

How the Entrepreneurial Mindset Supported the COVID-19 Transition in Engineering Unleashed Faculty Development

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Abstract

For several years Engineering Unleashed has provided in-person faculty development events focused on expanding an entrepreneurial mindset in undergraduate engineering programs. During Spring 2020, it was decided that ten faculty development workshops scheduled to be in-person multiple-day summer workshops would be delivered in a virtual format due to COVID-19. Workshop teams of facilitators and coaches structured the pivot to remote learning effectively and efficiently, reflecting the entrepreneurial mindset that infuses the workshops. The pandemic created an opportunity to build community and connections using new tools.

In this paper we share how the workshop teams of 47 facilitators and coaches restructured their workshops, creating value for the 229 faculty members participating. The approaches developed and lessons learned during this shift are outlined to provide a template for other groups offering remote faculty development programs. We discuss the importance of continuous feedback for improvement and of significant communications between facilitators and coaches. Surveys of faculty participants indicated that learning objectives were met by the remote workshops.

Introduction

Faculty development has always been considered an essential ingredient in improving engineering education. Faculty are a crucial driver for curricular and cultural change in educational institutions, often more than administrators or students. Faculty are the change agents in most units, making faculty development an important part of any change strategy.

The mission of the Engineering Unleashed (EU) network is to transform engineering education by promoting an entrepreneurial mindset (EM). This U.S. network of faculty members and their partner institutions promote an EM in their activities and courses with undergraduate engineering students across engineering disciplines. The network relies upon the sharing of best practices, collaboration, and the co-creation of teaching resources and models. These methods focus on specific mindset attributes that may be categorized by 3C's: Curiosity, Connections, and Creating value.

In a dynamic and interconnected world, it is essential that the engineers of tomorrow are empowered with both a technical skillset and an EM — fostering curiosity, connections and the

creation of value. An entrepreneurial mindset will allow engineers entering the workforce to create personal, economic, and societal value through a lifetime of meaningful work [1].

This goal to teach engineers about EM is focused on transformation of the minds and hearts of individuals, an invitation to become co-investigators in a nationwide experiment. Faculty development has become one of the four core strategies in this mission. The others include building thriving communities, working with affiliate organizations, and considering emergent ideas that surround higher education. Faculty development aligns with all three of the other core strategies.

One important aspect of the EU faculty development workshops has been a focus on community. The power of the EU network is the crisscrossing nature of relationships linking faculty members from different institutions including private and public, small and large, and urban and rural schools. This has created a natural opportunity to develop and offer faculty development workshops that build bridges linking faculty across disciplines and institutions. When the faculty development workshops were originally conceived, it was believed that in-person experiences were critical for community building, despite the significant investment in both cost and faculty time.

In 2019 six in-person faculty development workshops were supported and offered under the auspices of EU. One unique aspect of each of the workshops was that after participants engaged with facilitators at the workshop, they were provided with one year of coaching by a faculty peer mentor. This was an opportunity for participants to test ideas from the workshops with a support system in place and guidance as needed, all in a safe way. Coaching cut across disciplines in engineering and course levels and was successful in helping many faculty implement workshop ideas [2].

In 2020 nine in-person workshops were planned. The plans shifted swiftly to a remote format due to COVID-19 and raised several research questions aligned with this transition:

1. Does the COVID shift create long-term benefits for faculty development structures?
2. Did EM assist the faculty facilitators with the COVID transition? What facets of EM may have helped with the transition?
3. Did COVID create a specific need for new techniques and tools in the faculty community?
4. Did the virtual setting present an opportunity to reach a broader community?

Background

Engineering education has experienced transitions before, often during large cultural shifts. After the Second World War there was a significant transition in STEM curricula toward scientific integration [3]. In the early 2000s the change in ABET requirements for ethics created another sea change in engineering curricula [4]. The increase in active learning and evidence-based

instructional practices has started a slower change in engineering education during the last 20 years.

