

# **Professional Practice Simulations for Engaging, Educating, and Assessing Undergraduate Engineers**

## **Project Summary**

### **Problem**

Cutting-edge innovations in education are often not translated into new courses and curricula until decades after their development. Improving educational strategies in engineering cannot wait decades. The pool of engineers in the United States is neither large enough nor diverse enough to meet the needs of a growing high-tech economy and produce engineering solutions to the difficult problems the country faces nationally and internationally.

### **Objectives**

This Phase 2 CCLI proposal seeks to (a) develop a computer simulation game—*Nephrotex: The Dialysis Redesign Project*—for engineering undergraduates, modeled on authentic engineering practices, (b) incorporate this gaming technology into an engineering undergraduate course at the University of Wisconsin–Madison, and (c) assess learning outcomes through computer gaming platform–assisted data collection and analysis. The project will address the following four CCLI components: creating learning materials and teaching strategies, developing faculty expertise, implementing educational innovations, and assessing student achievement.

### **Intellectual Merit**

The project is tailored to the newest generation of engineering students who are more computer literate, electronically connected, and simulation game–oriented than any prior generation. It will make significant, positive contributions to knowledge about engineering education by testing an existing theory of professional learning in a novel context, targeting measurable outcomes and conducting a robust project evaluation. The complementary and non-overlapping areas of expertise of the principal investigator and co- principal investigator—including educational theory, practical and theoretical aspects of engineering education, and design and assessment of engineering curricula—make them uniquely suited to conduct the proposed work.

### **Broader Impact**

This work will simultaneously advance discovery in teaching and learning and promote training in engineering education among the mixed-level (faculty, graduate student, and undergraduate student) and interdisciplinary team of investigators. The results of the research will be disseminated to the education community and the engineering education community. The developed and tested *Nephrotex* game will be shared with engineering institutions nationwide, enabling engineering educators to customize, contextualize, and adapt it for use and/or research at their own institutions. The project is potentially transformative because it addresses a key aspect of engineering education – professional practice – and critical limiting factors in providing students with opportunities for experiencing professional practice – faculty time and institutional resources. Once developed and validated, our professional practice simulation can be widely used to engage and educate students about engineering early in their careers. Furthermore, since the skills required for success in professional practice are not identical to those required for success in gatekeeper math and science courses, we anticipate that use of our professional practice simulations early in the undergraduate curriculum will convince a different subset of students that they are capable of being engineers (i.e., by acquiring the engineering epistemic frame) and thus increase the diversity of students who persist in engineering.