Pre-packaged vs. make your own simulations: lessons learned

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Outline

- Using simulations in the classroom
- Boxed simulations
- DIY simulation engines
- The project I ran in my classroom
- Some student work
- Student feedback
- Lessons learned
- Try it out!

Using simulations in the classroom

Within a simulation, the information is non-contextual and presented with as few distractions as possible from the primary learning goal (National Research Council [NRC], 2011), allowing the user to focus on the phenomenon and the relationships that impact behaviour.

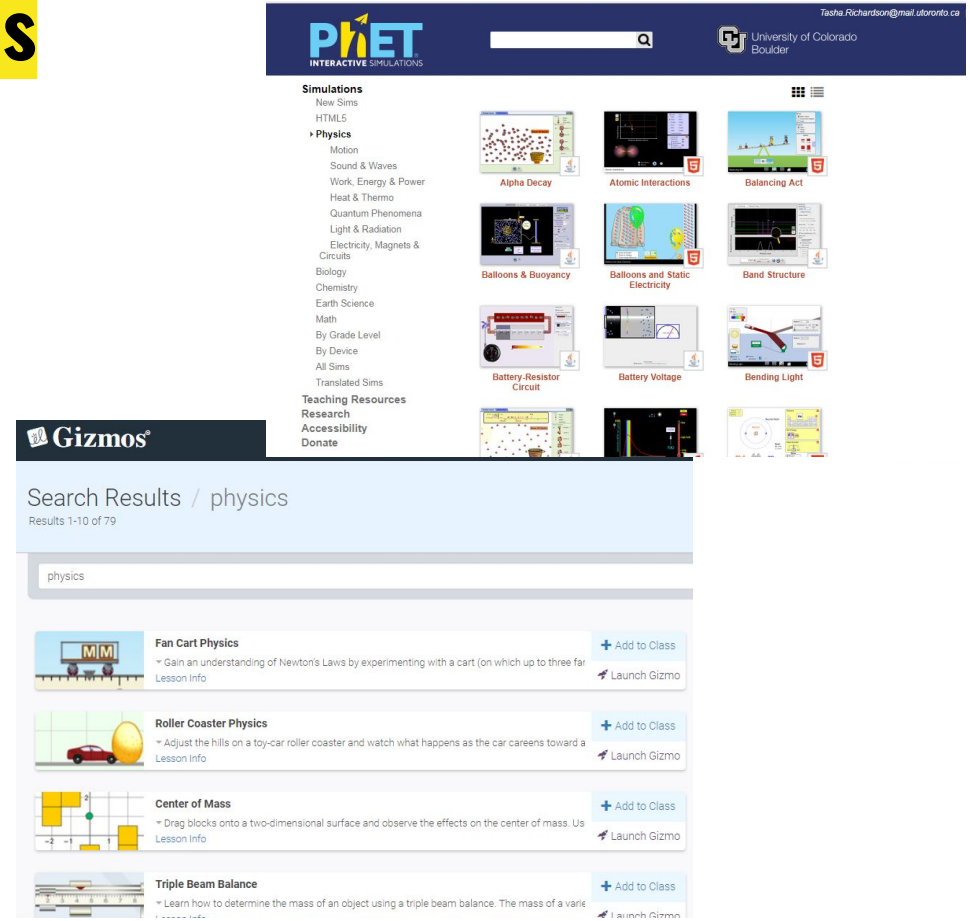
- Pre-packaged simulations are much more aligned with traditional classroom approaches that focus on applications to teach a fundamental law or concept.
- For physics, “hands-on” learning opportunities are critical to help learners understand incorporate otherwise abstract concepts into their understanding.

Typical boxed simulations

Many educators use simulations found online or through Board licences.

