Collaborative Research: DTI: Project SPAC3: A Culturally Relevant Approach to Spatial Computational Thinking Skills and Career Awareness through an Immersive Virtual Environment

OVERVIEW

Project SPAC3 is an NSF ITEST Developing and Testing Innovations (DTI) proposal that aims to develop upper-elementary Latinos' spatial computational thinking skills and awareness in computationally-intensive careers through designing an immersive enactive learning experience in MinecraftEdu, which emphasizes family engagement, near-peer mentorship, peer collaboration, and expert modeling. Spatial Computational Thinking Skills (SCT) are the ability to abstract key spatial features, to decompose shapes with geometric representation and recognize patterns, and to use programming and computing tools for spatial algorithm design. SCT is increasingly demanded in computationally-intensive industries given the advances in technology innovations of robotics, virtual realities, and smart geospatial systems. We bring together a team of learning scientists, educational technologists, and career development experts to create an innovative informal virtual learning program and an unique age-appropriate spatial programming module. Through design-based research, we will explore two research questions: 1) How can an immersive virtual learning environment be designed to support upper-elementary school Latino students' spatial computational thinking skill development, career exploration, and family engagement? 2) What are the immediate and sustained impacts of the SPAC3 program on participating elementary school students, parents, and college students? The usability study and feasibility study will inform the iterative design of the learning activity and learning environment; the field study will improve the program delivery model; the pilot study will gather preliminary evidence of the efficacy of the program.

INTELLECTUAL MERIT

The intellectual merit of Project SPAC3 originates from its contributions to the understanding of upper elementary school Latinos' SCT skill development and career development. In the existing literature, little is known about effective strategies to support family co-learning at the different stages of the concreteness fading process and effective mechanisms to foster the dynamic interactions between parents, peers, and college facilitators in informal virtual learning settings. Project SPAC3 provides an integrated new approach and will shed light on those theoretical and practical important topics. This project also innovatively fuses relevant physical and digital manipulatives in an immersive virtual learning environment to support the learning progression. The research will provide evidence-based understanding of this type of design on upper-elementary Latinos' learning outcomes. Importantly, this project will develop a unique set of extended and age appropriate visual programming functions to enable upper elementary school students to engage in spatial programming, thus will provide rich insights into the affordances of this invention and the influences of the use of this new tool on students' spatial reasoning, computational thinking, and interests in computing careers.

BROADER IMPACTS

The broader impacts of Project SPAC3 lie in its unique deliverables. The unique set of extended and age appropriate spatial visual programming functions that we will develop in Microsoft MakeCode provides an approach for thousands of visual programming users, mostly children, to get access to the experience of solving spatial challenges through coding and for educators and researchers to better integrate spatial reasoning and computational thinking in the elementary school level. The learning environment we developed in MinecraftEdu, if proven to be effective, can be scaled up to a national level and can be incorporated in afterschool programs as well as being used in elementary school classrooms as part of the CS course or integrated STEM curriculum. Because of the use of low-cost materials and the self-paced learning design, the learning activities are very flexible and affordable for families and educators who have different needs. The professional development sessions we developed and piloted in this project can also be turned into part of credential programs focusing on learning innovation, community engagement, and STEM education, which has the potential to impact elementary CS teacher workforce development. Furthermore, the research findings revealed through this project can provide rich insights into program design that foster Latinos' interest and awareness in computing and effective strategies to support family engagement, peer collaboration, near-peer mentor facilitation in immersive learning.