Minecraft-based Middle Grades Spatial Skills Learning

OVERVIEW

The overall goal of this DRK12 Level I "Learning Strand – Design and Development Studies" project is to design the early version of a portable and scalable Minecraft-based "Spatial Skills Curriculum" that can improve spatial intelligence of middle school students. The curriculum will be implemented as a series of spatial training modules within the Minecraft virtual 3D gaming platform. The ability to make spatial judgment and visualize has been shown to be a strong indicator of students' future achievement in STEM-related courses. Spatial intelligence has also been shown to be one of the only areas in which females perform worse than males, with noticeable differences emerging in the middle school years. This spatial reasoning gap can potentially reinforce stereotypes about gender roles in certain male dominated fields such as engineering and computer science, thus exacerbating the lack of gender diversity in the STEM workforce. Luckily, research has also shown that training exercises can close the spatial reasoning gap between males and females. As such, a portable, technology-based spatial training system that can be easily deployed in middle school could serve as an early version of a scalable intervention that could be further developed to dramatically increase broader participation in STEM. Further, the scalable curriculum could have major impact in improving STEM achievement of all learners, but especially of female students.

INTELLECTUAL MERIT

This research will contribute to knowledge of how to use gaming systems to teach skills critical for achievement in STEM. Specifically, this work is one of the first to empirically measure how intentional spatial reasoning training using the Minecraft virtual 3D building system improves spatial intelligence of 7th graders. Further, this project brings together an interdisciplinary team of researchers from the fields of education, engineering, physics, and film and photography to implement this work. The team has laid out an achievable plan based on prior experience running successful NSF-funded research projects.

BROADER IMPACT

The Spatial Skills Curriculum proposed will serve as an early version of an easily deployable and readily expandable training system that will build learners' spatial skills. Research regarding STEM pathways suggests that, in addition to academic performance, many non-cognitive factors influence interest in STEM including self-efficacy. Thus, strengthening STEM participation is not solely about increasing enrollment in STEM programs. Strengthening students' spatial intelligence could help develop confidence and content-specific self-efficacy. Since self-efficacy is one of the strongest indicators of motivation and performance, intervening early may have a significant impact on building STEM confidence among pre-adolescent students. Therefore, the broadly deployed, scalable game-based Spatial Skills Curriculum as proposed will grow learner's spatial skills, resulting in higher self-efficacy and interest in STEM, consequently leading to broader representation of all learners, including females, in STEM. The project will also provide summer camp STEM learning opportunities for middle grade learners, as well as introduce and encourage the integration of spatial skills training through Minecraft to participating preservice and inservice teachers. The curriculum will be made publicly available through the Craft-Academy, a global community focused on creating educational curriculums for K-12 based on the Minecraft gaming system. The project also brings together researchers from far-reaching disciplines, including education, engineering, science, and the arts, affording considerable opportunity for cross-pollination of ideas to fuel future innovative curricula for K-12 education.