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Título de la charla	Improving Student Learning: The Dual Roles of Conceptual Understanding and Reasoning Ability

Resumen

Why do students make errors on physics problems? Errors that directly contradict what they have been taught? Errors that don't arise from the failure to remember the correct formula? For the past several decades, physics education researchers have focused on one compelling explanation: students arrive in the classroom with pre-formed ideas about how the world works. Even though they may blend these ideas with those presented in formal instruction, the prior conceptions often win out. According to these accounts, students' prior knowledge has been built through rational, if imperfect, processes of observation and analysis, and any new or different ideas presented in the classroom must likewise be built, not simply received. Figuring out what ideas students bring with them to the classroom, and how to take them into account, has proven to be a complex, multi-faceted program of research that has significantly influenced physics teaching. However, it is not always the case that students produce incorrect answers through logical inferences based on incorrect or inappropriate premises - often they don't know why they chose a particular answer, just that it seems right. "Dual-process" theories suggest that their answers might not be based on so-called "slow" thinking, which is deliberate and laborious. Instead they might be based on so-called "fast" thinking, which is automatic and effortless. The basic idea is that students immediately and effortlessly form a first-impression of a physics problem. If this impression is found to be satisfactory, it will be adopted. Otherwise, a deliberate and analytical process ensues. It is believed that this sequence cannot be "turned off." That is, a first impression will always be formed. If it is attractive, and the benefits of engaging in more effortful thinking are not obvious, then a student may answer incorrectly, masking their conceptual knowledge. In this talk, I will discuss recent efforts to improve both conceptual understanding and reasoning skills. Examples will be chosen from first-year university-level physics.