Spring 2023 AE3 Lightning Symposium

ENHANCING ENGINEERING EDUCATION THROUGH ENTREPRENEURIAL MINDSET (EM)

APRIL 6, 2023
• All participants will be automatically muted upon entry to the Main Room.
• The symposium will consist of:
  • Eight (8) unique presentations of **5 minutes or less**
  • A general Q+A session following all presentations
  • The chat space will remain open during the lightning presentations.
  • You are encouraged to post questions, share ideas, and offer comments during the presentations; the presenters will not be responding to chat during their 5-minute presentations but rather during the Q+A session following all presentations.
  • AE3 staff will monitor for the chat for questions that may be addressed during the open Q+A sessions following all presentations.
  • Please **unmute** to ask open-mic questions during the Q+A session.
  • The symposium will be recorded and available on the AE3 website (**http://ae3.engineering.Illinois.edu**) later this week.
What is EM? What is KEEN?

Kern Entrepreneurial Engineering Network (KEEN)

KEEN seeks to represent the larger engineering education landscape, showing that the entrepreneurial mindset benefits students regardless of institution type, size, or location.

Engineering Unleashed: http://engineeringunleashed.com

About Us
Engineering Unleashed is a community of more than 4,000 engineering faculty and staff with a shared mission to graduate engineers with an entrepreneurial mindset so they can create personal, economic, and societal value through a lifetime of meaningful work.

The Entrepreneurial Mindset

An entrepreneurial mindset helps you identify opportunities, solve for problems, and create long-lasting value—in your classes, campus, community, and the world. When combined with the skills and work engineers already do, entrepreneurially minded engineers become powerful agents of societal good.

Community Membership

Membership to this community is open to faculty interested in inspiring future generations of engineers to identify opportunities, make a positive impact, and create value for the world around them.
Let's talk about Mindset.
The entrepreneurial mindset consists of three key elements: Curiosity, Connections, and Creating Value—the 3C’s. This emergent understanding came from years of work with KEEN faculty, students, and industry.

DEFINING THE 3C’S

Curiosity
In a world of accelerating change, today’s solutions are often obsolete tomorrow. Since discoveries are made by the curious, we must empower our students to investigate a rapidly changing world with an insatiable curiosity.

Connections
Discoveries alone are not enough. Information only yields insight when connected with other information. We must teach our students to habitually pursue knowledge and integrate it with their own discoveries to reveal innovative solutions.

Create Value
Innovative solutions are most meaningful when they create extraordinary value for others. Therefore, students must be champions of value creation. As educators, we must train students to persistently anticipate and meet the needs of a changing world.
Entrepreneurial Mindset

Coupled with

Engineering Thought and Action

Expressed through

Collaboration

And

Communication

And founded on

Character

Curiosity
Demonstrate constant curiosity about our changing world
Explore a contrarian view of accepted solutions

Connections
Integrate information from many sources to gain insight
Assess and manage risk

Creating Value
Identify unexpected opportunities to create extraordinary value
Persist through and learn from failure

Apply creative thinking to ambiguous problems
Apply systems thinking to complex problems
Evaluate technical feasibility and economic drivers
Examine societal and individual needs

Form and work in teams
Understand the motivations and perspectives of others

Convey engineering solutions in economic terms
Substantiate claims with data and facts

Identify personal passions and a plan for professional development
Fulfill commitments in a timely manner
Discern and pursue ethical practices
Contribute to society as an active citizen
Cozad New Venture Challenge

Accessible programming that fosters cross-campus connections and cultivates creativity to support students’ entrepreneurial endeavors

Jed Taylor, Technology Entrepreneur Center

April 6, 2023
Technology Entrepreneur Center

Mission to provide opportunities that foster the entrepreneurial mindset and empower our stakeholders to make a global impact.

