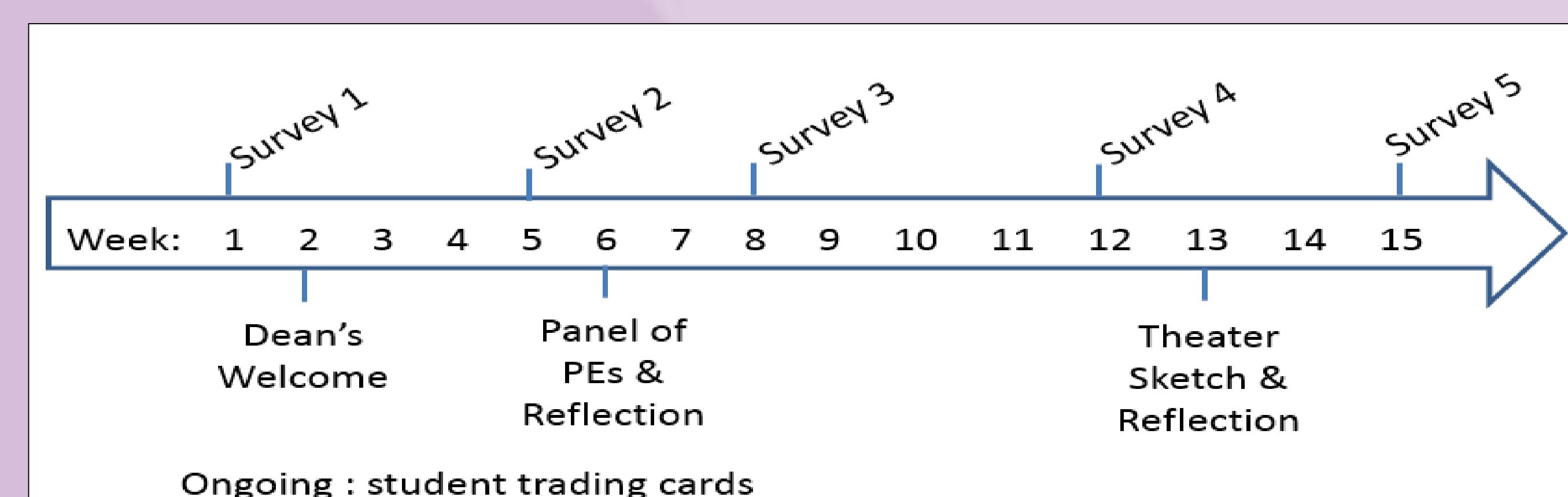
### Guest Lecture on the Nature of Engineering

- Senior faculty member delivered guest lecture to emphasize that engineering is design to improve quality of life and provide benefits for people
- Lecture emphasized the subjective nature of engineering: Who gets to decide what constitutes a benefit? And for whom?
- After the lecture, students completed a reflective writing assignment where they talk about their values and the effects of different perspectives in engineering problem solving

