

# **TRESTLE Course Transformation Final Report**

**Date of report: June 15, 2019**

**Course name: GEEN1400 First-Year Engineering Projects**

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## **1. Intro**

This final report provides a recap of the work done to transform GEEN1400 in line with the TRESTLE Course Transformation grant awarded in AY18-19. In F18 and S19, the course intervention consisted of two main activities: (1) Team Growth Plan and (2) Ethics Case Study assignments. While more specific details about the interventions follow in the next section, the overall motivation for transforming the course was to better create a baseline climate of equity and inclusion. As the first engineering projects class for ~60% of first-year students' degree pathways in the CEAS, GEEN 1400 sets the tone and expectations for subsequent collaborative work in engineering projects and courses. In the summer and fall of 2018, we developed concrete lesson plans, rubrics, and course assignments designed to provide a positive trajectory towards inclusion for subsequent engineering courses to continue, as we hope students will become more and more understanding and appreciative of diversity rather than less tolerant during their undergraduate careers at CU.

Per the TRESTLE award, we had one undergraduate student, James Le, pursuing Discovery Learning Apprenticeship (DLA) Research related to the GEEN1400 course, jointly supervised by faculty members Janet Tsai and Mindy Zarske. Due to unforeseen personal issues, James participated in the research program only during F18.

## **2. Course specific information**

### **A. About the course**

GEEN 1400, First-Year Engineering Projects, is a hands-on, team-based introduction to engineering projects that approximately 60% of the admitted first-year cohort of engineering students takes each academic year in the College of Engineering and Applied Science (CEAS). Students work collaboratively in teams of four to six to dream, design, build, program, and create a tangible project over the course of the semester that they present to industry judges and the general public at a culminating Design Expo event at the end of each semester. As the first engineering design project class along the undergraduate engineering degree pathway, the experience of students in the course is consequential for their feelings of belonging in engineering, desires to persist in engineering, and identity development as engineers.

In F18 and S19 there were 12 and 4 sections, respectively, of GEEN1400, each meeting five hours per week with one hour of lecture on Mondays and two hours of lab twice a week, either Tuesday/Thursday or Wednesday/Friday. Each GEEN1400 course features a three-to-five week Introductory Project, meant to introduce teams to basic skills across many areas: teamwork, communication, manufacturing, prototyping, programming, and circuits. Once the Intro project is complete, student teams move onto the ten-to-twelve week Final/Main Project portion of the course, where students apply their new skills to a bigger engineering challenge and present their designed solution at the Design Expo event at the end of the semester.

## **B. What did you do in the course transformation?**

The two specific course interventions employed in F18 and S19, as sponsored by TRESTLE, were the Team Growth Plan and the Ethics Case Studies. The Team Growth Assignment was introduced to all 16 GEEN1400 sections between the Intro and Main Projects (between weeks 3 and 5 of the semester) during a 50-minute discussion facilitated by the section instructor and a member of the Eplus faculty. The detailed lesson plan for the Team Growth Activity is attached to this report, and the lesson plan itself was initially developed for pilot implementation in Fall 2017 and iterated each semester through Spring 2019. Under TRESTLE, we were able to expand the concept of Team Growth past a single 50-minute lesson and homework assignment into a more meaningful and cross-cutting portion of the class, as Team Growth concepts were woven into every student team's public presentations including their final Design Expo Posters and the way they were judged at the end-of-semester Design Expo. Students were also asked to write individual reflections about Team Growth at the end of the semester. Notably for the first time in F18, 10% of the final semester grade across each GEEN1400 section was allocated for Team Growth, ensuring that students had a grade incentive to take the Team Growth concept seriously. Also, for the first time in F18, specific survey items were added to Pre/Post Course Surveys to directly examine student attitudes and opinions about Team Growth and their experiences in GEEN1400.

