PROJECT SUMMARY: Computational Creativity

Computational thinking and creativity are critical to addressing important societal problems and central to 21st century skills**. Computational thinking** is a collection of analytic skills that everyone, not just computer scientists, can use to help solve problems, design systems, and understand human behavior; comparable in importance and significance to mathematical, linguistic, and logical reasoning and vital to today's increasingly data-intensive and digital industries. Likewise, **creative thinking** is not just the province of a few individuals within the arts or of those possessing special talent, but is instead an integral component of human intelligence that can be exercised within any context and which can be practiced, encouraged and developed. Computational thinking and creative thinking are complementary skills that when blended together become *computational creativity*, enhancing learning and application of both. Our **long-term vision** is to address the growing need for computationally savvy, creative thinkers and problem solvers by incorporating *computational creativity* into the undergraduate CS curriculum to reach both CS majors and other students in STEM and non-STEM fields. A suite of Computational Creativity Exercises (CCEs) was created through a TUES grant (DUE-1122956). Evaluation found that students who completed the exercises had higher course grades and better learning of CS content. The goal of this project ***IUSE: Design, Development, and Implementation Projects: Computational Creativity to Improve CS Education for CS and non-CS Undergraduates*** is to build on the innovation and results from the previous TUES grant. *Specific aims* are to produce a final suite of validated, high quality CCEs and a Computational Creativity undergraduate course, and to conduct rigorous research to understand for *whom and under what conditions* the CCEs are most efficacious, *why* the CCEs are effective by studying students' collaborative interactions and learning processes, and *how* the CCEs impact students' enrollment and retention in CS and STEM courses.

Our proposed project uses design-based research and a Year 3 professional development workshop to further develop the CCEs and to evaluate their efficacy which in turn will maximize the dissemination and implementation of this proven effective instructional strategy. The final suite of CCEs and a Computational Creativity undergraduate course will be disseminated to other post-secondary institutions, thereby advancing student understanding of CS, computational thinking, and creative application of CS knowledge. Research findings on 1) the conditions influencing effectiveness will inform future implementation by identifying best practices for delivery and utilization, 2) student characteristics will inform classroom practices to motivate student engagement with and maximize student learning from the CCEs, 3) why the exercises are effective will advance understanding of how CCEs facilitate student collaborative interaction, learning of computational thinking/CS content, and creative competency, and 4) retention and enrollment will advance understanding of how CCEs can broaden CS and STEM participation and increase retention.

The enhanced CCEs and Computational Creativity Course will help advance CS learning for both CS and non-CS students, equipping them to creatively apply computational thinking to engage with the growing body of big data informatics and analytics. We will expand deployment of the CCEs within the UNL undergraduate curriculum and through dissemination partnerships with other post-secondary institutions. The CCEs and the Course can be delivered via distance education to reach extended audiences, including informal and business/industry settings. K-12 versions of the CCEs deployed on Google's Exploring Computational Thinking will be expanded to include all exercises, introducing K-12 students to computational creativity in a non-technical format that may increase the number of students pursuing future CS and STEM education and broaden the participation of women and other underrepresented groups. Research results will advance educational theory and practice, improve understanding of the learning processes involved in computational and creative thinking, and be disseminated to a broad range of scholars and researchers via journal and conference publications and workshops. This project will produce a large database consisting of research data and metadata and study findings that will be made available to other researchers as described in the Data Management Plan.