- Academics
- Programs
- Events
- Collaborations

Cozad New Venture Challenge

- **Curiosity**
  Cross-campus partnerships expand perspectives

- **Connections**
  Community building events, mentorship, and 1:1 advising

- **Creating Value**
  Content taught by entrepreneurs including new healthcare track
Sparking Entrepreneurial Mindset through near-peer mentoring in CEE

Ramez Hajj, Civil and Environmental Engineering

APRIL 6, 2023
• Revisit the “3 C’s”
• Near-peer mentoring allows students to connect project ideas with future coursework
• *Value is created* by allowing upper-level students to gain mentoring experience useful later in their careers, and mentees to learn more about the curriculum and program
• Students use *curiosity* to drive the development of the projects they are working on
Near-peer mentoring framework

- **Two broad categories**

  **General Mentoring**
  - CEE 495 – Professional Practice
  - CEE 190 – Project-Based Intro to CEE

  - 5 mentoring sessions throughout the semester
  - CEE 495 students visited 2 sessions each; 190 project groups attended all 5
  - CEE 495 mentors rotated between team tables and had list of discussion topics

  **Targeted Mentoring**
  - CEE 4XX - Concrete/Asphalt Materials
  - CEE 190 – Project-Based Intro to CEE

<table>
<thead>
<tr>
<th>Date</th>
<th>Meeting Objectives</th>
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</thead>
</table>
| Meeting #1 | Week 2 of Project  
Mentors and Mentees:  
- Share your project objectives with the other team  
- Present background information your team has gathered |
| Meeting #2 | Week 5 of Project  
Mentors:  
- Share early test results  
Mentees:  
- Collect data for your report  
Mentors and Mentees  
- Discuss implications of the data |
| Meeting #3 | Week 7 of Project  
Mentors and Mentees:  
- Share final results and conclusions |
• CEE 190 students found meetings beneficial

- Mentors were more mixed- small dataset but preliminary data indicated some felt it was not a good use of time and were unsure if it was beneficial to mentees
Thank you to everyone who collaborated on this project!
SIIP Team: Jacob Henschen, Jeff Roesler, Art Schmidt, Marie Bond
SIIP Mentor: Joe Bradley
Thank you to the Keen Network and SIIP for their financial support!

Questions?
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Redesigning Design: Incorporating 3Cs into MatSE Capstone Courses

Matt Goodman, Materials Science and Engineering

APRIL 6, 2023
MatSE Senior Design Course revisions

- Moving from a 1-semester, 3 credit course to a 2-semester sequence (1-credit fall, 2-credit spring).
- Piloted sequence in Fall 2022: MSE 398 (1 credit), 27 students.
- MSE 395 Spring 2023, 89 students.

Addition of Human Centered Design (HCD)

- Past projects devolved into research projects (at best) or literature review.
- No formal design course in the MatSE curriculum.
- Utilize campus (Siebel Center for Design) expertise.

Addition of Entrepreneurial Mindset (EM)

- 3 Cs naturally lend themselves to senior design/capstone.
- Explicitly formalizing and emphasizing the Cs assists the teams progress.
# Mapping Course Elements, HCD, and the 3Cs

## HCD Taxonomy

<table>
<thead>
<tr>
<th>HCD Taxonomy</th>
<th>Engineering Design Activities</th>
<th>Actual Activities</th>
<th>KEEN’s Opportunity, Design, Impact</th>
<th>KEEN’s 3 C’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand</td>
<td>Understand the Challenge, frame the problem, implement empathic techniques</td>
<td>Team Contract, Literature Review</td>
<td>Opportunity</td>
<td>Curiosity</td>
</tr>
<tr>
<td></td>
<td>Build Knowledge</td>
<td>Interviews, Weekly Reports, Lit Review</td>
<td>Opportunity</td>
<td>Curiosity, Connections</td>
</tr>
<tr>
<td>Synthesize</td>
<td>Weigh Options and Make Decisions</td>
<td>Interviews, Goals, Objectives, Constraints, Boundaries</td>
<td>Design, Opportunity</td>
<td>Connections</td>
</tr>
<tr>
<td>Ideate</td>
<td>Generate Ideas</td>
<td>Weekly Reports</td>
<td>Design</td>
<td>Connections</td>
</tr>
<tr>
<td>Prototype</td>
<td>Represent Ideas</td>
<td>Simulations, Weekly Progress Reports</td>
<td>Design</td>
<td>Connections, Create Value</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
<td>Experiments, Simulations</td>
<td>Design, Impact</td>
<td>Create Value</td>
</tr>
<tr>
<td></td>
<td>Troubleshoot</td>
<td>Interviews with stakeholders, discussion</td>
<td>Design, Opportunity</td>
<td>Connections, Create Value</td>
</tr>
<tr>
<td>Implement</td>
<td>Revise/Iterate</td>
<td>Experiments, Simulations</td>
<td>Design</td>
<td>Create Value</td>
</tr>
<tr>
<td></td>
<td>Reflect on Process</td>
<td>Final Portfolio, Poster Presentation</td>
<td>Impact</td>
<td>Curiosity, Connections, Create Value</td>
</tr>
</tbody>
</table>
Technical Feasibility (Lecture Worksheet)