The Ethics Case Study Intervention was attempted for the first time in F18, and required students to read, watch, or listen to a set of articles, videos, or podcasts on topics of current controversy in technology or engineering industry, all demonstrating ways technology is biased and the consequences of this technological bias on different world populations. After selecting a case study topic and doing the reading/listening/watching, students had to create their own individual infographics related to their case study, then meet up with 3-5 other students who selected the same topic to discuss how to report-out to the class. The class report-outs were 5-10 minutes each and were meant to encourage and inspire further conversation and understanding of technological biases.

### Individuals Involved:

- Derek Reamon: Eplus Co-Director and GEEN1400 course coordinator, established 10% baseline of grade devoted to Team Growth, assisted in intervention development, ran GEEN1400 instructor meetings to communicate details of both interventions to all GEEN1400 instructors
- Janet Tsai: GEEN1400 instructor and TRESTLE research lead, iterated interventions, course documents, rubrics, and assessment items
- Jacquelyn Sullivan: Eplus Co-Director assisted in course intervention development and championed purpose of interventions during GEEN1400 instructor meetings
- Mindy Zarske, Michael Soltys, Jacob Segil, Katy Sill: Eplus Faculty members who assisted with course intervention development, facilitated Team Growth Activities, provided input and administered the interventions in their own courses
- Ellen Parrish: Eplus Assessment lead for GEEN1400, developed and administered Pre/Post Surveys

- Christina Oerter: Eplus Program Assistant, scheduled and coordinated logistics for instructors and facilitators of Team Growth Activities
- Teach Engineering Video Team: Edited videos for direct use in Team Growth Activities
- James Le: Undergraduate DLA Researcher looking at GEEN1400 courses and team growth.

**C. What assessments or documentation of impact were or will be used?**

GEEN1400 Course Documents utilized in F18 Relevant to TRESTLE and included as attachments to this Interim Report:

1. Sample Syllabus (demonstrating 10% of course grade allocated to Team Growth)
2. Team Growth Plan – 50 minute Lesson Plan
3. Team Growth Plan – Student Team Assignment
4. Team Growth Plan – Grading Rubric
5. Preliminary Design Review (PDR) Rubric (demonstrating component of grade allocated to Team Growth)
6. Critical Design Review (CDR) Rubric (demonstrating component of grade allocated to Team Growth)
7. Expo Judging Rubric (demonstrating component of grade allocated to Team Growth)
8. Peer Evaluation Assignments (demonstrating component of grade allocated to Team Growth)
9. Individual Reflection on Team Growth Assignment
10. GEEN1400 F18 Post-Survey (demonstrating survey items focused on Team Growth)
11. Ethics Case Study – Introduction and Assignment for Students
12. Ethics Case Study – Infographic Grading Rubric, Ethics Case Study – Team Report-Out Grading Rubric

Selected Preliminary Results from F18 in the form of aggregate quantitative Pre/Post Survey Results are included as well as attachments to this Interim Report. Data from other sources including individual student reflection and peer evaluation assignments, open-ended comments on Pre/Post Surveys, and instructor comments will also be considered prior to administering the interventions in S19.

**D. How will you maintain the changes over time and across structures?**

The Course Material Archive, which includes the documents related to the two interventions as part of TRESTLE as well as other resources, lesson plans, assignments, lectures, etc. is in a shared Google Drive folder accessible by all GEEN1400 instructors and supporting staff. As Derek is the course coordinator for GEEN1400, a great deal of institutional memory and continuity is provided by his presence in the coordination role from semester to semester. The Team Growth Activity, in particular, has also been iterated across three semesters now and administered by members of the Eplus faculty, who are all engaged in the intervention's development and continued success. The overarching motivation to make our engineering projects classes welcoming and supportive for all students is also shared as a core value among

all Eplus faculty, so the desire to continue improving the Team Growth Plan and Ethics Case Study assignments will not vanish overnight.

That said, there are many remaining challenges to sustainability for these two course interventions. Both Janet and Derek have left the Eplus Program since the TRESTLE grant was awarded, but other major stakeholders remain.

