Student Conceptions of Entropy in an Introductory Physics Course

Warren Christensen
Department of Physics and Astronomy
Iowa State University

In recent years, traditional methods of teaching science and mathematics have been challenged by research which shows that students often emerge with poor understanding of the material being taught. However, discipline-based education research has been effective in improving student learning in a number of technical fields. For example, during the past 30 years physics education research has had significant impact on the ways we understand student thinking and learning of physics. By tapping research in cognitive science and educational psychology, we can develop theoretical frameworks of knowledge structure and development to help guide our investigations. As a concrete example of discipline-based education research, I will review recent research on student learning of thermodynamics. This work has shown that students face substantial difficulties in learning fundamental thermodynamic concepts, and that many of these difficulties persist into upper-level courses. I will illustrate the utility of PER methodology in the context of research on student understanding of entropy in an introductory calculus-based physics course. Many difficulties seem highly resistant to instruction, for example, students' inability to apply the second law of thermodynamics to entropy changes in spontaneous processes. We have been developing and testing tutorial-style worksheets to address these difficulties and I will discuss a preliminary assessment of their effectiveness.