- What important insights and “How Might We …” questions are driving the ideate phase?
  - Curiosity
- What MSE concept is at the core of your design project?
  - Creating Connections
- What are the fundamental equations? Create connections to courses you’ve taken.
  - Creating Connections
- What do you want the simulation model to capture?
  - Creating value
- What reference model are you comparing it to? Is this reference model “good” enough for comparison? How do you know?
  - Creating value
- What unknown variables are in the project? For each one, determine a likely range. How confident are you with this range? Do you need to narrow the range?
  - Curiosity
Students' knowledge of performing HCD processes such as understanding the design challenge, generating ideas for design solutions, and prototyping these solutions improved significantly.

In addition, it seems that some students’ skills associated with mindsets such as creativity, experimentation and communication improved significantly.

We are currently collecting Pre/Post survey in MSE 395 data in addition to classroom observations and interviews to better evaluate the impact of such interventions on students’ understanding of HCD and their development of EMs.

We are also investigating any differences in the learning experiences between students who took MSE 398 in the Fall and are now in MSE 395 and students who did not take MSE398 in the Fall but are in MSE 395.
Thank you to everyone who collaborated on this project!
SIIP Team: John Abelson, Jessica Krogstad, Saad Shehab, JC Stinville, Salil Paranjape
SIIP Mentor: Blake Johnson
Thank you to the Keen Network and SIIP for their financial support!

Questions?
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The Idea Fair and Celebration: Showcasing Innovative Ideas from TE 200 and Beyond

Keilin Jahnke, Technology Entrepreneur Center

APRIL 6, 2023
Do you thrive on innovation, entrepreneurship and creativity? Then this is the living-learning community for you! Innovation features The Garage, a dedicated workspace that you will use as you develop your new businesses and projects. On-site staff members are available to assist as you navigate the ample entrepreneurial and creative resources on campus and in the surrounding areas.
TE 200: Introduction to Innovation (1 credit hour, fall semester)

146 students in Fall 2022
~90% first-year students
98 from Grainger + ChemE
6 sections of <30 students

Early introduction to 3 Cs and entrepreneurial ecosystem at Illinois (programs + academics)

Understand different types of innovation
Team project that generates value + impact

Learning Objectives
Upon completion of this course, you will be able to:

1. Define innovation and entrepreneurship.
2. Assess and develop your entrepreneurial identity.
3. Summarize ten types of innovation and compare and contrast various innovation tactics.
4. Identify resources and opportunities on campus and in Champaign-Urbana through which you can practice.
5. Practice innovation leadership and pursue entrepreneurship.
6. Develop innovative product or service ideas.
7. Build a prototype.
8. Explain an idea and communicate its details and effectiveness to a broad audience.
9. Understand and apply the design process of problem discovery, ideation, and implementation.
LOCAL NEWS

U of I Technology Entrepreneur Center

by: Sarah Lehman
Posted: Jan 10, 2023 / 05:06 PM CST
Updated: Jan 10, 2023 / 05:06 PM CST
Thank you to everyone who collaborated on this project:
TEC Associate Director: Stephanie Faraci
ILLC Program Director: Chris Murphy
Technology Entrepreneur Center
TE 200 instructional team
Siebel Center for Design

Interested in collaborating?
Please email deahl1@illinois.edu!
The Not-so-Simple Drinking Cup: Materials Selection and the 3Cs

Jessica TerBush, Materials Science and Engineering

April 6, 2023
Premise

The KEEN Foundation’s 3Cs fit naturally within a lab or design class. The in-class activity described here touches on all three:

**Curiosity**

Why are certain decisions made during materials selection? What drives our choices?

