Moving Beyond the Textbook
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Girls and Physics

It's Essential to Go Beyond the Textbook

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I teach physics at an all-girl high school in Singapore. Traditionally, girls encounter more challenges in this subject than boys because of this discipline's development from the male-dominated perspective of scientists and engineers. This is why going beyond the traditional textbook becomes a necessity to cater to girls' learning needs.

First, I believe in giving students a voice so they can say what they feel is exciting about a subject. For example, in my grade 7 class (Secondary 1 in Singapore), I scheduled lesson time for a show-and-tell activity toward the end of the term. The students displayed creativity and enthusiasm as they shared topics of personal interest, such as the physics of *Harry Potter*, figure skating, and the physical impossibilities of *My Little Pony*. After the show-and-tell activity, students used their iPads to record peer and teacher encouragement and feedback for how to improve the presentations, including the need to clarify the physics concepts discussed in the presentation.

Next, I designed lessons that give students opportunities to learn through problem solving, observation, and discovery—with a dash of fun. My grade 1 students grappled with the concepts of density while competing in a mini-competition to design a simple device that stays suspended in the middle of a tank of water. My grade 10 students pondered the effects of pressure when they observed how water flows through a hole in a bottle of water if it is upright or inverted over a pond. After further discussion, I captured their observations and posted the videos online.

Another of my grade 10 classes explored the effects of pressure change by constructing and observing how a "marshmallow man" grew inside a bell jar when a vacuum pump drew air out of it. My fellow teachers and I also conducted lessons for grade 10 students to construct individual DC motors while learning about the interaction of current-carrying wires and magnetic fields. The benefit of such learning experiences is two-fold: it creates hands-on opportunities for both boys *and* girls to apply and practice physics, and these real-world applications are deeply engaging for students, making learning retention and retrieval more likely.

The Need for Authentic Learning

Plenty of authentic learning materials exist in this Internet age. I often refer to news reports to show students how physics affects our life and society in many ways, and that its application has many consequences.

Famous physicists like Stephen Hawking and Marie Curie are powerful examples of individuals who overcame adversity to practice science and make our world better as a result of their perseverance. Recently, when Hawking opened the 2012 Paralympics in London with a speech about the origin of the universe, I used it as an opportunity to remind students that resilience is part of the physicist's skill-set, too.

Through encouraging and mentoring students to participate in various physics-based enrichment

activities and competitions, I also hope to infuse the skills of scientific investigation, project management, and communication in more authentic settings than the two-dimensional world of the textbook.

Besides using resources from the Internet and the media, I have created my own web-based resources for independent learning, including online videos and tutorials on physics problem solving. I have greatly benefited from discussions with colleagues who are using such resources for flip teaching or reverse teaching in other subjects. In addition to teacher-created resources, I also believe in the power of student-created learning resources. After some instructional guidelines, my grade 7 students were able to create simple video resources for learning about the application of thermal physics in the school environment.

When the Textbook Makes Sense

The textbook still has a place in learning as an authoritative reference material, though I supplement it with other learning activities and resources. My grade 9 students, who are using iPads this year, will be able to download a physics e-textbook from a publisher next year. This e-textbook will allow teachers to embed digital resources such as presentation slides and Internet links. I will be work with my colleagues to design lessons that allow students to explore physics concepts with the effective integration of technology.

Through these efforts and constant innovation and sharing with like-minded teachers, I hope to make learning both meaningful and engaging for my students and incite the next generation of Marie Curies to love physics in the real world, unleashed from the stale confines of textbooks.

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