Teaching Nuclear Energy: The Challenges of Interdisciplinarity in the Classroom

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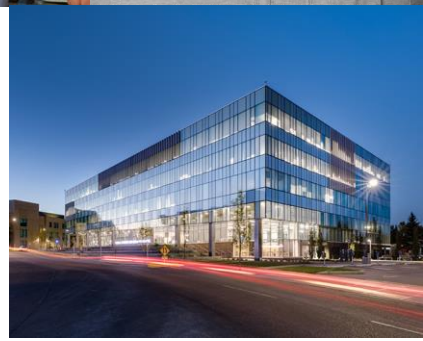
Imagining the Possible

Is it possible to teach
an undergraduate non-majors course
across the disciplinary divide in
nuclear and social science?

Context



- CHEM 3802
  - Team taught by Chemistry and Policy Studies
  - Run annually since Winter 2011
- Purpose
  - Students develop their position on nuclear energy, informed by both the science and the politics of the field
  - United Nations Sustainable Development Goals[1]
  - Systems thinking[2]

1) https://www.un.org/sustainabledevelopment/

2) ORGILL, YORK, and MACKELLAR, "Introduction to Systems Thinking for the Chemistry Education Community," *Journal of Chemical Education* (2019).

Science and Politics

- Audience is non-majors

- Time distribution:
  - Nuclear Chem: 6 weeks
    - Radiation, nuclear reactions, decay kinetics, detection equipment, worker safety, reactor design vs. weapons, science of disasters
  - Politics/Policy: 6 weeks
    - History, reactors in Canada, exports and trade, actors, security, safety, cost, public policy response to disasters
  - Shared: 3 weeks
    - Medical isotopes and other application of nuclear technology

Methodology and Data Sources

- Mixed-methods[3] study
- Qualitative:
  - Autoethnography[4] and Content Analysis
- Quantitative:
  - demographic statistics
  - anonymous online questionnaire for students
  - examination performance data

3) JICK, "Mixing qualitative and quantitative methods: Triangulation in action," *Administrative science quarterly* 24, 4 (1979), 602-611

4) ELLIS and BOCHNER, "Autoethnography, personal narrative, reflexivity: Researcher as subject," *Historical Social Research*, 36, 4 (2011), 273-290.

Population

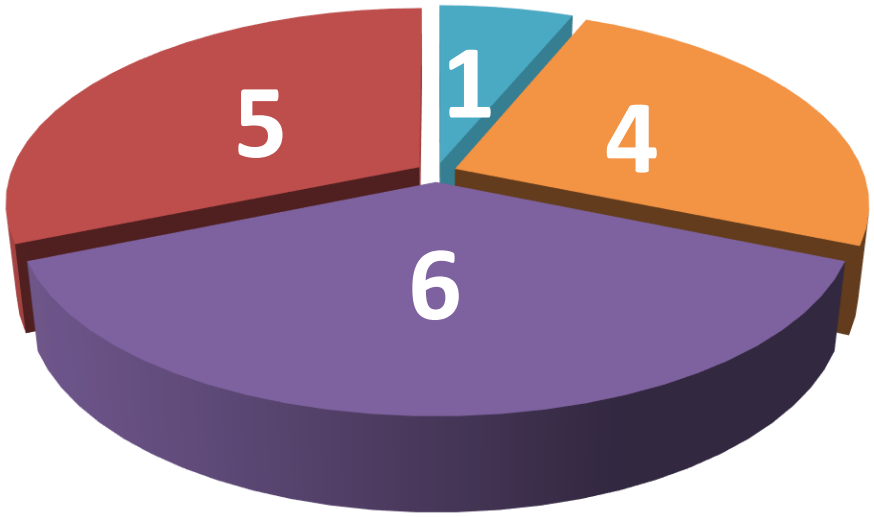
	2011	2012-2013	2017-2018
# of Students Registered	6	54	53
# of Students Who Completed	5	52	51
Faculty of Science and Technology	1	47	42
Faculty of Arts	-	3	4
Faculty of Business	2	2	7
Other	2	-	-

Motivations

Reason	Number of Comments (2012)	Number of Comments (2018)
Interest in nuclear energy	11	15
Chemistry minor	7	-
General Education requirements	4	7
Broaden my knowledge	1	-
My girlfriend was taking it	1	-
I know the professor	-	6

