

Revealing the Invisible: Data-Intensive Research Using Cognitive, Psychological, and Physiological Measures to Optimize STEM Learning

Principal Investigator: [Jodi Asbell-Clarke](#)

Co-PI: [Elizabeth Rowe](#)

Funder: [The National Science Foundation](#)

Virtual learning environments are an increasingly important component of individualized learning in STEM domains. New technologies (including biometry and neuro-imaging) provide new opportunities to unobtrusively measure student engagement and learning. This project—developed in connection with an Ideas Lab on Data-Intensive Research to Improve Teaching and Learning that NSF convened in October 2014—will utilize these technologies to provide foundational knowledge of the ways in which measures of implicit learning might be linked to explicit learning to develop educationally relevant games that are adaptive to diverse learners.

Investigators from TERC, Landmark College, and the Massachusetts Institute of Technology will collaborate to examine the relationships among:

1. patterns of play in a digital game ("Impulse");
2. student attention (measured from eye- and head-tracking devices); and
3. student learning about Newton's first and second law.

The researchers will collect measures of student engagement and learning outcomes embedded in the game. Subjects will comprise a neurodiverse group of students including regular undergraduates and those with Attention Deficit Hyperactivity Disorder and/or Autism Spectrum Disorder. The researchers will develop a model of visual attention and patterns of play, examining the extent to which eye movements are allocated strategically to objects of relevance to the current game state as a student learns in the game. They will then link the initial model with measures of student engagement and conceptual understanding of relevant physical science constructs to refine the model. The refined model will be used to develop a modified game based on the players' attention, and a prototype of the modified game will be tested. The final phase of the research will be a within-subject design with the adaptive version versus the normal version of the game across learners with different profiles of disability.