**Connections**

How does this relate to the concepts and properties we’ve learned in our intro MatSE courses? Or, how is what we’re learning in class applied in the real world?

**Creating Value**

How do we weight certain selection criteria? What trade-offs might be associated with our choice?
Let’s consider an everyday object: a cup

It seems simple, right? Not much engineering here.

Ask the students to share what they think of first. What does it look like? And more importantly, what sort of material is it made of?

There should be a multitude of answers. So now we need to think about HOW the choice was made. What were the decision criteria here? What material properties might come into play? How does this tie into what we’re learning now?

If we consider just one property (say, thermal conductivity), we still get multiple possibilities. So what trade-offs do we need to consider? Will everyone have the same selection criteria? How do you balance the need of different stakeholders? (Maybe better suited to design rather than lab class…)
• Consider a “simple” cup...
The take-away

This activity is easily adapted to fit other concepts (for example, durability, recyclability, etc). It’s also easily adaptable for various levels, from K-12 outreach (where we’ve run it successfully in a Detroit elementary school) to college.

One important caveat

Thanks to maternity leave this semester, I was not able to run this activity as planned in my MSE 308 class this Spring, so I don’t have any preliminary data yet to its effectiveness at the college level. So consider this very much a work in progress…
Thank you to my fellow SIIP team members: Rebecca Reck (BioE), Katie Ansell (Physics), Holly Golecki (BioE), Chandra Radhakrishnan (ECE), and Chris Schmitz (ECE) and our mentor Joe Bradley. Thanks also to John Norton (GLWA) for helping pilot this as a K-12 outreach activity.

Thank you also to the KEEN Network and SIIP for their financial support.

Questions?
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(Join our Community of Practice for lab and design instructors!)
Pathways to Impact: Broadening Professional-Vocational Perspectives of Engineering Students

Joe Bradley, Bioengineering & Technology Entrepreneur Center

APRIL 6, 2023
The objective of this project is to create a learning experience that provides students with a framework and set of tools for connecting personal values, interests, and goals with their skillset and exploring various professional-vocational pathways for impact.
Class Discussions: Understanding concerns, fears, worries, and excitement about your vocational-professional journey. Situate in the context of the Entrepreneurial Mindset (EM)

- Define the 3C’s in own words
- Tell a story how you may have exemplified one of the 3C’s in the past (e.g., internship, project, volunteer work)
- Pick one of the 3C’s you are excited to grow in. Discuss how this might happen within the next year?

Pre-class activity:
- Peer teaching
- Clifton Strengths Workshop - Self-awareness & Areas of Strength
- Reflection
• Designing Your “New” Work Life - Bill Burnett & Dave Evans (2021)
• My Pathways To Impact Journal (in collaboration with SCD)
• Panelist
• Guest speakers
Course General Takeaways

- Students seem to be engaged with the course
- Seems to be a space were students are comfortable sharing concerns about their future
- First time course has been offered, we will know more soon.....
Thank you to everyone who collaborated on this project!
SIIP Team: Keilin Jahnke, Jed Taylor, Andy Singer, Joe Bradley
SIIP Mentor: Blake Johnson

Thank you to the Keen Network and SIIP for their financial support!

Questions?
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Changes to a Circuits Lab Sequence to Encourage Reflection and Integration of Experiences Across Related Courses

Chandrasekhar Radhakrishnan
Connections

Making connections between disparate sources to gain insight

See multiple viewpoints and solutions
Connect multiple spheres of context, systems, data, and experiences
Apply systems-thinking
Apply associative thinking

Source: KEEN
Objectives:

- Help students relate learning objectives in a sequence of freshman-junior lab classes in the circuits area.
- Gain insight into senior-level follow-up classes.
- Gain exposure to industry applications.
- Explore multiple trade-offs and varied solutions to the same constrained engineering problem.
- Use experience and knowledge to explore expanded solution spaces to a newly proposed engineering problem.
ECE Multi-course thread

