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Humanizing online STEMM Education

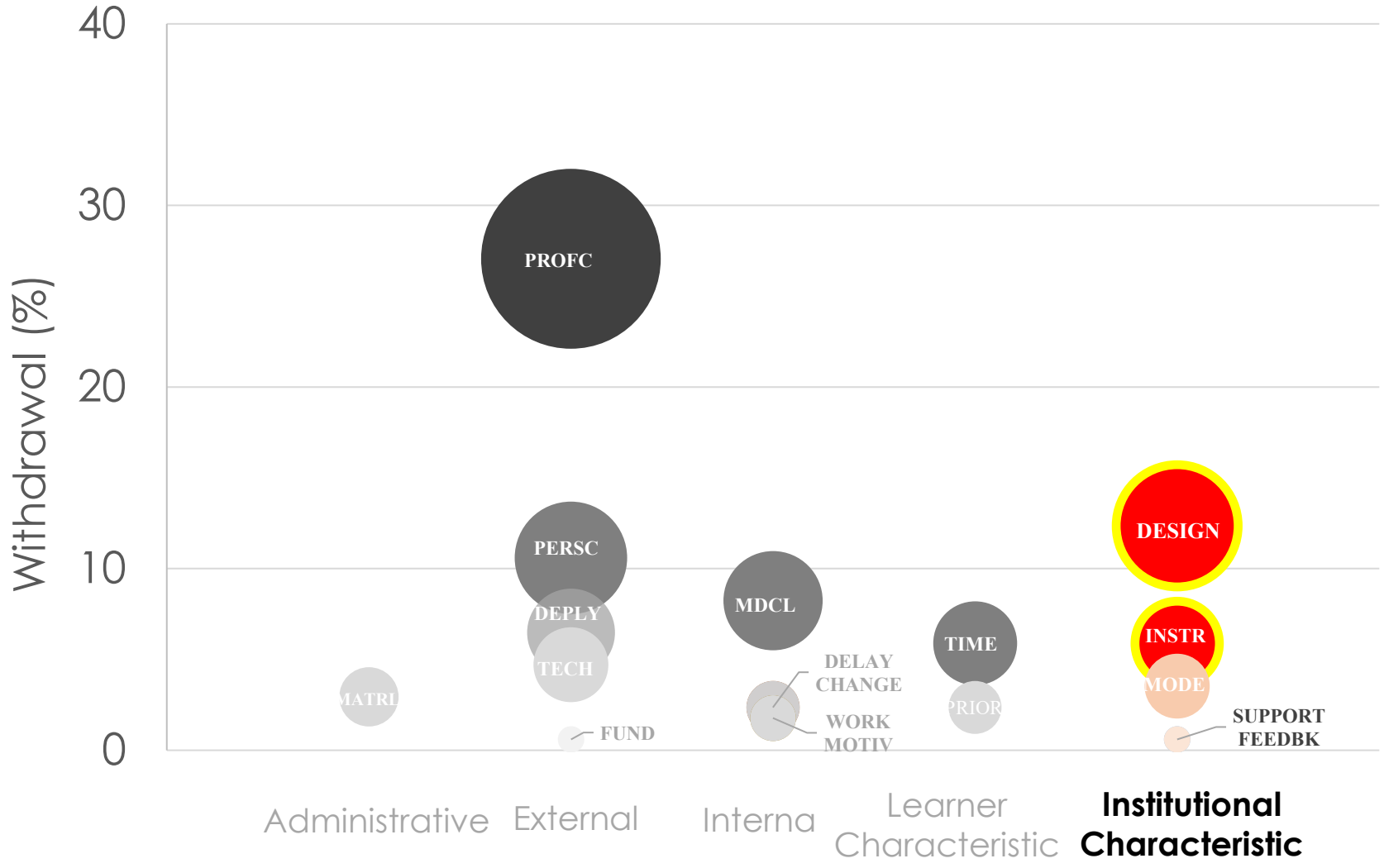
E. K. Faulconer
Embry-Riddle Aeronautical University, faulcone@erau.edu

"As long as you stay away from science, you should do OK"

Humanizing Online STEMM Education

Emily Faulconer, Ph.D.
Embry-Riddle Aeronautical University
Worldwide Campus

The instructor and course design can make a difference in online STEM course persistence.



Students want to see themselves in the curriculum and learning environment.

