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## Education research and reviews and its benefits

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## ABOUT THE STUDY

One of PER's primary goals is to develop teaching techniques and strategies to help students learn physics more effectively and to help teachers implement these techniques. Because even the basics in physics can be confusing, and teaching by analogy can lead to scientific misunderstandings, lectures often do not eliminate common misunderstandings about physics that students have acquired before learning physics. Research generally focuses on learning more about common misunderstandings that students bring to physics classes to design techniques that help students overcome these misunderstandings.

In most introductory physics courses, mechanics is usually the first field of physics taught. Newton's law of motion on the interaction of force and the body is the core of the study of mechanics. Many students hold the Aristotelian misunderstanding that keeping the body moving requires net force; Instead, modern physics models motion according to Newton's first law of inertia, stating that unless a net force acts on the body, the body will remain stationary or in motion. Like the students who hold these kinds of misunderstandings, Newton derives his three laws of motion through empirical analysis, despite his extensive research on data that includes astronomical observations. Students can dispel misunderstandings like this in a near frictionless environment, where they find that objects are moving at near constant speed without constant force. Conceptual understanding: investigating what students know and how they learn is the core of PER. Early investigations included the identification and treatment of misunderstandings of the principles of physics. Based on the consideration of alternative theoretical frameworks for student learning, the term has evolved into "student difficulty." The difficulty of a concept can be built into a correct concept; incorrect ideas are eradicated and replaced by correct ideas. The PER team at the University of Washington specializes in research on students.

Epistemology: Epistemology as a trial and error method to improve learning. Due to the shortcomings of this method, the theoretical basis for the research was developed very early, mostly through the University of Maryland. The theoretical basis of PER is mainly based on Piaget's construction. The theory of cognition in physics learning is proposed by Reddish, Hammer, Elby and Schell, who is based on disessa's "Knowledge in Sketch". The resource of the framework and development of this work, based on research in neuroscience, sociology, linguistics, pedagogy, and psychology. An additional framework will be published soon, and recently it is a "possibility framework" based on research that Watson and Philip Johnson Laird began to deductively reason. Problem-solving: The process played an

important role in advance physics research, and it appears in many traditional textbook exercises. Most of the research in this area is based on examining the difference between novice and expert problem solvers (first and second year students, undergraduate and postdoctoral students, respectively). Research on ways to solve problems has always been the focus, in every group at the University of Minnesota. Recently, an article was published in the special section of PRL: PER which is used to identify more than 30 levels of behaviors, attitudes and skills in solving a typical physical problem. It is used in the field of problemsolving ability, higher resolution, and special attention to detail.

Kinds of teaching materials: For college

students, publishers are now emphasizing their physics textbooks as an important selling point PER basis. One of the first complete physics textbooks containing the discovery of PER was written by Serway and Beichner. In addition to textbooks, instructional materials for college physics students now include simulations.