#### **E. Products arising from the work**

1. ShInDiG Discussion facilitated by Janet Y. Tsai, November 6 2018: “Opportunities and Challenges with Project-Based Learning & Student Teams, A story of potential transformation in first-year engineering projects courses.”
2. DBER presentation on Team Growth intervention on April 8 2019.
3. Survey results below

### **3. Community and expertise building in the department**

The two interventions, Team Growth and Ethics Case Study, have been a part of the GEEN 1400 course for four and two semesters, respectively. The Team Growth intervention has become part of the culture of the community of instructors who meet weekly during the semester. It is an expected course component, a part of the standard syllabus and grading templates, and a regular item of discussion among the faculty. Because the course has Learning Objectives related to ethics, the Ethics Case study has also become an integral part of the course and the community. We expect the Ethics Case Study to undergo further revision at the Eplus retreat later this summer. The regular discussions relating to Team growth has increased the focus on team dynamics and caused all faculty in the community to pay more attention to team development in their sections, and their expertise in the subject.

### **4. The process and structure of the work in the department**

Section 2 details the process for delivering the two interventions and the structures that facilitate the delivery and continuity of the work. The lesson plan for Team Growth has been iterated and is in a stable state that meets faculty needs. The Ethics Case study is on the agenda for iteration later this summer. The faculty will continue to develop both interventions in the Eplus faculty retreat and the GEEN 1400 instructor meetings.

## 5. Survey Results

### A. Belonging

These survey items related to 'belonging' in engineering have been a consistent part of the GEEN 1400 pre and post surveys for several years. Below are the results for the past three Fall semesters. The general increasing trend in agreement with positive belonging statements, and the general decline in disagreement with belonging statements are encouraging, and may indicate that the interventions are having the desired effect.

Please indicate your level of agreement:	Strongly Agree/Agree								
	FA16 n = 321			FA17 n = 220			FA18 n = 283		
	Pre	Post	Gain	Pre	Post	Gain	Pre	Post	Gain
I fit in well with the other engineering students	40%	42%	2%	40%	45%	5%	49%	53%	4%
People in engineering accept me	62%	65%	3%	55%	62%	7%	67%	75%	8%
I feel like I belong in engineering	55%	63%	8%	59%	57%	-2%	65%	68%	3%

  

Please indicate your level of agreement:	Strongly Disagree/Disagree								
	FA16 n = 321			FA17 n = 220			FA18 n = 283		
	Pre	Post	Gain	Pre	Post	Gain	Pre	Post	Gain
I fit in well with the other engineering students	4%	7%	3%	1%	5%	3%	2%	3%	1%
People in engineering accept me	1%	2%	1%	0%	1%	1%	1%	0%	-1%
I feel like I belong in engineering	1%	3%	3%	0%	6%	6%	1%	2%	1%

Below are the results for the past three Spring semesters. Again, the general increasing trend in agreement with positive belonging statements, and the general decline in disagreement with belonging statements are encouraging, though the small sample sizes in S19 (due to a survey administration error) make it difficult to support any strong conclusions.

Please indicate your level of agreement:	Strongly Agree/Agree								
	SP17 n = 156			SP18 n = 105			SP19 n = 47*		
	Pre	Post	Gain	Pre	Post	Gain	Pre	Post	Gain
I fit in well with the other engineering students	38%	38%	0%	36%	38%	2%	64%	63%	-1%
People in engineering accept me	65%	60%	-5%	53%	65%	11%	72%	68%	-4%
I feel like I belong in engineering	55%	59%	4%	60%	53%	-7%	65%	79%	14%

Please indicate your level of agreement:	Strongly Disagree/Disagree								
	SP17 n = 156			SP18 n = 105			SP19 n = 47*		
	Pre	Post	Gain	Pre	Post	Gain	Pre	Post	Gain
I fit in well with the other engineering students	4%	8%	4%	6%	10%	4%	2%	4%	2%
People in engineering accept me	1%	3%	2%	0%	3%	3%	2%	2%	0%
I feel like I belong in engineering	4%	7%	3%	4%	4%	0%	0%	0%	0%

#### B. Team Feedback

These survey items have also been a long term part of the GEEN 1400 post survey. Below are the results for the past two semesters. The results have improved gradually over several years, but the gap in men's and women's responses persists. We would have hoped for more of a closure of this gap due to this work and the two interventions.

