Bridging Internationalization and Equity Initiatives in Engineering Education

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From 2013-2015, Dr. Emmett served as Director of Academic Programs at the Rachel Carson Center for Environment and Society in Munich, Germany. He has taught humanities courses in interdisciplinary programs at the University of Wisconsin-Oshkosh, Wisconsin-Milwaukee, and Ludwig-Maximilians-Universität in Munich. He holds a Ph.D. in English (University of Wisconsin) and is a certified Project Management Professional.

Dr. Kim Lester, Virginia Polytechnic Institute and State University

Dr. Lester serves as the Director of Pre-College Programs at Virginia Tech's Center for the Enhancement of Engineering Diversity focusing on outreach and recruiting underserved students into STEM fields. She also worked as a global engagement specialist in the Office of Global Engineering Engagement and Research at Virginia Tech, providing assistance with the development, implementation and administrative support of international initiatives at the College of Engineering. She holds a Bachelor of Science in Animal Science and a Doctor of Veterinary Medicine degree from Cornell University as well as a Bachelor of Arts in Elementary Education from the College of Santa Fe.

Dr. Glenda R. Scales, Virginia Polytechnic Institute and State University

Dr. Glenda Scales serves as both Associate Dean for Global Engagement and Chief Technology Officer in the College of Engineering at Virginia Tech. In this dual role she serves as Executive Director of Virginia Tech's Academy for Global Engineering, as well as the Director of Engineering Online. In 2020, U.S. News and World Report ranked this online graduate program #10 in the nation. Additionally, she provides leadership at the state level and at Virginia Tech for Cardinal Education. This state-wide distance learning program has a long history of providing engineers with access to exceptional graduate degree programs. Dr. Scales was the administrative lead in the college of engineering on the high performance computing project that created System X, a homegrown supercomputer. In 2003, System X ranked in the TOP500 list as the third-fastest supercomputer in the world and "the world's most powerful and cheapest home built supercomputer." Additionally, she worked with her team and the university to expand Virginia Tech's wireless network in 2008 with their Tablet PC initiative in order to accommodate large lecture classes using Virginia Tech's wireless network for in-class learning activities. She holds a Ph.D. from Virginia Tech, a M.S. in Applied Behavioral Science from Johns Hopkins and a B.S. in Computer Science from Old Dominion University. Prior to coming to the College of Engineering in 2000, Dr. Scales was the Director of Instructional and Research Computing at North Carolina A&T where she led a university team to successfully launch their first virtual campus. She began her career working as a computer analyst for the National Security Agency. In 2018, Dr. Scales was appointed by Governor Terry McAuliffe to the Southern Regional Education Board for a second term. This board works with 16 member states to improve public education, from prekindergarten through post-secondary education.

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Dr. Kim Lester, Center for the Enhancement of Engineering Diversity, Virginia Tech (CEED)
Dr. Glenda R. Scales, Associate Dean, Global Engagement

[SLIDE 1]

Welcome to "Bridging internationalization and equity initiatives in Engineering Education!"

Where we're coming from...

GEER and CEED have common ground in *an explicit commitment to diversity, equity, and social justice.*

Despite this reality, DEI and international initiatives are housed in different offices at our institution and at many others we are familiar with.

As a consequence, collaboration has required working across internal institutional boundaries.

[SLIDE 2]

Like many public research universities, Virginia Tech has robust campus internationalization initiatives in engineering along with the leadership and mentorship of CEED to enhance and retain a more diverse student body in engineering. Yet, like all but one public HE in Virginia, our institution continues to fall short of representing racial and ethnic diversity across our enrollment (see for example *Scratching the Surface*, http://edreformnow.org/wp-content/uploads/2021/04/VA-Issue-Brief-4.15.pdf). Enrollment of international students has grown over the last two decades. At times, "global" and "inclusive" seem to function as code words for opposed institutional priorities at our university. We proposed this presentation and facilitated discussion to explore ways to bridge these areas.

