

Title: Building Valid and Reliable Educational Instrumentation to Measure Student Learning and Retention in Physics

Abstract: My research program in Physics Education Research is grounded in evidence-based practice, equity, and inclusion, with a focus on two interconnected areas: the assessment of student learning and the evaluation of STEM retention efforts. Motivated by longstanding concerns about inequities and demographic biases in traditional physics assessments, my work seeks to develop fair, valid, and inclusive educational instrumentation that more accurately measures outcomes across diverse student populations. In this talk, I will first discuss my multi-institutional, NSF-funded collaborations that have redesigned the widely used physics concept inventories and have developed open-response assessments that investigate students' mathematical sensemaking across biology, chemistry, and physics. These projects have generated extensive assessment item libraries, engaged more than 10,000 students, and advanced efforts to ensure assessment validity across student groups.

Complementing this work, my research on the evaluation of STEM retention efforts is within the context of improving pathways for community college transfer students. Through federal, institutional, and private support my team has developed a novel mixed-methods design that examines students' self-efficacy, STEM identity, transfer student capital, and has explored academic trajectories using institutional and national datasets. Together, these tools help us identify structural barriers to transfer students' success and points toward actionable ways to address them. Over my time at MSU, my research lab has advanced equitable assessment practices and data-informed strategies for improving student persistence in STEM, while contributing to broader efforts to expand access, opportunity, and success in higher education.

Bio: Rachel earned her Bachelor of Science degree in physics from Slippery Rock University in Pennsylvania. She then went on to do her graduate work at West Virginia University where she completed her Master's and PhD in physics. Her dissertation work was supervised by John and Gay Stewart where she focused on the gender inclusivity of the commonly used physics assessments. In 2018, she moved to Michigan where she did her postdoctoral work in collaboration with Danny Caballero in the Physics Education Research Lab at Michigan State University. During that time, she focused on developing formal structures to support the newly transformed physics laboratories while developing assessment tools and practices for understanding student learning within these courses. In 2020, Rachel was hired as an Assistant Professor at MSU where she is jointly appointed in the Department of Physics and Astronomy and the CREATE for STEM Institute. Generally, Rachel is a mixed-methods researcher who focuses on developing and implementing inclusive and equitable assessment tools that can be used to improve the learning and retention for students seeking Bachelor's degrees in STEM. She has served as a member-at-large for the APS Topical Group on Data Science and the APS Topical Group on Physics Education Research. She has also served as the chair of the American Association of Physics Teacher Physics Education Research Leadership and Organizing Council (PERLOC). She is currently a member-at-large for the Eastern Great Lakes Section of APS, an Editorial Advisor on the Physical Review Physics Education Research (PRPER) Statistical Modeling Review Committee (SMRC), and an evaluator of the APS Gender Inclusive Physics Community conferences.