- ECE 110: Introduction to Electronics
- ECE 343: Electronic Circuits Lab
- Low complexity, low efficiency, output current limitations

- ECE 343: Electronic Circuits Lab
- ECE 483: Analog IC design
- Low noise, High current output, Small area, Low efficiency

- ECE 469: Power Electronics Lab
- High efficiency, High noise, Large area, High current output
New Lab Exercises can be classified into:

- **Procedural Exercises**: Main activity is to compute efficiency of different types of converters.
- **Demonstration**: A circuit designed in a follow-up class (ECE 469) to help students evaluate noise-efficiency-area trade-offs.
- **Reflection exercises**: Based on procedural exercise and circuit demonstration.

- Identify analog components on the Iphone
- What is output voltage of Lithium-ion battery on a cell phone?
- Analog require 1.2 V -1.8 V input. Which converter will you use?

- Solar panels in ECEB
- We would like to transfer 20 kW to the grid. Which converter would you use?
Lab exercises - examples
Student Feedback

- 6 Likert scale questions
  - Connections between different DC-DC conversion techniques.
  - Follow-up classes in circuits.
  - Challenges in DC-DC conversion.
  - Applications in commercial products.
  - Improvements in circuit design in the industry.
  - Need to improve skillset.

- One multiple-options question
  - Rank resources students would consider to improve their skillset

- Two open ended questions
  - Activities and exercises students liked.
  - Suggestions of improvements.
Thank you to my fellow SIIP team members: Rebecca Reck (BioE), Chris Schmitz (ECE), Katie Ansell (Physics), Holly Golecki (BioE), Jessica TerBush (MatSe), and our mentor Joe Bradley. Thanks also to Arijit Banerjee (ECE) and Yi Zhou (TA ECE 343).

Thanks to the KEEN Network and SIIP for their financial support.

Questions:
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An Entrepreneurial Mindset-Driven Framework for Undergraduate Research

Blake Everett Johnson
EM in Undergraduate Research – Project Purpose

We seek to incorporate the Entrepreneurial Mindset to enhance undergraduate research programs.

Collaborative project supported by KEEN involving UIUC, Baylor, Lawrence Tech, Rose-Hulman, and Georgia Tech
Studies indicate great benefit for students who participate in undergraduate research (UGR)

UGR not emphasized in curricular design as much as coursework

This project seeks to connect 1st- and 2nd-year undergraduates with UGR

Emphasize three early objectives for the students:
1. Knowledge – having awareness of research opportunities
2. Mindset – understanding the role of EM in research
3. Motivation – lowering barriers to entry
The Early Student Exposure team is creating content for instructors to use in 1st and 2nd year courses.

**EM in Research Videos:**
- What Is Research?
- Why Should I Get Involved In Research?
- What Is The Entrepreneurial Mindset?
- How Does Research Get Done?
- How Can I Get Involved In Research?

**Classroom Activities**
- Minute paper reflections after videos
- Interview with researchers assignment
- Research in daily life brainstorming session
- Find a grant program assignment
- Research Opportunity BINGO
Thank you to my fellow team members:
Tony Jacobi, Sophie Wang (UIUC, MechSE)
Ken van Treuren, Mary Lauren Benton (Baylor)
Liping Liu, John Peponis (LTU)
Maysam Nezafati (Ga. Tech)
Michelle Marincel Payne, Irene Reizman (Rose Hulman)

Thanks to the KEEN Network for their financial support.

Questions:
bejohnso@illinois.edu
Q&A
Celebration of Teaching
FRIDAY, APRIL 14TH, 2023 | 1PM-3PM
1306 EVERITT LABORATORY

Event highlights include:

- Keynote: Associate Dean for Undergraduate Programs, Jonathan Makela
- Recognition of contributions to the teaching mission of the College
- Collins Scholar (new faculty) graduation
- Virtual poster presentations by our 17 current Strategic Instructional Innovations Program (SIIP) grant teams

Website: https://e3.engineering.illinois.edu/ Email: engineeringeducation@illinois.edu
Thank you for joining us today!

Questions/comments:

Jay Mann, Director
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217-333-4861

A recording of today’s symposium will be available on the AE3 website: https://ae3.engineering.illinois.edu/