Faculty Fellows Project Report

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Project Title: Enhancing Engagement, Equity, and Workforce Development through Innovative Online and Immersive Learning Strategies

Project Summary: This project focused on two interconnected initiatives aimed at addressing engagement, equity, and workforce development in engineering education. This work resulted in two conference publications. The first paper titled *Advancing Engagement and Equity in Asynchronous Online Education*, explores strategies to improve learning experiences in asynchronous online degree programs, particularly for students transitioning from non-technical backgrounds. The second paper titled, *Revolutionizing Semiconductor Education: An Immersive Virtual Cleanroom for Enhanced Nanofabrication Training*, introduces an immersive virtual reality (VR) based cleanroom to enhance hands-on learning and workforce readiness for semiconductor fabrication jobs.

Both projects were conducted as part of the Faculty Fellows Program and have been accepted for presentation at the 2025 ASEE National Conference which will be held in Montreal, Canada on June 22 – 25, 2025. Together, the two papers demonstrate how targeted pedagogical innovation, and emerging technologies can be leveraged to equip students with the skills and hands-on learning experiences needed for successful careers.

Why This Project Is Important: This project reflects my strong commitment to advancing student success and ensuring equitable access to high-quality technical education through practical and impactful initiatives. My goal is to create learning environments that address systemic barriers, whether those are related to the lack of hands-on training opportunities on the local/national levels or the challenges faced by students in asynchronous online programs.

For students, these projects offer more engaging, responsive, and accessible learning experiences. For faculty and academic/research institutions, they provide models for incorporating artificial intelligence and immersive technologies into curricula in ways that enhance learning outcomes and prepare students for the workforce. For industry stakeholders, the focus on skill alignment and experiential learning helps ensure that graduates are ready to meet immediate and future demands of the industry.

Challenges Addressed: Two challenges stood out:

1. Low engagement and high dropout rates in asynchronous online courses, especially among students from non-STEM fields.
2. Limited access to hands-on semiconductor training, which is essential to fill in industry demands driven by legislation like the CHIPS and Science Act.

Both challenges require scalable and innovative solutions that preserve academic rigor while increasing flexibility and relevance to real-world applications.

Desired Result

- Increase retention and success in asynchronous online programs by addressing isolation, motivation, and equity through AI enhanced learning environments.
- Create scalable and immersive learning platforms that improve students' understanding of fabrication processes and hands-on skills.
- Align educational outcomes with workforce needs by integrating feedback from industry and leveraging real-time data.

The Project - What Was Done

Asynchronous Online Education Enhancement

- Conducted a needs analysis of online learners, particularly those interested in switching careers.
- Explored the integration of AI tools and their potential in providing instant feedback, supplementing in-person tutoring, and improving student outcomes.
- Analyzed student engagement metrics, course performance, and feedback.

Immersive Virtual Reality Cleanroom for Semiconductor Training

- Began development of an immersive cleanroom simulation to replicate industry-standard nanofabrication environments.
- Initiated implementation of a real-time feedback system to support skill development.
- Established initial collaborations with industry (Micron Technologies) and faculty experts from Mechanical Engineering, ATLAS, and CMCI) to align the immersive reality training components with professional expectations.
- Developed preliminary surveys to collect feedback that will inform ongoing refinement of the immersive reality platform.

Outcome – What Worked, Challenges Encountered, and Lessons Learned

What Worked:

- The project opened strong channels for industry-academic feedback which has the potential to enhance curricular alignment with workforce needs.
- Students in the AI-supported online courses showed heightened curiosity and engagement, with many expressing a stronger sense of connection and a desire to explore course content more deeply.
- The immersive reality cleanroom experience sparked enthusiasm and exploration, with trial users showing excitement about interacting with complex nanofabrication processes in a low-risk environment.

Challenges Encountered:

- An NSF proposal was submitted for the scaling of this project; however, we were not able to secure NSF funding
- Limited student access to Virtual Reality equipment revealed equity gaps in technology availability.

Lessons Learned:

- Technology is a powerful amplifier and human-centered design remains essential.
- Continuous feedback loops from students and employers are critical for sustainable impact.
- Equity must be considered in content delivery as well as in technological access and design.

Reflection on the Faculty Fellows Program and Your Project Experience

The Faculty Fellows Program provided the structured space, community, and support needed to explore ambitious educational innovations. The regular check-ins, guidance and mentorship, and interdisciplinary conversations inspired new ways of thinking and offered a testing ground for ideas that might otherwise remain unexplored.

This experience deepened my appreciation for interdisciplinary collaboration and reinforced the value of designing with empathy and intentionality.

Copies of the ASEE conference papers can be made available after the conference conclusion in late June.