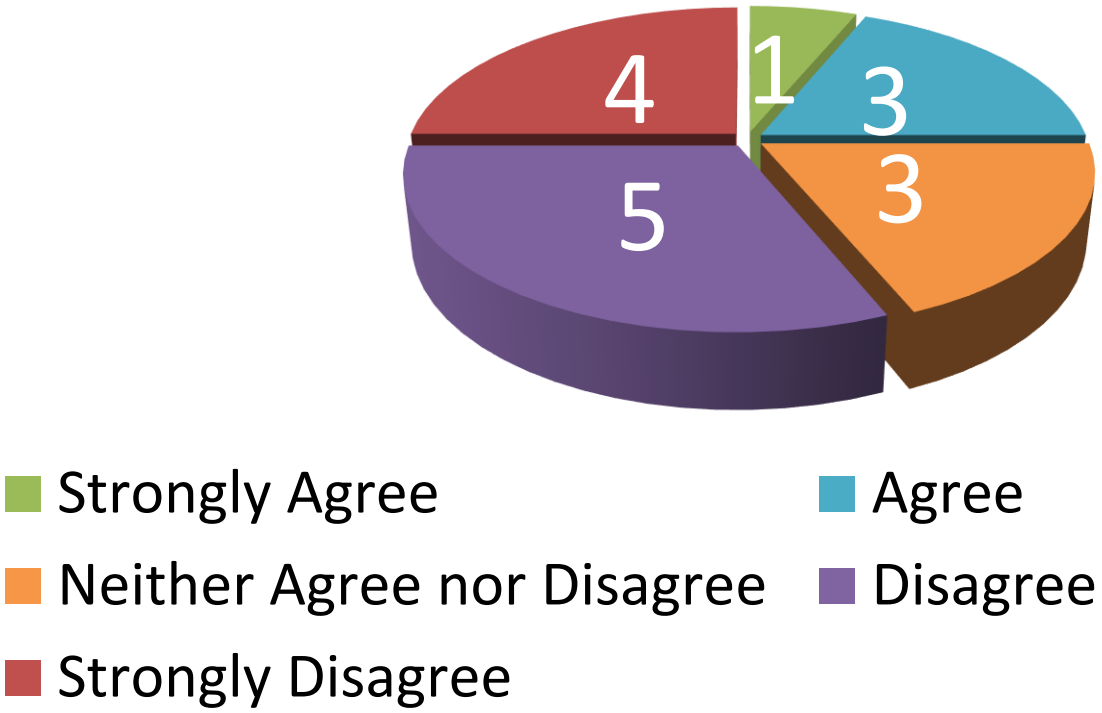
Student Survey

I knew a lot about nuclear energy prior to enrolling in CHEM 3802.



Student Survey

The Fukushima-Daiichi nuclear accident made me more concerned about nuclear energy.



Challenges

- Location of MRU
- Characteristics of MRU
- Student Fears
- Team-teaching

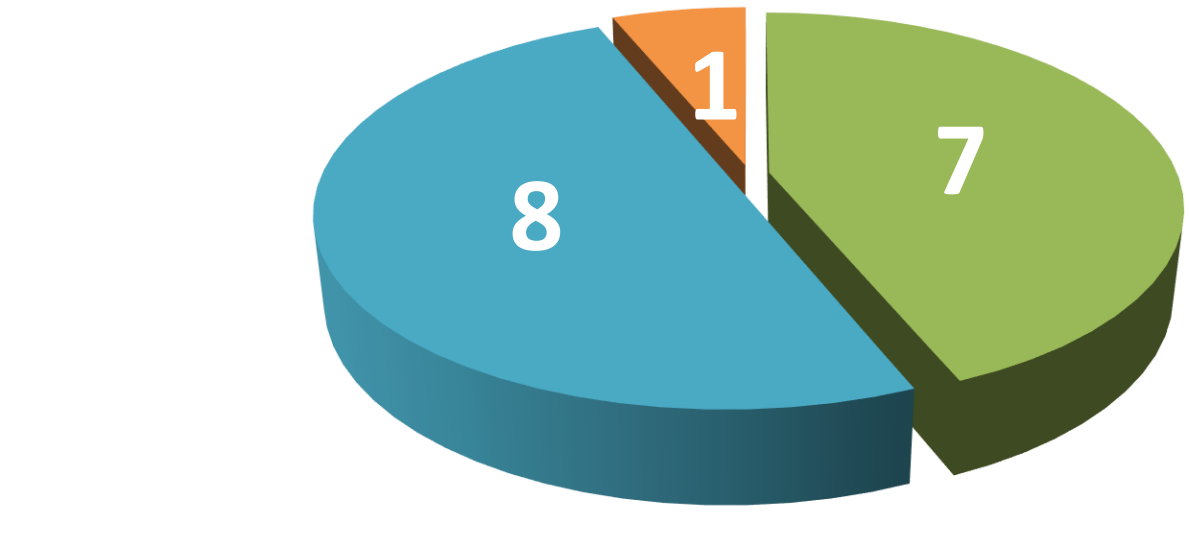
Benefits

- Students Enjoy the Class

- It is creating well-rounded citizens, not specialized workers for the nuclear industry

Student Survey

Nuclear energy is a safe and efficient form of electricity generation.



Evolving the Course

- Keeping the course current
  - Bratt's visit to Fukushima-Daiichi in 2017
  - Small Modular Reactors
  - Permanent nuclear waste site selection in Canada
  - Iran and North Korea
- Addressing concerns over term paper from science students
- Flipped classroom[5]

5) MCCOLLUM, et al, "Relationships in the Flipped Classroom," Canadian Journal for the Scholarship of Teaching and Learning 8, 3 (2017), n3.

Active Learning Classroom

Moving Forward

- Increase non-science enrolment
- Increase integration of topics?
- Science students' perception of politics

Suggestions for Developers

- Craft “wishlist” of topics then find commonality
- For common topics, decide if they will be taught from one approach, or if time should be doubled to teach from both points of view
- Fewer topics is better; time to fill in foundational gaps in either population

Suggestions for Developers

- Identify the importance and availability of learning materials
- Play to the strengths of the different disciplines
- Maximize group work, especially combining people from different discipline backgrounds
- Team-teach if possible

Realizing the Possible

"Brett you ruined my life. At the start of the course, I told you that I was anti-nuclear and there was no way you were going to change my mind. You said that you weren't going to try to change my mind, but that you would expect me to present my position supported by evidence. After looking at the evidence and learning everything, I changed my mind. I'm now pro-nuclear. But my family is still anti-nuclear, and now dinner time is never peaceful."

(Former Student)