Another example of transformation in engineering education is the development of Massive Open Online Courses (MOOCs) in the last dozen or more years. Researchers have explored the applications in engineering [5], the challenges of credentials [6], and the opportunities for increasing knowledge of entrepreneurship [7]. The challenge of retention in MOOCs has been explored by several researchers [8]–[10]. The slow MOOC evolution of teaching in the remote space has been accelerated by COVID in the last year.

An important paradigm shift in higher education was described by Charles Vest as the emerging meta-university [3]. He describes how technology might change education, allowing collaboration across different domains. In 2020 this grand experiment accelerated as the pandemic forced collaboration shifts. One important facet of the EM aligns well with this idea, that faculty may create value for a broader community of colleagues and students. The mindset has been associated with paradigm shifts in many individuals. Faculty and students tell stories of the type of person they were before they started to think deeply about creating value for others.

In 2019 the addition of a formal coaching program supported the transformative nature of faculty outlooks on education [2]. The exchanges that occurred during one-on-one participant-facilitator meetings often focused on supporting challenging shifts in education. The coaching process provided support and feedback to faculty to help create value for stakeholders. A summary of the participant experience in faculty development is shown in Figure 1.



Figure 1. Summary of the participant experience during the EU faculty development.

Methods

To manage the COVID transition the faculty development leadership team leveraged several aspects of the EM.

- Curiosity. Priority was given to remote teaching methods that could be adopted by faculty members during their own pandemic adaptations. Whenever possible, the faculty were

encouraged to try the methods in their own remote teaching. This included exposing participants to a wide range of tools including Zoom rooms, Mural, Google documents, etc.

- Connections. Building community was emphasized in each remote workshop session. While challenging to build community in the virtual format, specific techniques, like maintaining breakout room teams, were encouraged. Most of the workshop facilitation teams created space for co-creation and communication.
- Creating value. The leadership team focused on how a remote workshop could create value for each faculty member participating in the workshop. We encouraged the facilitators to think about this as an opportunity to create value, rather than fixating on all the challenges of moving to a remote format quickly.

Additional techniques were used by the EU leadership team as well. The team developed asynchronous training materials for the facilitators and coaches. This provided templates, technology ideas, and an overview of the process. The asynchronous training also served as an example of how videos, discussion boards, and activities could be used to engage in a remote setting.

The team encouraged communication across the facilitation teams to help manage the COVID transition. Each workshop team was in communication with a group that was reviewing the emergent techniques and ideas from all the facilitation teams. Best practices emerged quickly as the first few workshops were completed, and they were passed to other workshops that were still in development. This included the spacing and duration of breaks, the volume of asynchronous content, and the adaptation of materials. A summary of the workshops offered remotely is shown in Table 1, in the order which they occurred between June and August 2020.

Table 1. Summary of the workshops held in 2020 with unique features of each workshop.

Workshop Name	Remote Learning Features	Community Building Features
Coaching and Facilitation Support	100% asynchronous content designed to support the coaches and facilitators, and to serve as an example for asynchronous structures. Content focused on helping the facilitators and coaches utilize EM whenever possible in their approach.	<ul style="list-style-type: none"> - Discussion boards - Reflection prompts - Meetings with facilitators and coaches with Kern Family Foundation and Facilitator Leader and Coaching Leader
Integrating Curriculum with EM (June)	<ul style="list-style-type: none"> -Developed a large volume of asynchronous videos and tutorials -Active learning using items (springs, playdoh, etc.) previously used during the in-person 	<ul style="list-style-type: none"> - Dedicated social time each day - Heavily integrated the coaching team in workshop execution

	workshop, now shipped to participants	
Leadership Unleashed	Focus on synchronous discussion and reflection	Coaching meetings (individual and cohort meetings)
Value Creation	Focus on synchronous discussion in small groups	Maintained the same breakout rooms through the week
STEM	Active learning that supported data collection using household items	Maintained the same breakout rooms through the week
Problem Solving Studio	Explored unique technology features of technology tools	
EML Research	-Scheduled long cognitive breaks between synchronous sessions with small assignments -Mailed participants hats/costumes to facilitate specific activities in the workshop and create community while distanced	-Dedicated social time each day -Heavily integrated the coaching team in workshop execution
Integrating Curriculum with EM (August)	Modified schedule and materials based on first workshop offering	Dedicated social time each day
Making with Purpose	Mailed participants small 3-D printing kits to support active making	Fully integrated the coaching team in all aspects of workshop planning and execution