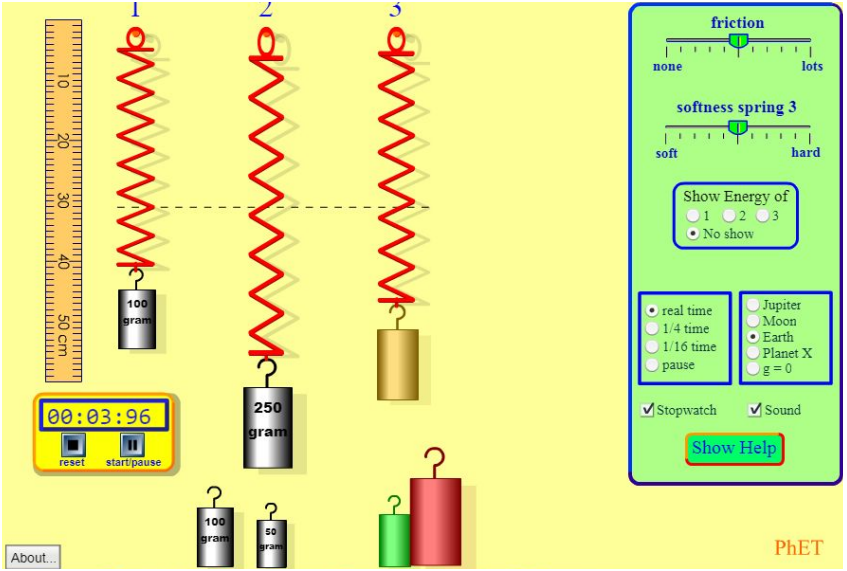
These are:

- Focused
- Expertly designed
- Aligned with curriculum
- Many available

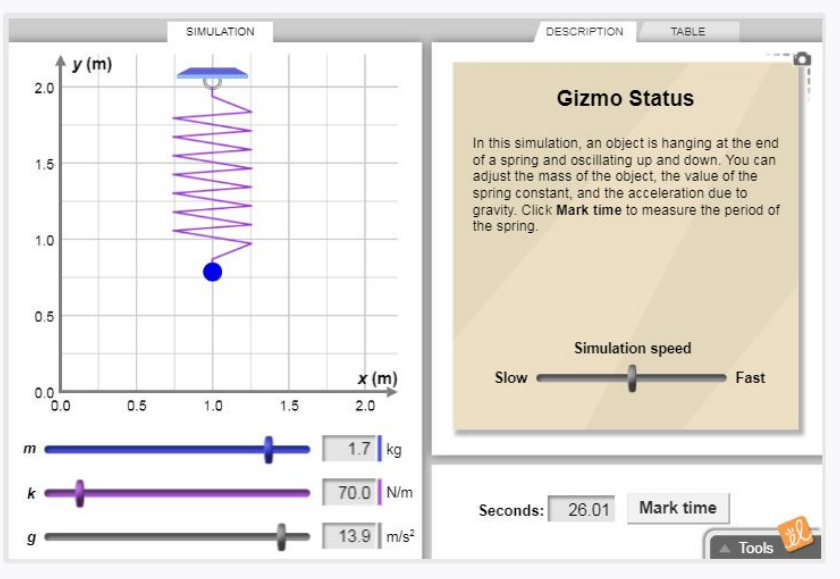


Pre-packaged simulations

PhET (Physics Education Technology): Masses & Springs

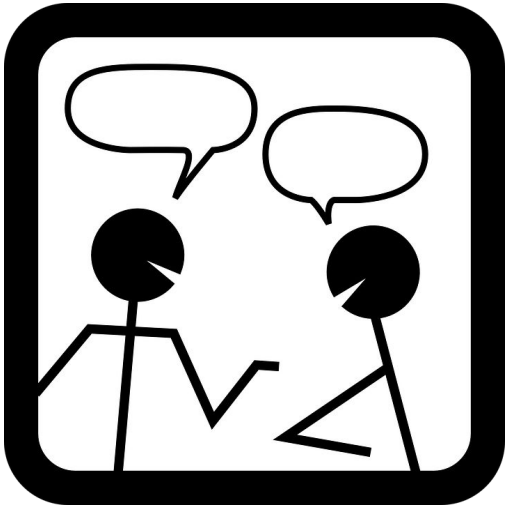


Gizmo: Period of Mass on a Spring



So, what's wrong with simulations built by experts?