A little housekeeping first: we will "set the table" here with a few more comments, then we will have our first "taking the pulse" audience activity, then we will outline specific ways that CEED and GEER have collaborated, then we will reserve at least 15 minutes for the second interactive activity, when will hope to explore and gather practices and strategies from your institutions. We will be using the collaborative "ideation" tool Miro for this, so that *by the end of this session, we have produced a visual documentation of the range of approaches and challenges associated with bridging internationalization and equity initiatives.*

Before we "take the pulse," here is some relevant research and practice context for this work. Study abroad programs have been crafted specifically to support engineering students' participation, and our colleagues have pursued steps to make these programs more accessible. Still, recruitment of minoritized students into international travel programs for engineering students remains a challenge. Increasing opportunities for global experiences requires more than increasing engineering students' rate of studying abroad—less than 5% of U.S. students annually, during non-pandemic times.[1] The global dimensions of engineering *practice* are well documented. As a result, researchers in international engineering education have published studies of effective programs [2]–[4] and proposed principles of global engineering competency [5]–[7], which includes intercultural communication, reflection on professional ethics in a global context, and increasingly, virtual team skills. The existing literature can inform a new paradigm: globalizing engineering curricula to incorporate analysis of cultural difference with an explicit equity framework and analysis of power that reckons with legacies of colonialism and racism.

Taking the pulse

Audience interaction 1 of 2

https://miro.com/app/board/o9J_lzpUflo=/

[SLIDE 3]

We will be using a live interactive "whiteboard," starting with the "Quick Poll" questions section. This feature allows for more immediate social feedback and interaction while also permitting audience members' anonymity if they wish. (Their identities do not appear in Miro unless they are logged in and wish them to.)
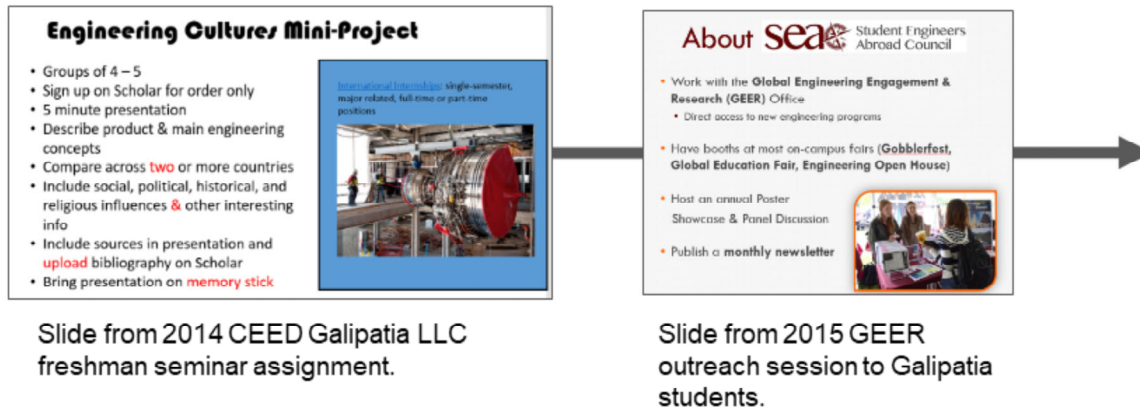
These are questions meant to "take the pulse," and see "who's here" as well as the collective diversity of the group.

Our "quick poll" questions will focus on eliciting awareness of the overlap between international connections and diversity and equity imperatives in H.E. For example: Use map of U.S. and world, "where are you based?"

They will also ask "How much current collaboration occurs at your institution between international initiatives and diversity, equity and inclusion initiatives?" and the level of support, as defined by participants, for DEI and international initiatives.

International and Equity initiatives intersect at Virginia Tech

GEER and CEED collaborate to offer short global learning activities during summer pre-college programs and in CEED's Living Learning

Slide from 2014 CEED Galipatia LLC freshman seminar assignment.

Slide from 2015 GEER outreach session to Galipatia students.

[SLIDE 4]

We have sought to make space for conversations about the cross-cutting issues of global problem-solving and social justice in co-curricular spaces. This takes place at an administrative level and at a program content level.

