

Adaptive Learning Modules to Promote Conceptual Understanding in Mechanics

Dr. Brian P. Self, California Polytechnic State University, San Luis Obispo
Ms. Eileen W. Rossman, California Polytechnic State University, San Luis Obispo
Emily Flores, California Polytechnic State University San Luis Obispo

Students who struggle with mechanics principles can often work through problems without a strong conceptual understanding of the underlying principles behind them. As a result, our team is conducting research, user group interviews, wireframing, and designing Adaptive Learning Modules (ALMs) to help students develop the foundational understanding of these underlying concepts.

Our Adaptive Learning Modules are centered on the students' understanding and progress. Currently, our learning modules have the following format: student engagement, a short lecture video, a coupled multiple response (CMR) question, supplemental instruction videos, an instructional intervention, a summative assessment, and a survey. The student engagement portion of the module will mostly be done through a video format to inspire and/ or motivate our students to see the different possibilities and roles in which they can apply their knowledge after graduation. This is especially helpful for our marginalized and first-generation students to see people with similar identities in their respective fields. The engagement portion is followed by a short lecture video on the given topic. Then, students will be given the CMR to gauge their understanding. Based on those answers, they will be given a Supplemental Instruction module to make sure they are prepared for the upcoming Instructional Tool.

Our Instructional Tools are developed in the following format: warm-up, cases, and survey. The warm-ups were created to give researchers a baseline to the student's understanding before engaging with the instructional tool. Once the warm-up questions are completed the students are given a series of case questions that build off one another. The cases are in the following format: prediction questions, confidence questions, simulation and/or video, questions, and finally a conceptual check. This format allows the students to engage in critical thinking and reflection by going through a prediction phase for students to use their current understanding of the topic to predict the movement of the given problem. Students are then able to reflect on their answers and their understanding through the simulation and or video demonstrations of the given problems. The confidence questions allow us to see how students are feeling as they progress through the instructional tool, and the final conceptual check allows us to see whether the students also feel more comfortable and confident in their understanding of the underlying principles. Once, the students complete the cases they are then given a final survey to give us feedback on the questions, videos, and simulations. Our adaptive learning modules go through an iterative process as we receive more survey responses to ensure that we are providing enough support to our students.

Currently, our team has completed one module on velocity and acceleration and is working on ones on Newton's second law and on Coriolis accelerations.