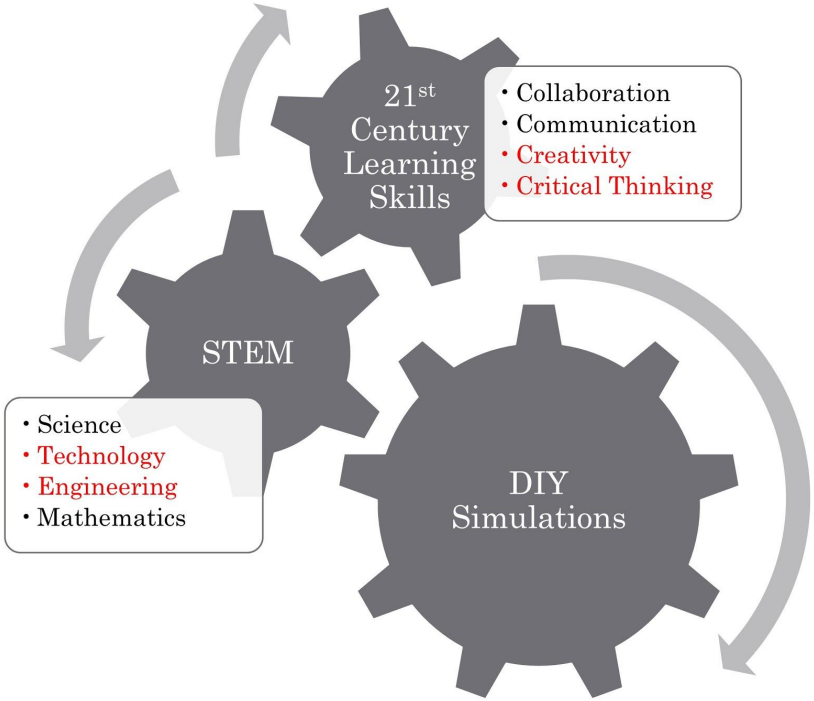
But… I had a conversation with a former student…



Nothing!

- Opportunities to "do" something that is otherwise inaccessible
  - Resource limitations (funding, practicality)
  - Safety concerns
  - Concrete experience with abstract concepts

What learning can a DIY simulation support?



The project I ran in my classroom

- Design an activity:
  - To explore a relationship between variables for a system
  - that could be run both in the class and within a simulation
- Run the investigation
  - Gather data in each environment
- Analysis
  - Produce an equation to describe the relationship between variables
  - Compare the results from each environment
- Submit
  - Report on the results
  - Reflection (modifications? Simulations?
  - Simulation file

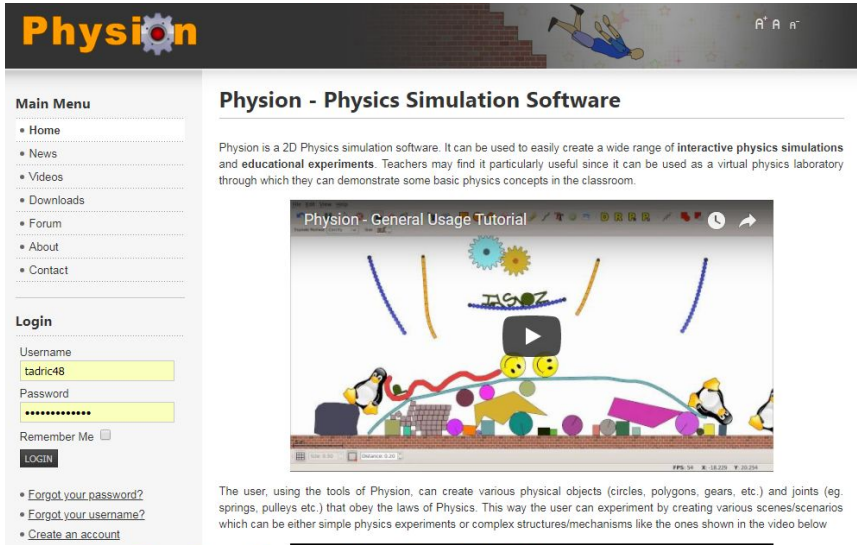
➔ Simulation software *must* be free

➔ For those unable to DIY, what can they do instead?