To understand how a remote workshop setting might allow us to reach a broader community two decisions were made. First, the registration fees for attendance of all workshops were waived. Second, faculty members from any university, including from non-KEEN partner schools, were eligible to enroll in the workshops. These changes were possible as a result of budget savings (due to the elimination of travel costs) and were supported by the Kern Family Foundation. A summary of the registration data is shown in Table 2.

A related change in the 2020 workshops was the participation of all the coaches. In previous years, travel and schedule constraints prevented coaches from attending the workshops, whereas in the remote setting most coaches were able to participate in the full workshop. This offered benefits to building the coaching relationships earlier in the process, giving coaches more direct access to the content of the workshops, and supporting the facilitators in many ways.

Table 2. Summary of registration data for all the 2019 and 2020 workshops hosted by Engineering Unleashed.

	2019	2020
Total registrations	232	319
Total attendees	217	229
Individuals that attended more than one workshop	10	15
Network partner schools represented	47	44
Non-network partner schools represented	8	27

Feedback from participants was collected frequently to help understand the effectiveness of the workshops due to the virtual-mode transition. While no direct comparison with 2019 was possible, a survey was developed for the 2020 participants that focused on the workshop outcomes. Data analysis was possible from the course management software (Thinkific) that was used to host the asynchronous materials for all the workshops.

Results

Reflecting on the COVID paradigm shift that occurred in the last year many aspects of traditional faculty development have been altered. The largest shift was the removal of external motivators for faculty participation in remote workshops. In person, faculty might choose to attend a faculty development workshop to experience a new city or take time away to focus on a specific topic. In remote faculty development, the motivations are now intrinsic. This changes many facets of the experience for faculty development, and creates an environment that allows a different type of person to thrive. Reaching this group of intrinsically motivated faculty members is an important part of creating long-term change in engineering education.

Q1 - Does the COVID shift create long-term benefits for faculty development structures?

The COVID shift has some long-term benefits for faculty development that can be further explored. For example, in 2019 the participants of the Making with Purpose workshop met in person and worked with different types of 3D printing systems. In 2020, due to savings in the budget from no travel costs, each participant received a small 3D printer that was used in workshop activities and design challenges.

The shift to remote workshops appears not to have been harmful to most participants in achieving many of the outcomes for the workshops. A summary of the survey results is shown in Table 3.

Table 3. Summary of the workshops survey results by workshop.

Workshop Name	Attendees/ Responses	Survey Result Highlights	Participant Quote
ICE (June and August)	63 / 28	100% of faculty participants intended to implement one or more of the activities/ideas covered in this workshop.	“The ICE workshop has provided great insight into how to better develop a curiosity in my students to help self-motivation. It has provided me with practical ideas on how to better my teaching and the engagement of my students.”
Leadership Unleashed	31 / 14	93% of faculty participants believed that this workshop was useful for professional development.	“Leadership Unleashed helped me to understand my own leadership strengths and values and set me on a path to improve and grow as a leader and faculty member. I better understand how to leverage resources that will improve my leadership skills and potential.”
Value Creation	22 / 12	100% of faculty think an entrepreneurial mindset is important for success in this discipline. 100% also plan on continuing to develop their and their students’ entrepreneurial mindset after this workshop.	“I think that the concepts of Value Creation are transformative to the way that students and faculty should perceive and engage with all aspects of the world around them. The skills that I have learned from Value Creation workshops have made me a more engaging teacher, a better researcher and a more effective contributor to my local community.”
STEM	17 / 9	100% of faculty participants believed that this workshop was beneficial and valuable to them, and felt they had a good understanding of what entrepreneurial mindset is. Faculty valued being able to meet other educators who were also interested in improving the learning experiences of their students.	This was a fantastic workshop that gave me real world tools to implement EML activities in my classes. It also pairs me with a mentor and resources to help me actually implement them. Even if you've never heard of EML, you owe it to your students to complete a workshop like this and transform your teaching.”
Problem Solving Studio	37 / 11	91% of faculty participants felt they gained an understanding of the foundations of the problem-solving studio and its	“The KEEN/Engineering Unleashed workshops provide an incredible learning opportunity in a safe and honest environment. Learning is highly

