



Award Abstract #1623125

IUSE/PFE:RED: Reinventing the Instructional and Departmental Enterprise (RIDE) to Advance the Professional Formation of Electrical and Computer Engineers

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[Div Of Engineering Education and Centers](#)

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Investigator(s): David Jiles dcjiles@iastate.edu (Principal Investigator)
Sarah Rajala (Co-Principal Investigator)
Mack Shelley (Co-Principal Investigator)
Joseph Zambreno (Co-Principal Investigator)
Diane Rover (Co-Principal Investigator)

Sponsor: Iowa State University
1138 Pearson
AMES, IA 50011-2207 (515)294-5225

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ABSTRACT

Electrical and computer engineering (ECE) technologies have evolved from simple electronics and computing devices and tools to complex systems that profoundly change the world we live in. Designing these complex systems requires not only technical knowledge and skills but also new ways of thinking and the development of social, professional and ethical responsibility. Through the RIDE project, the Department of Electrical and Computer Engineering at Iowa State University is involving students, faculty, engineers and others in collaborative, inquiry-driven processes to collectively and systematically transform

the department and the engineers it trains. Students are not only learning about fundamental ECE technologies in core courses during their sophomore and junior years (middle years), but also the socio-technical context to go beyond the hardware and software toward responsible development. Students are expanding their analysis and design skills to create solutions that work for individuals and society. To accomplish these goals, faculty are reshaping core curricula using evidence-based pedagogical strategies and are working together to enhance their understanding and integration of these strategies in courses. This work is being done through new structures for collaboration and facilitated through departmental change processes. The project is expected to advance scholarly teaching and education research department-wide; serve as a model for ECE, computing and engineering departments across the country; enhance the capacity to conduct engineering education research at Iowa State; develop a diverse, socio-technical-minded ECE workforce; and broaden the participation of underrepresented groups in ECE, especially women, through inclusive learning experiences.

Through this project, the ECE department is undergoing a transformation to a more agile, less traditional organization able to respond to industry and society needs and sustain innovations. This transformation is being driven by the project's novel cross-functional, collaborative instructional model for course design and professional formation, called X-teams. X-teams are reshaping the core technical ECE curricula in the middle years through pedagogical approaches that (a) promote design thinking, systems thinking, professional skills such as leadership, and inclusion; (b) contextualize course concepts; and (c) stimulate creative, socio-technical-minded development of ECE technologies for future smart systems. X-teams are also serving as change agents for the rest of the department through communities of practice referred to as Y-circles. Y-circles, comprised of X-team members, faculty, staff, and undergraduate and graduate students in the department, are contributing to an organizational culture that fosters and sustains innovations in engineering education through an agile framework that blends several documented change theories, including collaborative transformation, crucial conversations, and essential tension. Y-circles are engaging in a process of discovery and inquiry to bridge the engineering education research-to-practice gap. Research studies are being conducted to answer questions to understand (1) how educators involved in X-teams use design thinking to create new pedagogical solutions; (2) how professional formation pedagogy in the middle years affects student professional ECE identity development as design thinkers; (3) how ECE students overcome barriers, make choices, and persist along their educational and career paths in the middle years; and (4) the effects of department structures, policies, and procedures on faculty attitudes, motivation and actions. These studies are informing and improving project activities, advancing knowledge, and supporting adaptation by others.

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