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Promoting Students' Proportional Reasoning Using Invention Tasks

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To many students, introductory physics may seem a fast-moving parade of abstract, mysterious quantities. Most such quantities are rooted in proportional reasoning. Using ratio, physicists construct the force experienced by a unit charge and characterize motion with the change in velocity for a unit time. While physicists reason about these ratios without conscious effort, students may resort to memorized algorithms and struggle to match the appropriate algorithm to the situation encountered. Dan Schwartz and colleagues at Stanford University have developed invention instruction as a means to prepare students for future learning. Invention tasks present open-ended situations in which students must invent a procedure or quantity in order to make meaningful comparisons. Through creative thinking and struggle, students are primed to make sense of the accepted scientific solution. A collaboration between Western Washington University, Rutgers, and New Mexico State has developed sequences of invention tasks to promote proportional reasoning. Central to our work is the development of assessments to gauge student learning. This talk presents an overview of the coordinated research and curriculum development project together with selected examples.