		implementation.	valued at these workshops and any struggles you may have the faculty coaches will help you get past it. This network is really working hard to create a superior culture of learning and diffuse that idea across as many institutes of higher education as possible and it shows. I always look forward to any chance I get to take part in a KEEN workshop or activity.”
EML Research	29 / 6	100% of faculty participants participated in this program because they wanted to improve their students' learning and development. 100% of faculty felt that had a good understanding of what the concept of entrepreneurial mindset is.	“I enjoyed the learning modules and workshop activities, in particular the material on curiosity and student recruitment. The facilitators succeeded in communicating the material, guiding the activities, and building a community of engaged practitioners.”
Making with Purpose	30 / 12	92% of faculty participants felt: •Prepared to develop creative confidence in students through hands-on experiences. •That they developed familiarity with common makerspace processes and technologies.	This workshop offers the opportunity to hear from many different perspectives about different activities that can be done in your class to engage students in EML, design, engineering. It is great to have people from very different backgrounds to generate well rounded projects

Q2 - Did EM assist the faculty facilitators with the COVID transition? Was there a difference in the facets of EM that helped with this transition?

Each facilitation team tackled the remote transition in different ways. Many innovations in delivery were developed by the teams, and several best practices emerged. The focus on creating value for each of the workshop participants was particularly helpful for the facilitation teams, since they were invested in developing asynchronous materials that would serve as reference and resource materials for participants after the completion of the workshop. One facilitator wrote, “EM helped me think about the faculty’s needs when it came to FD. Although I know that each faculty member elected to participate in order to improve their own knowledge and skillsets, it was important to acknowledge that they were balancing many more factors than they had anticipated when signing up. For this reason, thinking through faculty needs and how to create a schedule that would work for individuals in different time zones and with different family responsibilities was at the core of our pivot with ICE. We also sought to find new and unique ways to connect the faculty with one another during the workshop through open meetups before and after each day’s content agenda and ensuring that faculty were within the same breakout

group throughout their experience so they had a set of faculty members that they got to know on a deeper level.”

Two of the workshop teams developed a significant quantity of asynchronous material. The ICE and EML Research workshops used the course management tool to make materials available to faculty before and after the workshop. The average completion rate for the materials was 44% with an average time of 12.6 days.

Several best practices emerged from the workshop teams:

1. Select a few co-creation tools and take time to train the participants in the tools at the beginning of the workshop. Examples of tools tested include Google documents, Mural, Miro, jamboard, etc.
2. Plan a list of quick-reference links for the participants each day. Reference it frequently.
3. Collect formative feedback about the workshop each day from participants.
4. Develop active learning elements that include other members of the household, or inspire curiosity in the participants. Facilitators of one workshop mailed playdoh to participants and facilitators of another workshop sent different hats for people to wear. Each prop allowed active learning to occur and enhance mindset shifts about remote learning.
5. Schedule breaks that allow deeper meta-cognition and time to review asynchronous materials. These longer breaks allowed participants to deal with childcare and email so they might focus more effectively during the synchronous sessions.

Q3 - Did COVID create a specific need for new techniques and tools in the faculty community?

The workshops shared a set of asynchronous pre-work modules focused on helping participants understand EM and build a shared language. Facilitation teams were encouraged to modify and enhance these modules during the synchronous portions of the workshops. We found that the average completion rate for the pre-work was 85% with 92% of the participants completing at least 30% of the pre-work. This finding was interesting since anecdotally the pre-work during 2019 in-person workshops was completed at very low rates. It is borne out this year by faculty and students in the classroom as well [11].

