Overview of Research Activity

My overarching research agenda revolves around all aspects of undergraduate students' mathematical learning. At the macro learning-level, I consider how different types of educational activities (e.g., discussions, quizzes, exploratory activities, digital manipulatives) may affect student understanding. At the micro learning-level, I create models that predict how students may respond to individual questions that are used to provide automated feedback. My wide range of educational research, statistics, and programming skills has also led to productive collaborations where I act as an expert in data collection and qualitative/quantitative data analysis.

My scholarly activity, compared to total expectations outlined in the COAS ERAU-W Academic Guidelines and Criteria for Tenure and Promotion to Associate Professor, is provided in a summary chart below.

	Peer-Reviewed Publications	Conference Presentations	Internal/External Funding Proposals
Year 1	3	5	1
Year 2	3	1	1
Year 3	2	2	3
Year 4	NA	NA	NA
Year 5	NA	NA	NA
Expected	5	5	1
Actual	8	8	5

As the chart illustrates, I surpased the scholarly activity expectations by the end of year 2. Peer-reviewed publications were submitted to a variety of well-respected locations: national conference proceedings (4), peer-reviewed mathematics education journals (3), and as a book chapter (1). Presentations primiarly took place at national and regional conferences (8), though I also presented at ERAU-hosted local and regional events (3) and was invited to talk about my research at another university as part of a seminar series (1). All funding proposals I was a part of were successful: I was PI on internal funding (2), PI on external funding (1), co-PI on an NSF grant (1), and will have an additional funding proposal submitted by the end of year 3. Note that while my Record of Activities lists 6 grants, I was brought in as a co-PI on grant [**4**] after it was submitted and am not counting it in the funding proposal list.

Given the numerous successful funding proposals I have been a part of, I have organized my various research projects below by their funding source and summarized how they fit within my research agenda.

Externally-Funded Research Projects

- **PI**: ***Machine Learning Affordances in Collegiate Mathematics Education Research*** This solo project focuses on the ways Machine Learning can enhance the teaching and research of college-level math. Methods to enhance teaching include developing: models for levels of understanding certain mathematical concepts, automatic targeted feedback, asynchronous discovery-based learning activity, mastery-based large-scale mastery-based grading. Methods to enhance research include: data management, machine classification of qualitative coding, and machine classification of question responses.
- **Co-PI**: ***Community of Inquiry and Cognitive Load*** This NSF-funded project focuses on exploring the social and cognitive ways students engage in discussion posts in math and physics courses. It also explores the aspects of cognitive load students perceive as inhibiting their contribution to discussions. Seventeen terms of discussions in two courses, MATH 111 and PHYS 102, were collected for analysis using the Community of Inquiry model. My main role in this project is managing and analyzing this massive amount of data – approximately 900,000 sentences of discussion.
- **Co-PI**: ***Undergraduate Research for Fully Online STEM Students: Impact of Expanded Curricular Options on STEM Attitudes, Identity, & Career Ambitions*** This NSF-funded

project is a continuation of a previous NSF project that focuses on developing resources for supporting undergraduate research in online programs. This second stage will, expand the impact to all ERAU-W students, develop an Undergraduate Research minor, expand on resources to support undergraduate research, and study the effects of these efforts. My main role in this project is to formally study the effects of efforts.

Internally-Funded Research Projects

- **PI/Co-PI**: ***Collective Knowledge Progression and Proliferation in Asynchronous Calculus Discussion Boards*** This project focuses on developing a theoretical framework for categorizing and analyzing how students develop and share knowledge in asynchronous online discussions. After initial development, we have tested and refined the theoretical framework with pilot data and recently collected preliminary data. I work in equal amounts with the other PI, Dr. Zack Reed, on all aspects of the project.
- **PI**: ***Undergraduate Covariational Reasoning in Calculus*** This project was the result of mentoring an undergraduate student, Teegan Bailey, for three years. After a year of informal discussion on collegiate mathematics education theoretical frameworks and prominent topics, he chose to investigate calculus students' reasoning on how two different quantities change with respect to one another. My primarily role was as a research mentor. Bailey has graduated and thus this project is complete.

Scholarly Products not Associated to an Active Research Project

- ***Project NExT Activities*** Project NExT (New Experiences in Teaching) is a one-year professional development program designed for early-career faculty to learn about best practices in teaching and research. As part of this program, I organized three special sessions that brought in tenured faculty to speak to research in particular.
- ***Presentations as an Expert in the Field*** As an expert in mixed-methods data analysis, collegiate mathematics education, and technology in education, I have spoke locally at ERAU, at a regional conference hosted by ERAU, and at national mathematics conferences. While this talks may mention parts of other research projects, they primarily focus on speaking to a non-research audience to impart generalized wisdom based on one of my expertise.