How to foster the formation of STEM identity: studying diversity in an authentic learning environment. https://doi.org/10.1186/s40594-020-00254-z

- Students **notice diversity** in the curriculum
- Students **intertwine** their **gender and ethnic identities** with **STEM identity**
- Attention to diversity and inclusion can **build positive STEM identities**

Engaging in science practices in classrooms predicts increases in undergraduates' STEM motivation, identity, and achievement. https://doi.org/10.1002/tea.21623

- Recognition as a scientist and positive classroom climate related to learning outcomes for underrepresented minority students

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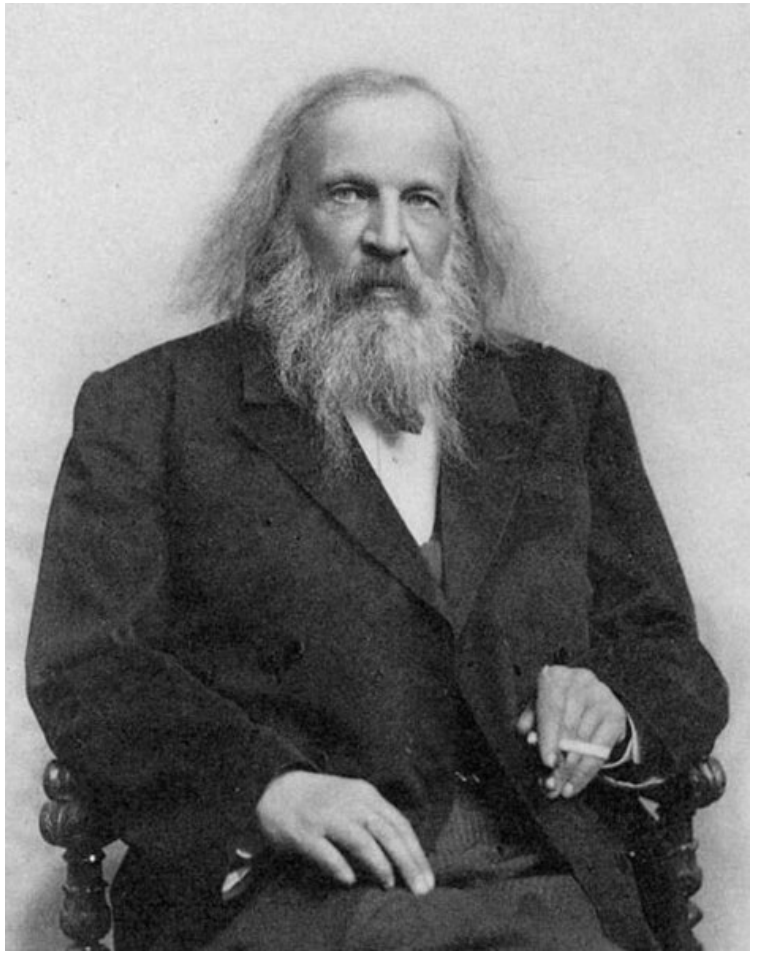
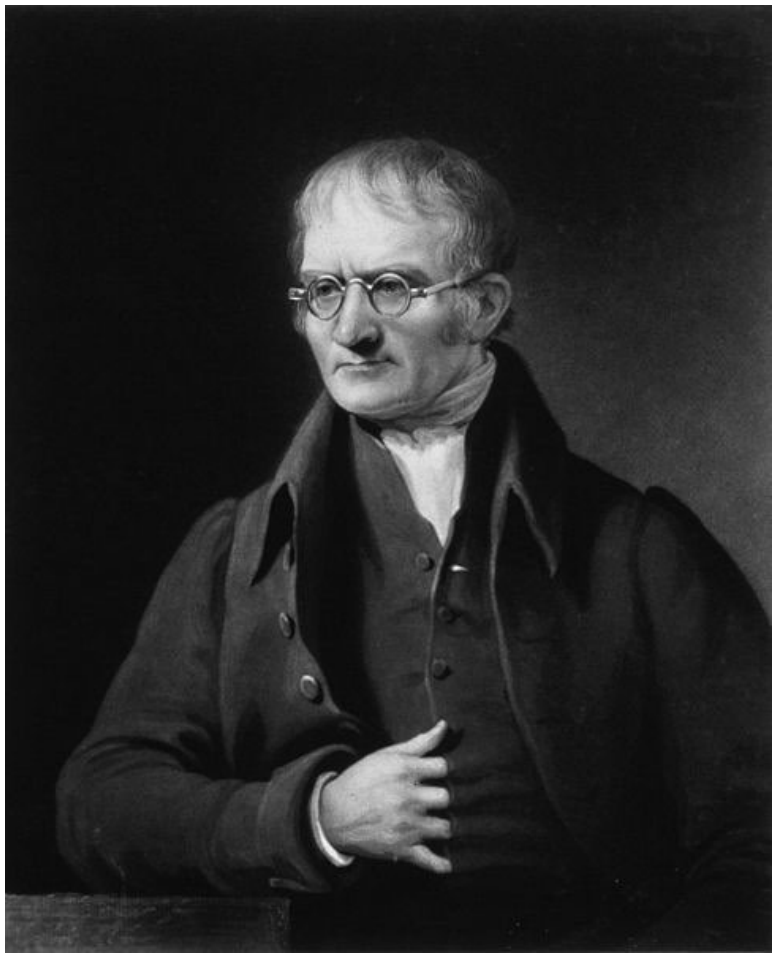
Many introductory science courses focus predominantly on western male contributions.

Neils Bohr, 1922



Dmitri Mendeleev, 1897



John Dalton, 1834

Culturally responsive teaching empowers students by embracing diversity.