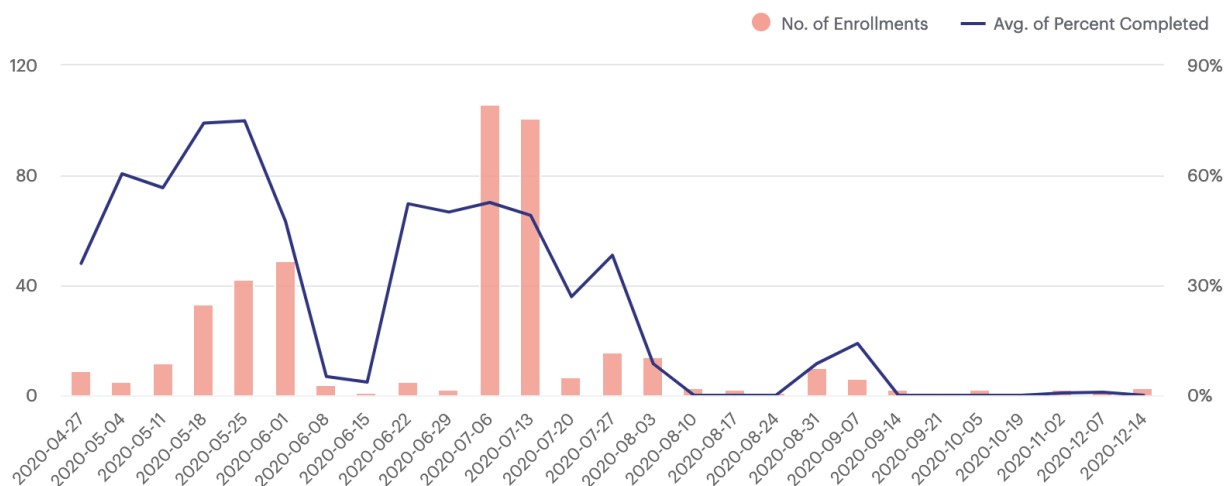
The transition to asynchronous learning during the workshops was a new experience for all the facilitation teams, although some pre-work had been completed asynchronously in 2019. Figure 2 shows a summary of the engagement of participants in the course management software tool over the course of the 2020 workshop cycles. This includes all the asynchronous materials for all courses, so the total completion rates are lower overall.

Other examples of new techniques included modification of all in-person active learning. For example, one workshop had a history of using a “house of cards” activity to engage participants

and introduce the EM. Due to COVID the facilitation team was forced to carefully examine the learning objectives for this activity. The end result was a team modeling project using playdoh that was mailed to each participant. The teams worked in breakout rooms and the experience mirrored many of the same discovery moments from the in-person activity.

Another example was a workshop that had several in-person activities focused on understanding student mindset. To engage the participants in a remote setting the facilitation team mailed out different types of costume hats to facilitate role playing and create a sense of community. The hats worked well in the remote video format and provided a way to engage family members in the workshop.

Enrollments and completion rate



Average Days to Complete

12.6

Average Percentage Completed

48%

Figure 2. Summary of enrollments and completion rates for participants of all 2020 faculty development workshops from course management tool.

Q4 - Did the virtual setting allow us to reach a new part of the broader community?

The best outcome from the COVID transition was a broader community of faculty participants. The reduction in travel cost and logistics allowed participation from 27 non-network schools (up

from about 8 in prior years). One participant joined from Canada, reflecting the reach of the faculty development program.

The remote nature of the workshops allowed faculty with families and childcare responsibilities to participate when travel would have been more difficult in the past. Most of the workshops took special care to structure the work in a way that allowed frequent breaks and time to disconnect. One of the most successful implementations of this structure included tasks and activities for the participants to work on during each break. An example schedule is shown in Figure 3.