We have been very intentional in socializing our staff and graduate students to the existence, work, and importance of our respective units on campus. This began naturally out of the need for pre-college
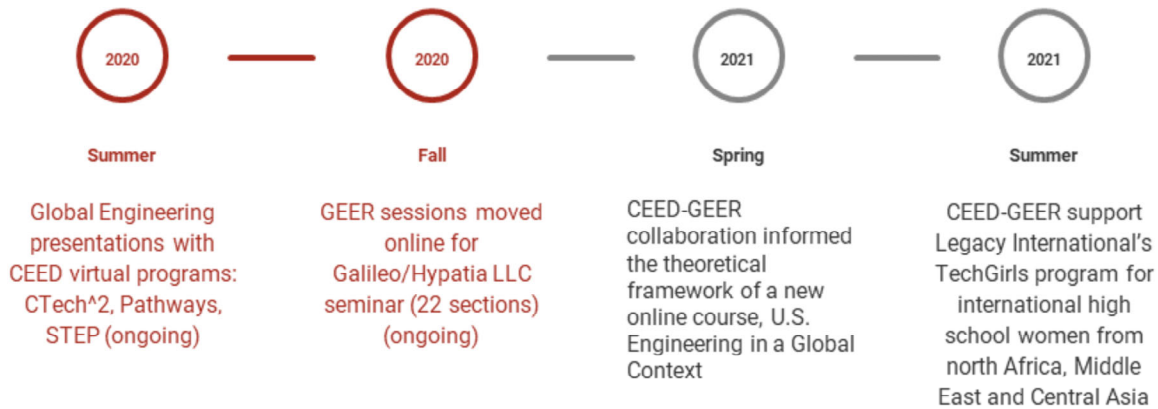
program activities for students (CEED) and a need for sharing practical opportunities to study abroad (GEER). CEED staff invited GEER staff and students to share study abroad opportunities and information directly in the course associated with the CEED Living Learning Communities. The Galileo (men) and Hypatia (women) LLCs are housed in the same residence hall and help freshman engineering students develop skills for academic success, professionalism and personal growth through peer support, upper class mentors and a first year experience course [8]. All participants take part in two diversity workshops, one on cross-cultural communication and the second on identity and culture [9].

Through these experiences, students have been exposed to the relevant connections between global experiences and the importance of diversity and equity in engineering education. Learning about the value and practical opportunities to study, work, or conduct research outside the United States became an established required program element in the "Galipatia" LLC. Additionally, some of these students

go on to be part of GEER as global engineering ambassadors or graduate assistants.

From these information and outreach sessions, further conversations about learning activities (we are all teachers, researchers, & practitioners) took place, deepening the connections between the two office.

The pandemic spurred adaptations that brought together online learning, global initiatives, and diversity and equity.

2020 Summer	2020 Fall	2021 Spring	2021 Summer
Global Engineering presentations with CEED virtual programs: CTech^2, Pathways, STEP (ongoing)	GEER sessions moved online for Galileo/Hypatia LLC seminar (22 sections) (ongoing)	CEED-GEER collaboration informed the theoretical framework of a new online course, U.S. Engineering in a Global Context	CEED-GEER support Legacy International's TechGirls program for international high school women from north Africa, Middle East and Central Asia

[SLIDE 5]

GEER outreach to CEED programs continued as we went virtual and both offices moved programs online during the pandemic response. Actually, developing and running programs online-first made scaling up delivery of outreach (and learning activities) easier.

Because CEED's C-Tech^2 summer program had international participants, and they were taking part in a team engineering design project, it was clear that intercultural competencies were important. And it made little sense to only present "opportunities at Virginia Tech to go global." We saw the need for a learning activity that could be conducted online with participants, wherever they are, that would deepen awareness of how intercultural skills are

relevant for engineering work. We developed an hour long session based on the work of Jesiek et al. (see www.geer.info) NSF project on global engineering competencies, using workplace scenarios and ethical judgment and reasoning across cultural boundaries. This concept came directly from a conversation with Brent Jesiak at a virtual session of the Center for Ethics / Ethics division of ASEE about pedagogical use of his assessment tool and workplace scenarios.

In fall 2020, outreach presentations about global opportunities were delivered online to Galipatia courses and were, for obvious reasons related to the pandemic, rather abbreviated.

Spring 2021: the CEED-GEER collaboration informed the theoretical framework of a new online course, "U.S. Engineering in a Global Context"

The course was developed to meet general education requirement for "Equity and identity in the U.S., especially in comparative perspectives."

Currently it is the only course in the College of Engineering that meets this area requirement.

It teaches Sorrells's "intercultural praxis" approach to communication.

