PROJECT SUMMARY

Overview

This Early Stage Design and Development project in the Learning Strand aims to create and study an Equitable and Interactive Mathematical Modeling (EIM2) program that positions students as decision makers in their own learning. The program involves collaborations with 6th and 7th grade students, a professional learning community series with their mathematics teachers, and the creation of the EIM2 platform. We will create a dynamic online platform to host the EIM2, which will feature videos with an option space of real-world multiple scenarios and interactive discussion feeds. Through the program, students will recognize and celebrate mathematical dimensions of their home cultures in a classroom setting, while choosing, comparing, and adapting ways of thinking mathematically. The program will be created through a partnership between the University of Florida's mathematics and multicultural education faculty members and the Lastinger Center for Learning; Vanderbilt University's learning sciences faculty; and middle schools in a Florida school district, Alachua County Public Schools.

Despite the value of connecting students' life experiences with mathematical learning, its practical implementation has proven challenging in a classroom setting. The scenarios typically presented in word problems are often nonsensical to students. Even an authentic problem scenario interesting to one group of students might not seem important to another group. EIM2 addresses these issues by supporting students to engage in equitable mathematical modeling, a process of using mathematics to address problems introduced in the scenarios that are curated by diverse representative groups of students. The dynamic online EIM2 platform allows students to easily select scenarios based on their interests; experience the scenarios with visuals and animations; and compare, synthesize, and refine their mathematical ideas. We will use multi-tier design-based research and a mixed-methods approach to facilitate the characterization, evaluation, and refinement of our EIM2 program. The program development will be guided by design principles and hypothesized learning processes that support students' cultural competence, their evaluations of multiple mathematical solutions, and mathematical identity development. Over the four-year project span, we will (1) explore the nature and impact of the iterative EIM2 program, assessing how it promotes a shared vision for the learning of all students, including racial and ethnic minoritized students, in the classroom setting; (2) examine whether and how students' engagement in EIM2 supports their identities and achievement in mathematics; and (c) understand how teachers enact EIM2 and whether they change their attitudes toward modeling over time and across contexts.

Intellectual Merit

The proposed project fills a theoretical gap related to scalable design models for interactive mathematical modeling curricula that are culturally sustaining for students. In alignment with the Learning Strand's aim of transforming current practices, our model of learning processes and design principles will be tested and refined through multiple iterations. We will investigate how our approach of leveraging students' decision-making in learning mathematics supports their mathematical identities. We will also compare the mathematical achievement of the participating students with those of non-participating students in the same district to test if the students' engagement in EIM2 affects their mathematical achievement. Our model improves upon current practices of mathematical modeling by transforming existing curricula to reflect students' lived experiences and foster their active learning, leveraging the interactive nature of digital curricula. Our proposed work has the potential to be transformative for STEM teaching and learning as we aim to develop and refine a model of interactive curricula and instruction built on an asset-based understanding of students, which can be applicable for other STEM education fields of study.

Broader Impacts

The proposed project has the potential to establish a robust foundation for a large group of students, particularly minoritized students, to be excited about STEM classes and careers. In alignment with the Learning Strand's aim of broadening participation in STEM by targeting underserved learners, EIM2 targets traditionally underserved racial and ethnic minoritized students with the goal of centering their voices in designing and refining curricula to enrich all students' participation in STEM. Through the refinement of our model over four years, EIM2 will provide field-tested frameworks for equitable mathematical modeling, its interactive learning process, and relevant teaching practices for all students. The materials and frameworks developed in the EIM2 project will be candidates for inclusion into the main curriculum and teacher professional development materials of Lastinger Center's digital math curriculum, Math Nation, which currently serves a population of over 600,000 students and their teachers across the nation and is growing rapidly.