

Building Bridges (but not with balsa wood) through Scalable Engineering Design Process Lessons

Dr. Betsy Chesnutt, University of Tennessee at Knoxville

Betsy Chesnutt is a lecturer in Engineering Fundamentals at the University of Tennessee-Knoxville. She is interested in understanding how to prepare pre-service teachers to teach engineering, as well as how to support current K-12 teachers so that they can implement engineering into K-12 classrooms more effectively.

Prof. Laura Knight, University of Tennessee at Knoxville

Laura Knight is an Assistant Professor of Practice in the Department of Industrial and Systems Engineering at The University of Tennessee, Knoxville, and an advocate for expanding the numbers of future engineers through education and community outreach.

Laura returned to academia after over 25 years of working in locations across the country and raising a family. She held engineering and manufacturing leadership roles with a variety of private and public companies, including President/Owner of a developing children's discovery museum, which brought outreach programs to underserved populations.

Collaborating across communities, industries, and academic disciplines and developing innovative, effective methods of actively involving learners are both integral parts of her efforts and success.

Workshop: Building Bridges (but not with balsa wood) through Scalable Engineering Design Process Lessons

Workshop Purpose

The purpose of this workshop is to expose STEM and first-year engineering educators to a greater depth and breadth of understanding of the engineering design process (EDP) in order to strengthen their self-efficacy with teaching engineering and ability to motivate student interest in learning engineering principles and to provide educators with lesson plans and supplies to implement these skills immediately. In this workshop, first-year engineering educators and K-12 STEM educators will be provided with two high-quality and scalable engineering lesson plans that can be immediately utilized across a wide variety of educational settings, from K-12 classrooms and informal educational settings to first-year engineering programs. All participants will also be provided with all the supplies necessary for up to 25 students to complete these activities.

Workshop Goals

- Provide participants with immediately usable lesson plans that are scalable so that they can be utilized in a variety of educational settings
- Provide participants with all supplies necessary to complete the two lesson plans presented in the workshop.
- Empower participants with increased confidence to motivate students in engineering
- Motivate participants to develop additional lessons and teaching tools
- Facilitate interaction and provide a ‘network of support’ for first-year and K-12 engineering educators

Workshop Participants

This workshop is designed for first-year engineering educators, current and future K-12 teachers, leaders of community youth development groups, and anyone interested in engineering education and outreach.

Workshop Description

This workshop will begin with an overview of the EDP and how it can be authentically utilized in design projects in first-year classrooms, as well as K-12 and informal education spaces. Two lesson plans will be provided, one for a catapult project and one for a biomimetic robot project. The workshop will also include time for participants to discuss how to scale these lesson plans for diverse classroom settings and age groups. These projects were originally developed by the workshop facilitators as engineering design projects used in first-year engineering courses. They have since been revised to be easily scalable for use in a variety of educational spaces. For example, both lesson plans have been utilized in summer engineering programs for K-12 students and included in engineering project boxes that have been sent to middle school teachers in Tennessee.

The facilitators developed both activities and have successfully implemented them with students in a first-year engineering program and younger students in grades 3-12, in both formal and informal educational settings, such as camps and outreach events, and in time blocks as short as less than an hour to as long as a week. In the workshop, the facilitators will share their experiences and the modifications that have been

made to scale each activity for these diverse groups of students. At the conclusion of the workshop, each participant will receive a kit containing all materials necessary to complete these two activities with a group of students.

The EDP is an integral part of the curriculum of first-year engineering design courses, as well as K-12 STEM and engineering classes. Several grants awarded to Tickle College of Engineering at the University of Tennessee Knoxville have addressed this curriculum component, as well as helped create and evaluate lesson plans for educators to use in their classrooms. This workshop will expand on the work of those grants and other workshops by providing first-year and K-12 engineering educators with scalable EDP-focused lesson plans that can be modified for use across multiple grade levels and abilities.

Workshop Activities

- EDP Content - instruction
- Interactive EDP lesson applications
- Sharing of ideas and experiences
- Development of future plans
- Creation of informal support network

Workshop Tentative Timeline

15 min	Introductions
15-30 min	Instructional/Background Content
15-45 min	Breakout groups - participate and complete Lessons and share with group
15+ min	Group uses brainstorming techniques to share ideas how to immediately implement the EDP and these lessons in classroom
15+ min	Wrap-up and presentation of participant ideas for future implementation and expansion

Previous Educator Workshops Conducted by Facilitators

- OneUT 1000s STEMs Professional Development sessions and ongoing activities: Facilitators received system-wide, multi-discipline internal university grant to identify current needs and develop innovative methods to assist STEM educators. The project transitioned to support virtual learning and conducted online professional development sessions across the state. One session was focused on utilizing the EDP in the classroom.
- Industrial and Systems Engineering Department Professional Development sessions for local school district STEM/IT educators: Facilitator developed and conducted two professional development sessions with local educators to share new methods of teaching the EDP in the classroom and use ISE tools. Participants created new connections within their own district and

with university resources. Students and cross-campus partners also participated through supporting the workshops.

- TCE Student Success Professional Development session: The Office of Student Success held three teacher professional development opportunities during the fall of 2022. Two of these opportunities were at Tickle College of Engineering and incorporated lab tours with instruction on using the engineering design process to teach about biomimetics/build biomimetic robots. The third was a collaboration with the University of Tennessee Space Institute, where teachers and 4-H agents learned about hypersonics and toured different UTSI lab facilities. These opportunities were funded by a grant from the Office of Naval Research; similar opportunities will be offered this fall at UTSI and virtually.

Workshop Facilitators and Qualifications:

- **Betsy Chesnutt** - Lecturer in Engineering Fundamentals at the University of Tennessee-Knoxville, member of the Tickle College of Engineering outreach committee and professor of a course on K-12 engineering education
- **Anne Skutnik** - Director of Student Success for Tickle College of Engineering; previously classroom teacher and outreach coordinator for NSF-ERC CURENT.
- **Laura Knight** - professor of practice and coordinator of outreach and engagement for the Industrial and Systems Engineering Department. More than 25 years of industry and community outreach experience.