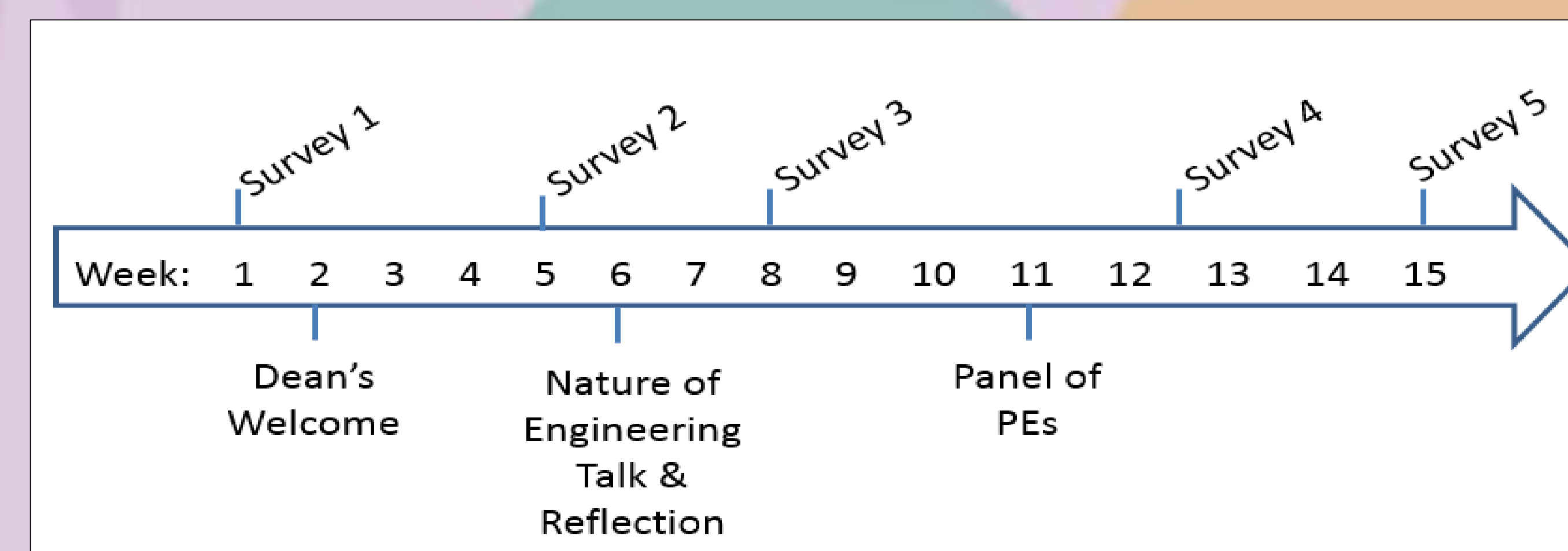
### Interactive Theater Sketch

- Inspired by Finelli and Kendall-Brown [3]
- Troupe of actors delivered a performance that depicted a group of students struggling to work together, which included aspects of gender bias
- Students had the opportunity to interact with the actors by interrupting the performance and stepping in as an additional team member to help improve team dynamics
- After the performance, students completed a reflective writing assignment to describe what they will do to mediate team conflicts

