
Angela Calabrese Barton1, Marcos Gonzalez2, Christina Restrepo Nazar1, Kathleen Schenkel1 & Edna Tan2
1Michigan State University
2University North of North Carolina at Greensboro

Project Overview & Objectives

Project Overview:
I-Engineering supports identity development in engineering as a part of (not apart from) learning two core practices in engineering: 1) defining problems and 2) designing solutions. The I-Engineering framework and tools help teachers/students to localize the engineering design process. The process of localizing engineering design as involving iterative engagement with both the technological and social dimensions of engineering design towards refining the problem constraints/specifications while exploring possible modes of solution optimization for particular people/contexts. We are also generating empirically based understandings of how to support identity work of middle school students engineering for sustainable communities across spaces and over time. Our framework and tools support teachers in understanding how students develop this identity work in their classrooms when designing for community and local concerns. We are currently underway in reading curriculum and teacher tools that support teachers and students with thinking, planning and reflection around community ethnography and the design process when engineering for sustainable communities.

I-Engineering Framework

Design Challenge: Getting off the Power Grid

- Module 1: Grand Challenge
- Module 2: Community Ethnography
- Module 3: Designing Solutions

I-Engineering Tools

- Framework Tools
- Automatic Tools

Examples of Youth Engaging in EISc

- Youth-maker
- Teacher

Mashani, Mabola (Africa)
- Rumbula, Maceta (Kenya)
- Rolled out of school because of poverty
- Wanderlust
- High technology
- Bicycle frame
- Plastic pipe
- Community was suffering from a drought and had no access to electricity

Cohiba, India
- Water Filter System
- Low technology
- Sand
- Student

Michigan
- Making a Change afterschool program
- Light-up football & Phantom, Jetpack
- Security concerns led family to design a football for children to play in dark areas and an alarm jacket

Curriculum Modules
Engineering has played a significant role in the advancement of civilization while also contributing to the ways in which our global society is not sustainable. Our design challenges focus the relationship between the electrical production & consumption system and climate change as one critical grand challenge of engineering that demands solutions at both the global and local community level.

Our challenges are designed to cover:
- Engineering practices of defining problems and designing solutions;
- Big ideas related to energy transformations, energy production, and large scale energy systems;
- Community perspectives.

By integrating community ethnography with the technical dimensions of engineering, students will experience what it means to become an engineer for sustainable communities. Our student engineers will ask questions around: Who is the project for? Whose knowledge counts? Who takes part in the data collection and analysis and who takes action?

Productive Identity Work (PIW)

PIW Framework Tree


- Project Overview & Objectives

- Conceptual Frameworks

- I-Engineering Framework

- I-Engineering Tools

- Examples of Youth Engaging in EISc

- Piw Framework Tree

- Other Learning Outcomes Supported by Piw

- Traditionally Assumed Outcomes

- Student Achievement & Equity

- Knowledge and Practice

- Teacher’s Thinking on Piw

- Youth-maker

- Framework Tools

- Automatic Tools

- Teaching & Learning Tools

- Teaching & Learning Tools

1. Knowledge and Practice: Students’ funds of knowledge along with disciplinary knowledge are leveraged in the classroom to transform the STEM curriculum.

2. Recognition: Others noticing and publicly valuing the strengths that students bring to STEM, even when these are not traditional STEM resources (e.g., being funny).

3. Agency: Supporting students to feel engaged, capable, and competent in the engineering classroom context.

Engineering for Sustainable Communities (EISc): Core Design Principles and Educational Implications

Design principles help teachers navigate from a topic to a problem space where students can develop realistic and testable tools based upon current knowledge, empirical investigation of technical & social dimensions, and operational constraints and specifications.

1. The problems identified by engineers and community members are those that improve the daily lives of people with special attention to issues of injustice.

2. Designing solutions that positively affect sustainable communities requires multiple perspectives, including local perspectives.

3. Sustainable community members are empowered to design & maintain long-term solutions to problems that affect them directly.

4. The design process equally balances political, environmental, and social effects of decisions.