

Using Model Predictions to Solve Challenges in a Team Design Project

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Context: In-class; Introductory calculus-based physics I lab

Keywords: physics, lab reflection, predictions

Student Activity Time: 10-15 minutes in-class

In a lab, students reflected on theory, experiments, and simulations to make a prediction about the success of their team design project.

Introducing the Reflection Activity

As part of an alternative simulated-research-experience lab, first and second year engineering majors completed mini labs that culminated in them making predictions for a series of challenges. The goal of the team design project was to provide an engaging laboratory experience in which students had the opportunity to develop theoretical or mathematical models, design experimental procedures, and make predications using computer simulations. The team design final project included a culminating series of challenges that required students to make predictions about how a toy car would perform on a variety of track shapes. The purpose of these predictions was to support students' reflection on their lab work, specifically on how the theoretical models, experimental procedures, and computer simulations can be used to solve problems.

Towards the end of the semester after teams had completed their design project, the teams participated in challenge sessions. These contests included hitting a target, stopping on a cliff, negotiating a loop, and jumping through hoops for the given track shapes. A week before the challenge session, the educator provided students with the challenge information, so they could use their model to make predications in advance of the challenge session. The challenge session included five challenges that were progressed in difficulty. During the challenge session each team used their model to predict the performance of their car on a variety of track shapes. Once students competed the challenge and had the opportunity to see immediately if their prediction succeeded or failed, students were equipped to see how the actual outcomes map to their expectations—did the outcomes map to their expectations and if the outcomes did not map to their expectations, what went wrong? This evaluation was documented in a final paper. This paper provided another reflective opportunity for students to reflect on their design decisions, goals of their project, and what they did to achieve these goals.

In terms of outcomes, there was potential for students to think about and evaluate their design and how they engaged in the design process. Additionally, it is possible that students could use what they learned from the challenge to adjust their future engagement in design projects.

Recreating the Reflection Activity

	Description
1	Design the lab to be project-based with connected mini labs that culminate in a final design project with a challenge that requires students to use a model to make predictions.
2	Assign students to groups to complete the team design final project.
3	Introduce the team design project.
4	Provide students with information they will need for the challenge.
5	Facilitate the final challenge.

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2.1 Project Description	
2.2 Final Paper Rubric	

In the Words of the Educator: Tips and Inspiration

Watch group size carefully. In my experience, too small groups struggle to complete tasks, while in groups too large students often lose out on the opportunity to actively contribute to the project. I've found that four students per group is a good balance.

Develop a challenge that is purposeful. I gear the series of challenges to increase in difficulty towards a 50% success rate on the final challenge because it needs to test the prediction capability of their model, but should not be impossible to solve. Utilizing a “Bull’s Eye” scoring system allows for a relative measure of the success of their results.

Be prepared for the amount of effort needed to run a lab like this one. In my experience, it is more effort to run a lab like this one—both preparation effort and grading effort.

What was the inspiration for the reflection activity? The chair of my department encouraged first-year physics educators to start something new—incorporate projects into general physics courses.