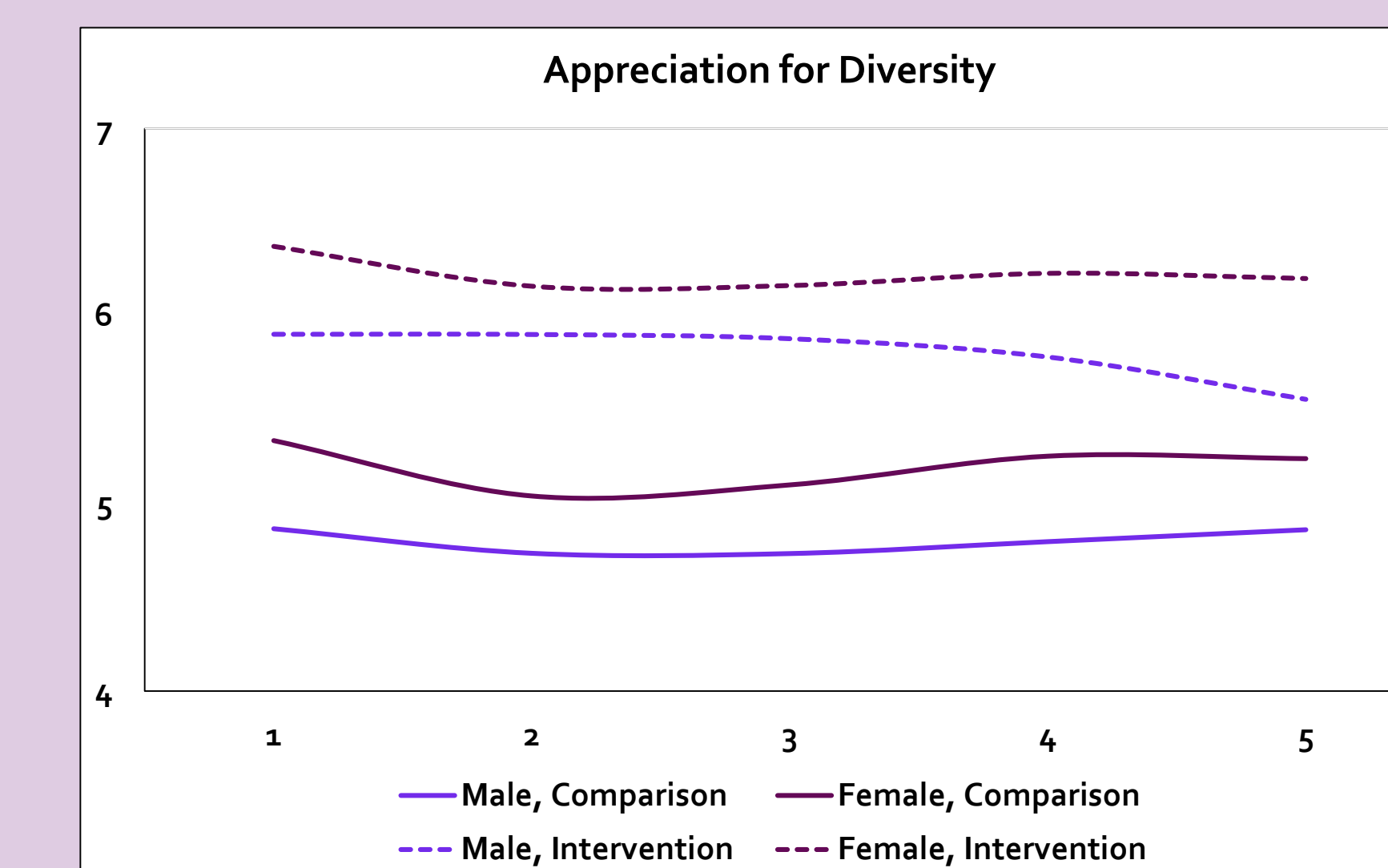
### Timeline for Grand Challenges in Engineering (ENGR 101) surveys and interventions