Clockwise from upper left:
1. Mary Jackson, NASA engineer (NASA.gov)
2. Service Without Borders and Dhumba residents building a warming hut together, Nepal (SWB photo)
3. Betty Jean Jennings and Frances Bilas programming ENIAC (U.S. Army)
4. Service station in Oregon during 1973 oil crisis (U.S. National Archives)

[SLIDE 6]

Dr. Amer Ahmed (see http://www.amerfahmed.com/) first connected one of us with Kathryn Sorrells' work, which has been a direct influence on a new course we developed that combines equity and global perspectives. The theoretical framework of Kathryn Sorrells is called "intercultural praxis" and it makes social justice an explicit framing of intercultural communication [10]. Kristen Koopman and Rob Emmett integrated that critical thinking paradigm, the intercultural praxis model, into the new course that trains students to think about U.S. engineering in a global context. It was designed to meet Virginia Tech's general education requirement around critical thinking about identity and equity in the U.S., especially from comparative perspectives. "Intercultural praxis" also describes our course development method.

Conversations between CEED and GEER staff and students influenced how the class analyzes power, equity, and identity in engineering practices. The course learning activities were enriched by informal conversations with students in the CEED living learning communities of Galileo and Hypatia who were also global engineering ambassadors. Kristen and I also deliberately sought feedback in a more formal manner from a former CEED/Hypatia RA, who we recruited to work as a GA in the GEER office, Demi Alabi. Demi was the "beta tester" for content as we developed it in fall 2020 through iterations of design/test/re-design. In this manner, we made the "dialogue" dimension of intercultural praxis a real component in our course design process. The course ran as a successful pilot in spring 2021 with 11 students.

TechGirls 2021 program (funded by U.S. Dept. of State)

TechGirls Legacy International LLC social media feed (front-end)

LMS infrastructure of collaboration and learning at Virginia Tech (back-end)
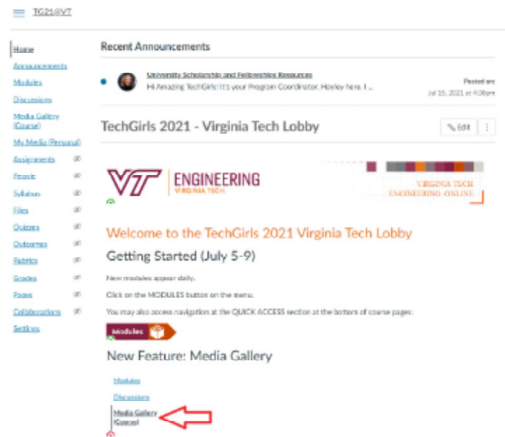
[SLIDE 7]

In summer 2021, GEER worked with CEED to support a virtual campus for 105 high school girls from North Africa, the Middle East and Central Asia as part of the TechGirls program funded by the U.S. State Department and administered by Legacy International, a third party non-profit organization.

This began out of systematic strategic planning around seeking external grants for online learning between CEED and GEER. We essentially began exploring how to pilot online learning activities that would be cohort-based and delivered as modules in the Canvas LMS (spring 2021) around a small grant proposal. While that external grant was not funded, the resulting concept and language laid the groundwork for participating on the TechGirls

grant for summer 2021. The TechGirls program, usually a residential camp for high school female students, moved completely online due to the pandemic. Participants took part in a two-week-long course led a Virginia Tech faculty on a technology-related topic such as web design or data analytics. They also spent time interacting with additional faculty, staff and students learning about the different disciplines within engineering, student life, the college admissions process and developing a growth mindset.

The instructional design challenges included: 105 students not registered at VT as degree-seeking students or with prior access and experience with Canvas; 13 hour difference across time zones; 4 faculty members developing concentrated 2 week courses with a range of online teaching experience.

Take-away lessons bridging international & equity

1. *Align your strategic planning and objectives*

1. *Socialize staff - if your units are siloed*

1. *Leverage the value of shared resources: expertise networks, programming, LMS resources (online modules)*

1. *Name and claim the shared values*

[SLIDE 8]

As we have named and claimed the shared values of diversity and equity, global program content has become a more established component in CEED work. In Fall 2021, GEER offered an hour long session on global engineering competencies for students in the CEED Galipatia LLC. We continue work on proposals to support further development of shared online educational resources.

While there are important conceptual edges to the missions of CEED and GEER, we have common ground. A key factor in allowing this multi-year collaboration to develop was an early meeting during the College's strategic planning cycle in 2018-2019, when Dean Scales and Dean Watford met with Dr. Sanderlin and Dr. Emmett. That planning effort involved gathering data on past program participation and benchmarking against other universities.