1) Validating students' pre-existing knowledge
2) Providing comprehensive and multi-dimensional learning opportunities
3) Transforming student learning with high-quality peer and instructor interactions
4) Empowering students through leadership opportunities

I highlight the impacts of science as a global endeavor, emphasizing collaboration.

Consider: How do accuracy and precision impact the success and safety of space operations?

- What are the key considerations that the **team of scientists and engineers** must address to ensure accurate and precise measurements in the context of space missions?
- How might the responsibility of accurate and precise measurements **be approached by the team**, considering the team may be globally distributed?

I add global context to understanding the impacts of chemistry advancements.

Consider: How do the unique chemical and physical properties of aluminum, shaped by its electron configuration, position it as a pivotal resource for the **sustainable future of aviation**?

Think about the global implications, which could include environmental impact, technological advancement, international collaboration, economics, safety & reliability, policy landscape, societal impact, supply chain, energy efficiency, and more.

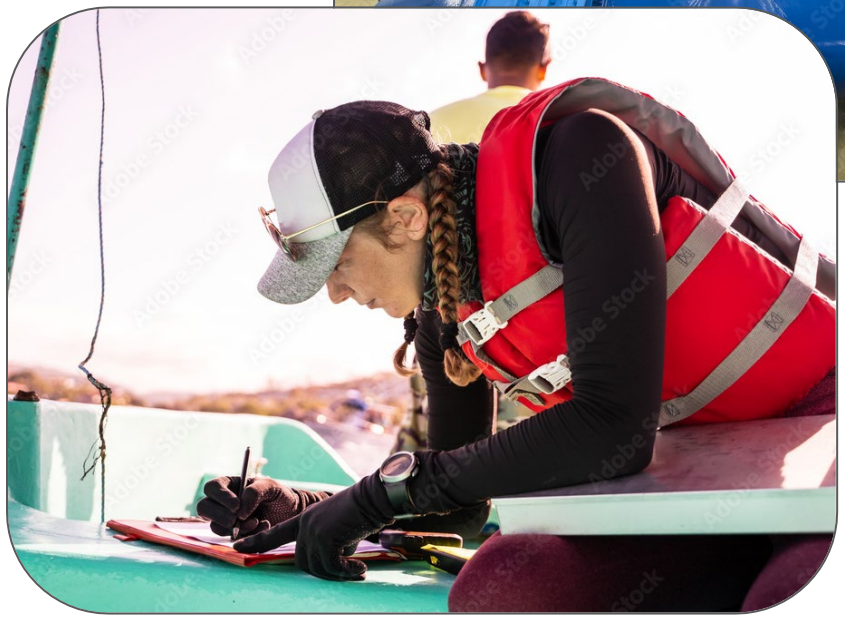
I present diverse science histories.

The journey from Democritus' "atomos" and **Kanada's "paramanu"** and beyond serves as a fascinating backdrop to our modern understanding of atomic bonding and the importance of molecular structure on properties.

I showcase STEM role models from different backgrounds and cultures.

While at first glance it may not be obvious, but solution chemistry and redox chemistry are foundational to major issues we face globally (with local implications): changing ocean chemistry, large-scale batteries for energy storage, and supplying potable water.

Consider: **Who is a champion addressing one of these issues** related to redox chemistry and/or solution chemistry?



I encourage reflection on the ethics of applying science in a global society.

The works of American inventor Thomas Midgley Jr., killed millions around the world – and could have potentially eliminated much of life on Earth. **Were the consequences unintended or were they unanticipated?**

In 1921, Midgley invented leaded gas. While Midgley did not *intend* to cause millions of premature deaths through the increased the rate of heart disease, stroke, and cancer from atmospheric lead exposure, he surely should have *anticipated* this consequence since the negative health effects of lead were known. General Motors called the substance "Ethyl" to avoid mentioning lead at all. To tout its safety, he washed his hands with the substance and inhaled its vapors in front of crowds. Unsurprisingly, he developed lead poisoning.

Midgley's second great invention, though, CFC refrigerants, is a different story. Their impact on Earth's ozone layer was unknowable based on the understanding of atmospheric chemistry at the time and thus the millions of premature deaths globally due to skin cancer were both *unintended* and *unanticipated*.

I give students a voice.

Consider: How would you respond to learning about one of the following?

- A nearby mountain is being excavated and prepared as a repository for deep geological disposal of nuclear waste.
- A new facility is being built in the industrial center of your town for transmutation of radioactive medical wastes.
- The nearby rocket launch site is being prepared for a special nuclear payload for space disposal.
- Your local power plant is breaking ground on a new recycling facility that will extract useful material from spent nuclear fuel to use in nuclear reactors and reduce the volume of radioactive waste.

This is an active area of research for me.

Instrument developed from Laird (which focused on faculty perspectives rather than student perspectives)

Laird, T.F.N. (2011) Measuring the Diversity Inclusivity of College Courses https://doi.org/10.1007/s11162-010-9210-3

Science is competitive, aggressive, demanding.

It is also imaginative, inspiring, uplifting.