2020 EML Through Research		Zoom or synchronous		Optional session or asynchronous
		Week of: July 27		
Eastern Time	7/27 MONDAY	7/28 TUESDAY	7/29 WEDNESDAY	7/30 THURSDAY
8:30 AM				
9:00 AM				
9:30 AM		Networking and Office Hours (Facilitators online)	Networking and Office Hours (Facilitators online)	Networking and Office Hours (Facilitators online)
10:00 AM		Optimized for eastern times	Optimized for eastern times	Optimized for eastern times
10:30 AM		Research partners	Outreach and broader impacts	Participant Report Outs
11:00 AM		Project structures		
11:30 AM		Activities and work time	Activities and work time	Call to Action
12:00 PM				Coaching Meet and Greet
12:30 PM		Recruiting and Motivating Students	Student publishing	
1:00 PM		Curiosity types		
1:30 PM	Technology testing and troubleshooting	Activities and work time	Activities and work time	
2:00 PM	(facilitators online)			
2:30 PM	Welcome and introductions	Mentoring	Timeline activity	
3:00 PM	Framing	Project operations		
3:30 PM	Project/Card Overview	Activities and work time	Activities and work time	
4:00 PM	Activity - brainstorm your project (Facilitators online)			
4:30 PM		Research in the time of COVID-19	Gallery walk	
5:00 PM		Networking and Office Hours (Facilitators online)	Networking and Office Hours (Facilitators online)	
5:30 PM		Optimized for western time zones	Optimized for western time zones	

Figure 3. Example schedule for one remote faculty development workshop. Optional sessions and work time each day are shown in green.

The last outcome from the virtual setting was that many facilitation teams were highly successful in building community connections in a virtual space. Our 2019 activities with virtual year-long coaching helped us manage this, and we confirmed that it is possible to create inspirational EM workshops using remote techniques. As a result, the decision was made to keep all faculty development workshops remote in 2021.

Discussion

After coordinating a shift from in-person to remote faculty development in 2020 we posit several advantages. First, the workshops were available to a broader group of faculty inside and outside the KEEN network. This allowed the workshop ideas to spread widely, with a focus on those that might be most intrinsically motivated to create changes in engineering education. While no student data was collected in this work, the participants were encouraged to collect student data as they implement the new practices they learned.

Second, the techniques and tools for remote learning were explored quickly by each facilitation team. This helped many faculty with remote learning plans for their own classrooms in the Fall as the pandemic continued. This advantage was more fully realized as faculty launched into hybrid and remote teaching for another academic year. The frustrations and challenges that students often encounter in a classroom were magnified for the faculty participants in the remote setting. This provided empathetic insights about remote learning for the faculty participants.

Another advantage was the facilitation teams learned techniques for building community in virtual spaces. While not all techniques were successful, the spectrum of efforts provided feedback for the teams. We confirmed that coaching in the virtual space aligns well and provides consistency for the faculty participants.

The faculty development workshop teams observed that some aspects of the remote transition were not helpful. The zero-cost of entry for the workshops created a situation where faculty signed up to participate but did not join. Although it was anticipated, it made planning more challenging for the facilitators. A small cost for each workshop may be a viable compromise for enrollment.

Many of the teams confirmed that while community building in a virtual space is possible, it is more challenging. Eating together and sharing experiences does create a bond for workshop participants that is important. Hybrid workshops might be one method for addressing this post-pandemic, allowing a shorter in-person experience for some workshops.

A significant disadvantage was the preparation time for remote facilitators is significantly higher than for traditional workshops. Focusing the facilitation teams on creating value allowed some of the teams to prepare more fully, even during a difficult time. This is a one-time challenge for most of the teams, and the remote offerings in 2021 are expected to re-use large pieces of the content developed.

The central focus on EM is one of the keys to the successful transition, implementation, and experience of the remote workshops. The facilitators and coaches had to embody EM in shifting their pedagogy, practices, and activities. Participants brought an interest in EM and saw it demonstrated by the facilitators and coaches, and learned how to develop it themselves in response to the shifts being asked of them in the COVID-19 remote teaching transition. Participants learned how to communicate and inspire EM to their students as students adjusted to the COVID-19 remote learning transition. Thus, EM, as a cornerstone of the EUFD workshops, helped make the transition, implementation, experience, and effectiveness of the workshops a success. The 2021 faculty development workshops will be run in a remote mode, offering an opportunity to refine and improve this experience for faculty participants.

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