It became clear that to increase global experiences for students in the College, we needed to be deliberate in diversifying participation. There are massive inequities in who participates in study abroad, for example, within engineering disciplines as well as across disciplines. GEER took the step of making diversifying participation in study abroad a strategic objective. The pandemic hit and stopped all travel, but the ensuing time has been used wisely for planning and brainstorming creative ways to move forward together. For CEED, we recognized the need to move beyond merely exposing students to study abroad options, to understanding that global perspectives on diversity are as essential as local or national concerns and cannot actually be separated. An important element beyond "strategic alignment" is socializing our staff. This is about relationships, not just "strategic thinking!" As we have continued to build relationships, this has included more intensive collaboration between CEED, GEER, and online initiatives (VTEO). Now we have "shared resources."

These four lessons are grounded in our experiences over the last three years.

Discussion & gathering of good practices

Audience interaction 2 of 2

https://miro.com/app/board/o9J_lzpUflo=/

[SLIDE 9]

We will be using the "discussion of good practices" frame in the Miro and gathering ideas, practices, language, and stories directly into the shared workspace.

Participants will be invited to add directly into the whiteboard using virtual sticky notes OR to speak aloud ideas that we will gather and add ourselves, to maximize accessibility and participation.

Our guiding questions, which we will take one by one, will be:
1. How are you bridging international and equity initiatives at your institution?
2. Where have you encountered opportunities?
3. How have you overcome barriers or challenges?

Bibliography

[1]   "Open Doors Report on International Education Exchange," Institute of International Education, 2019. [Online]. Available: http://www.iie.org/opendoors
[2]   K. A. Davis and D. B. Knight, "Impact of a global engineering course on student cultural intelligence and cross-cultural communication," J. Int. Eng. Educ., vol. 1, no. 1, p. Article 4, 2018, doi: 10.23860/jiee.2018.01.01.04.
[3]   V. Maldonado, L. Castillo, G. Carbajal, and P. Hajela, "Building international experiences into an engineering curriculum – a design project-based approach.," Eur. J. Eng. Educ., vol. 39, no. 4, pp. 377–390, Jul. 2014.
[4]   A. Parkinson, "Engineering study abroad programs: Formats, challenges, best practices," Online J. Glob. Eng. Educ., vol. 2, no. 2, p. 2, 2007.
[5]   G. L. Downey et al., "The globally competent engineer: Working effectively with people who define problems differently," J. Eng. Educ., vol. 95, no. 2, pp. 107–122, 2006, doi: 10.1002/j.2168-9830.2006.tb00883.x.
[6]   B. K. Jesiek, Y. Haller, and J. Thompson, "Developing Globally Competent Engineering Researchers: Outcomes-Based Instructional and Assessment Strategies from the IREE 2010 China Research Abroad Program.," Adv. Eng. Educ., vol. 4, no. 1, pp. 1–31, 2014.
[7]   D. B. Knight, K. A. Davis, T. Kinoshita, M. M. Soledad, and J. R. Grohs, "Assessing students' global and contextual competencies: Three categories of methods used to assess a program with coursework and international modules," presented at the 2017 ASEE Annual Conference and Exposition, Columbus, OH, Jun. 2017.
[8]   C. Brozina, E. Edmister, J.M. Kampe, A. Martin, M. Stimpson, and B.A. Watford, "Freshman engineering living-learning communities at Virginia Tech," Proceedings of the 2007 ASEE National Conference, Honolulu, June 23-26.
[9]   A. R. Taylor, K. Boyd-Sinkler, S. Arnold-Christian, W.C. Lee, B.A. Watford, C. Matheis, K. Lester, (2018, April), Embedding Cross-cultural Communication Awareness and Skills Training in a Living-learning Community for First-year Undergraduate Engineering Students Paper presented at 2018 CoNECD - The Collaborative Network for Engineering and Computing Diversity Conference, Crystal City, Virginia. https://peer.asee.org/29503
[10]   K. Sorrells, Intercultural Communication: Globalization and Social Justice. SAGE Publications, 2015. [Online]. Available: https://books.google.com/books?id=eapiCgAAQBAJ

Additional background readings:
https://files.eric.ed.gov/fulltext/EJ799706.pdf
http://www.m.www.na-businesspress.com/JHETP/OzturgutO_17_6_.pdf
https://www.acenet.edu/Documents/at-home-in-the-world.pdf
https://eric.ed.gov/?id=ED440610
http://www.amerfahmed.com/

[SLIDE 10]

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