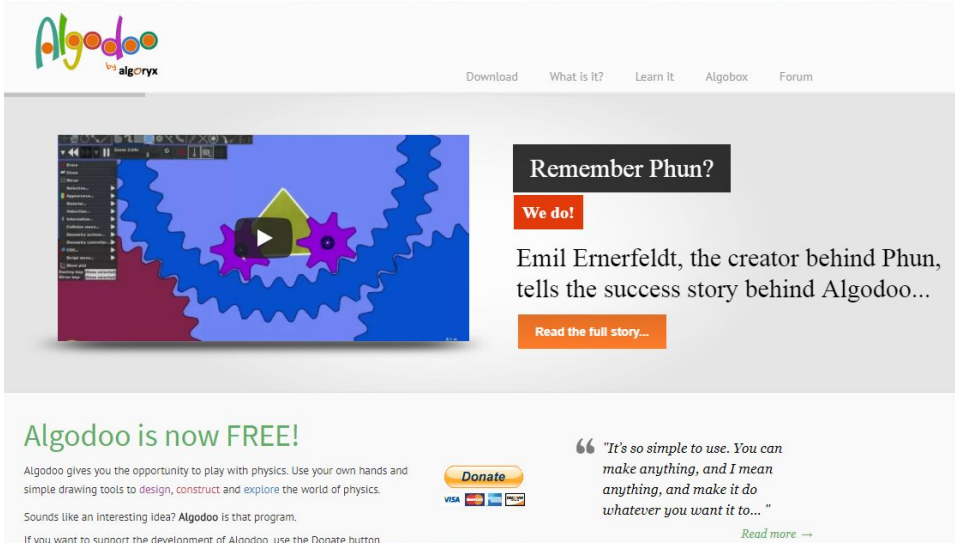
➔ Emphasize **simple**

DIY Simulation Engines

Physion



Algodoo (by Algoryx)



Some student work

Student feedback

Simulation software (easy vs hard to learn, limited functionality)

“I had a tough time to get familiar with the software. I watched some tutorial videos to understand the function of each command. Finally, the simulation came up the way that I expected”

“When creating the simulation of Physion, it was extremely simple to understand and learn the software.”

“Even though Algodoo looked like more fun and easy to use, its ropes/pulley system worked absolutely terribly, forcing me to use Physion which is much harder to use”

“While simulating with Algodoo, I wanted to reduce the uncertainty of the angle measurement… to accomplish this, I found the script menu and played around with the numbers until I was successful.”

“Algodoo had great accessibility to tools, but most of them were only limited to classical physics: there were no batteries, or data showing the laser.”

Student feedback

Simulation vs physical lab

“the time spent in the virtual lab was less than the time spent in a physical experiment. In the simulation, I was able to repeat the experiment for four trials in the same amount of time of one trial in the physical experiment.”

“Success with the simulation is that because one is able to pause the experiment to determine the range which will be more easy an accurate to measure”

“another success I had with this project is being able to see the data from the simulation fit a line of best fit almost perfectly, it's the best graph I've seen in my life so far.”

“the experience with performing the lab was both a discovery and learning opportunity, it allowed me to discover all the physics resources at our disposal, and allowed me to "play" with software that allowed me to simulate many simple physics experiments at home.”

Student feedback

A few additional comments

“Creating my own lab was also a bit of a struggle because I didn't know what relationship to explore and when I did decide what I wanted to do, it was too complicated to set up in Physion.”

“In a sense, the limit put forth by not having real access to electrostatic simulation software encouraged me to think creatively and put to use my understanding of these two separate strands of physics. I could even say that I learned just as much about these strands as I did about learning to use simulation software.“

“… and I had always personally been interested in conducting an Atwood machine experiment to confirm the force of gravity near Earth's since being taught about it in this course.”

Lessons learned

- Emphasis on *simple* for a simulation/physical comparison
- Support for students to learn software
- Keep it open-ended
- Due to focus on Mechanics of software, consider as a consolidation activity mid-semester, or as an exam review activity.
- Introduce an earlier check-in point with the class
- Continue to explore other simulation software as they become available (those for purchase exist… Board licences?)
- Other thoughts?

Try it out!

Keep the conversation going

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