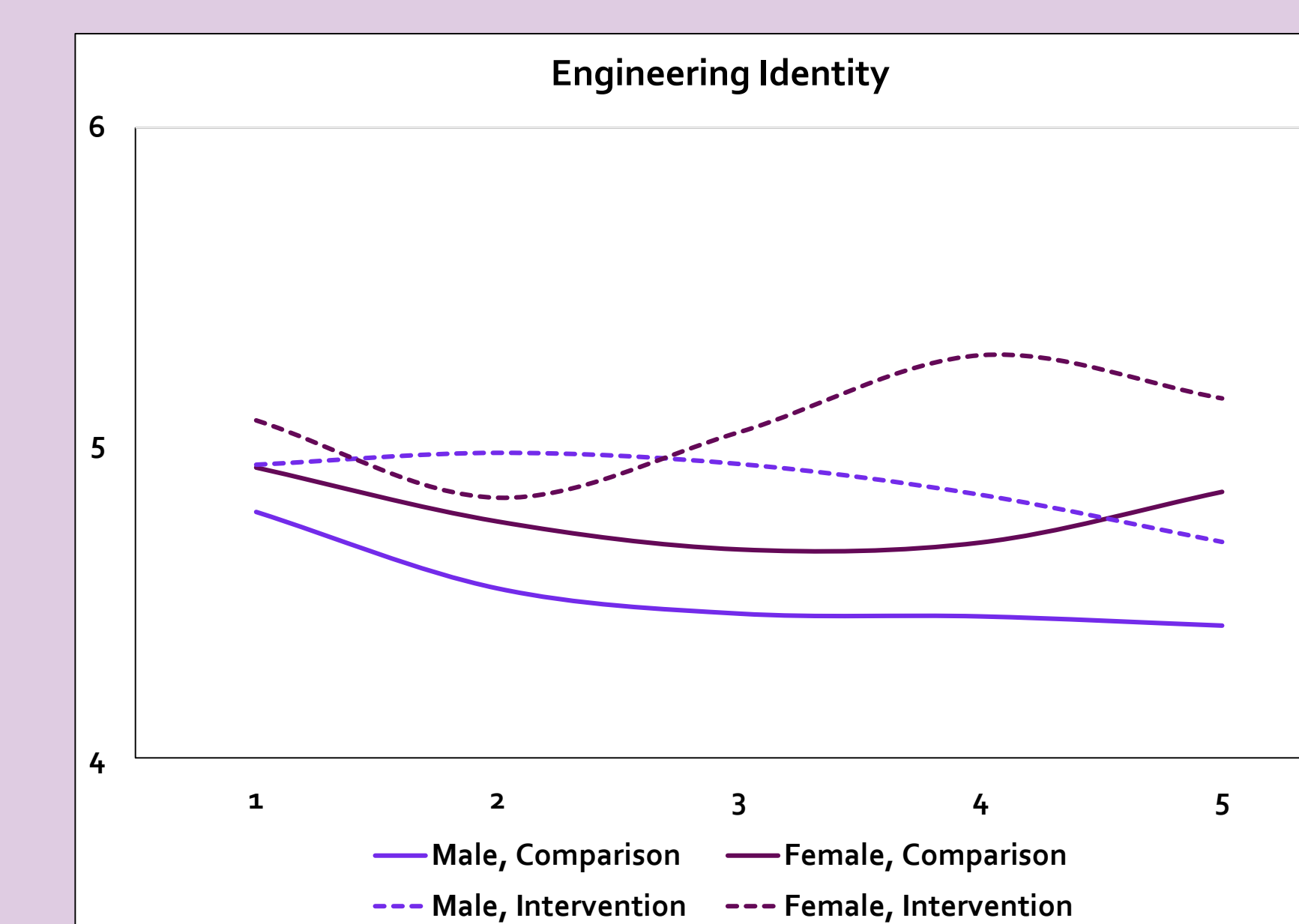
### Timeline for Introduction to Civil and Environmental Engineering (CIVE 102) surveys and interventions



## QUANTITATIVE FINDINGS



- Although students in the two different years started with different initial levels of appreciation for diversity, in both years there was a fairly small change in diversity appreciation over time. The course activities seemed to have little impact.



- Engineering identity also did not change much over time in either the intervention or comparison years. Men in both years showed a slightly lower identification with engineering at the end of the semester, while women's identities increased and decreased during the semester and ended up very close to their original level.

## QUALITATIVE FINDINGS

- As part of the survey, we asked students to answer the following:
  - Which course activities increased your appreciation for diversity in engineering?
  - Which course activities helped you identify as an engineer?

- Opportunities to work in groups, either on labs or projects were an important place for students to learn about diversity. Significant portions of students in both CIVE 102 and ENGR 101 indicated that nothing in the course content increased their appreciation for diversity, suggesting that the interventions may have been too subtle. Also, "doing" engineering was the best way to build engineering identity.

## CONCLUSIONS AND FUTURE WORK

- Quantitative findings indicated that students did not show much gain in terms of appreciation for diversity or engineering identity development. Intentional efforts to promote engineering identity development are necessary. Activities related to diversity awareness and appreciation must be more overt.

- Qualitative findings suggest a potential way to be more direct in teaching about diversity while maintaining relevance to engineering is to use group engineering projects as the rationale for teaching students about diversity.

- In Fall 2016, we will implement a new experimental curriculum that places greater emphasis on teamwork and addresses diversity issues, such as bias, more directly.

What ideas do you have for us?  
What works at your institution?