Fall 18: n = 283 (all), n = 110 (women), n = 170 (men)

Please indicate your level of agreement below:	Strongly agree/agree			Disagree/strongly disagree		
	All	Women	Men	All	Women	Men
I felt comfortable on my project team.	78%	69%	84%	4%	4%	4%
I felt that I am a part of my project team.	87%	83%	89%	3%	4%	3%
I felt that I am supported on my project team.	71%	65%	75%	6%	6%	6%
I felt that I am accepted on my project team.	83%	75%	89%	3%	4%	2%

Spring 19: n = 99 (all), n = 32 (women), n = 63 (men)

Please indicate your level of agreement below:	Strongly agree/agree			Disagree/strongly disagree		
	All	Women	Men	All	Women	Men
I felt comfortable on my project team.	81%	84%	81%	2%	0%	2%
I felt that I am a part of my project team.	84%	78%	87%	1%	0%	0%
I felt that I am supported on my project team.	73%	72%	76%	2%	3%	0%
I felt that I am accepted on my project team.	83%	78%	87%	1%	0%	0%

### C. Team Growth

These survey items were added to the GEEN 1400 post survey to evaluate the Team Growth intervention. Below are the results for the past two semesters for four survey items. This data will be more interesting and useful once we can look at longitudinal trends, but with the majority indicating agreement with positive outcomes of the team growth objectives on the first three items, the initial data is promising. The fourth item indicates that students are not experiencing significant linkage between team growth and sense of belonging. It was not necessarily expected that students would find this strong linkage, but if it were present, it would have been strong support for the underlying purpose of this work and the interventions.

How often did you take on tasks that were completely new to you, out of your comfort zone, during your 1400 projects course this semester?	Always/often			Rarely/never		
	All	Women	Men	All	Women	Men
Fall 2018; n = 283 (all), 110 (women), 170 (men)	59%	57%	61%	8%	11%	6%
Spring 2019; n = 99 (all), 32 (women), 63 (men)	64%	75%	57%	7%	0%	10%

  

To what extent was team growth a focus of your 1400 projects course learning experience this semester?	Extremely/very			Slightly/not at all		
	All	Women	Men	All	Women	Men
Fall 2018; n = 283 (all), 110 (women), 170 (men)	51%	48%	52%	15%	15%	14%
Spring 2019; n = 99 (all), 32 (women), 63 (men)	52%	59%	48%	8%	6%	10%

  

Was the focus on team growth helpful to your learning?	Strongly agree/agree			Disagree/strongly disagree		
	All	Women	Men	All	Women	Men
Fall 2018; n = 283 (all), 110 (women), 170 (men)	56%	52%	58%	14%	15%	14%
Spring 2019; n = 99 (all), 32 (women), 63 (men)	68%	69%	65%	11%	9%	13%

  

How did the focus on team growth throughout the semester contribute to your sense of belonging in our engineering community?	Extremely/very			Slightly/not at all		
	All	Women	Men	All	Women	Men
Fall 2018; n = 283 (all), 110 (women), 170 (men)	34%	35%	34%	26%	24%	28%
Spring 2019; n = 99 (all), 32 (women), 63 (men)	34%	44%	29%	29%	28%	29%

### 6. Future Plans

The EPlus Program has a new director, Angela Bielefeldt, who will also be the new course coordinator for GEEN 1400. It will be up to her to continue this work. She will be working with a core group of faculty who have been working on this intervention for over two years, so we anticipate that this intervention and this work will continue, but the specific plans will be up to the new director.