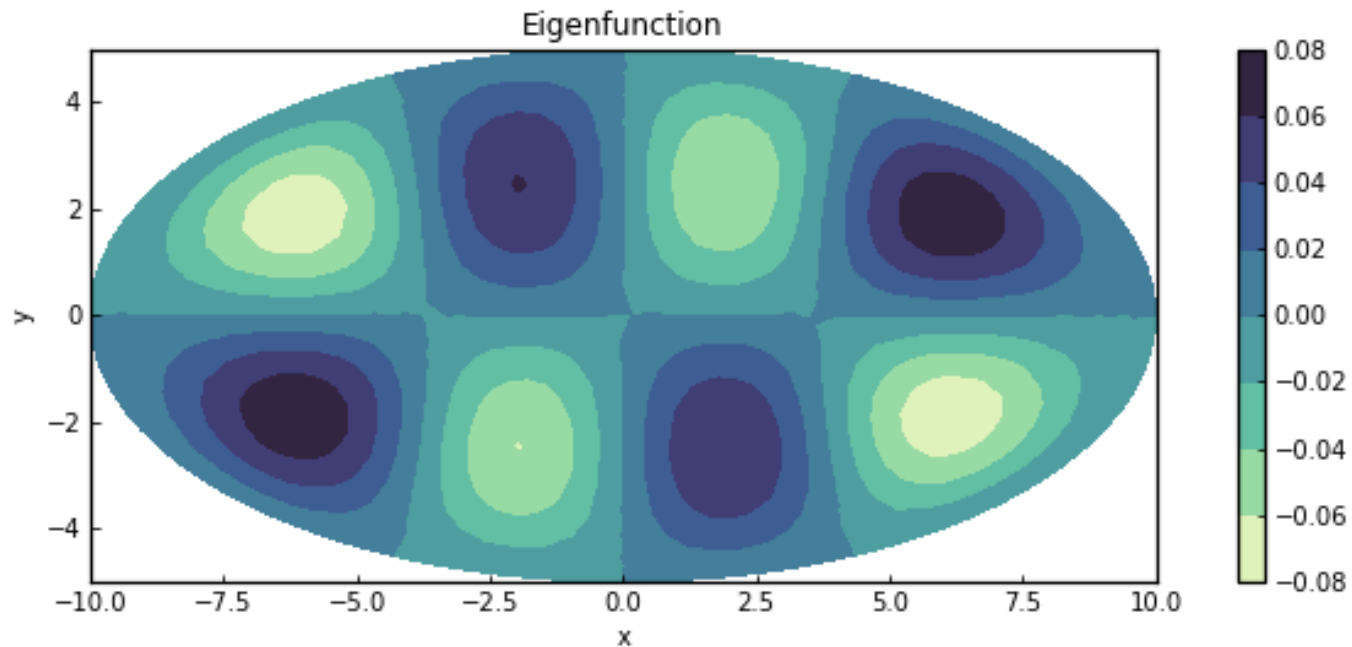


ELMS: Experiential Learning through Model Simulations



By Francis J. Poulin and Aaron M. Baier-Reinio

Outline

1. Mathematical Modelling
2. Experiential Learning
3. Learning Outcomes
4. Student Assessments
5. ELMS
6. ELMS Explorations
7. Survey

1. Mathematical Modelling

- Applications
 - Waves on a guitar string or drum membrane
 - Diffusion of dye in water
 - Waves in the oceans
- Math is the language of science and use PDEs
- AMATH 353: intro to PDEs (analytical tools)
- Research uses numerical solutions
- Can bridge the gap between these two

2. Experiential Learning (EL)

- I am learning through experience
- Hard to define but can include
 - Learning based on experiential events
 - Vocational learning
- Science has been doing labs, why not Math?
- David Kolb's EL Model
 - Concrete experience
 - Reflective observation
 - Abstract conceptualization
 - Active experimentation

3. Learning Outcomes

- Develop mathematical models using PDEs
- Determine what analytical method to use
- Apply analytical methods
- Model simulation of PDEs
- Physically interpret solutions
- Effectively communicate ideas using paragraphs, equations and figures

4. Student Assessments

- Assignments: 20% (two weeks to do)
- ELMS: 10% (two weeks to do, only 4)
- Midterm: 20%
- Final Exam: 50%

5. ELMS

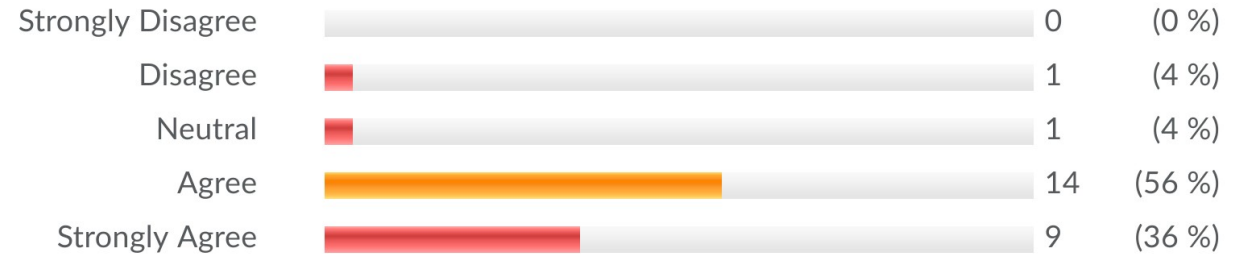
- Added a weekly tutorial (12 hours of fun!)
- Week 1: intro to writing
- Week 2: intro to LaTeX
- Week 3: intro to Python, Jupyter, Firedrake
- Weeks 4-5: ELMS 1
- Weeks 6-7: ELMS 2
- Weeks 8-9: ELMS 3
- Weeks 10-11: ELMS 4

6. ELMS Explorations

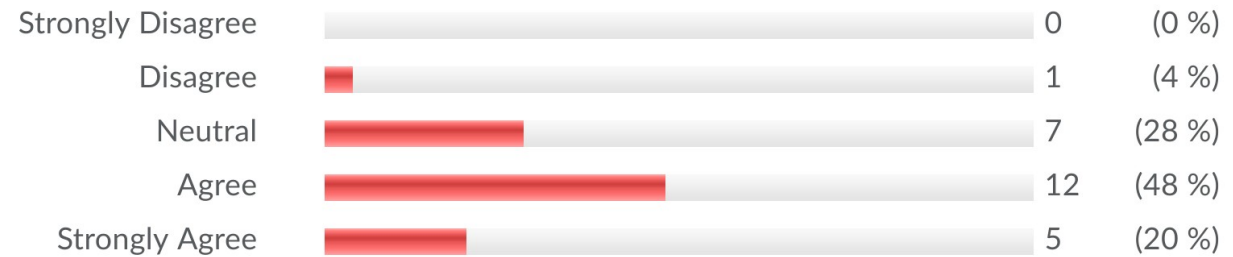
- Fancy name for a lab report (inspiring?)
- First was difficult since we had no reference
- I graded all then made a rubric
- grad TA's graded the remaining
- Gave basic questions to get them started
- 15% based on creativity to encourage them
- Worked in groups of 2 or 3 (max of 10 pages)

7. Survey

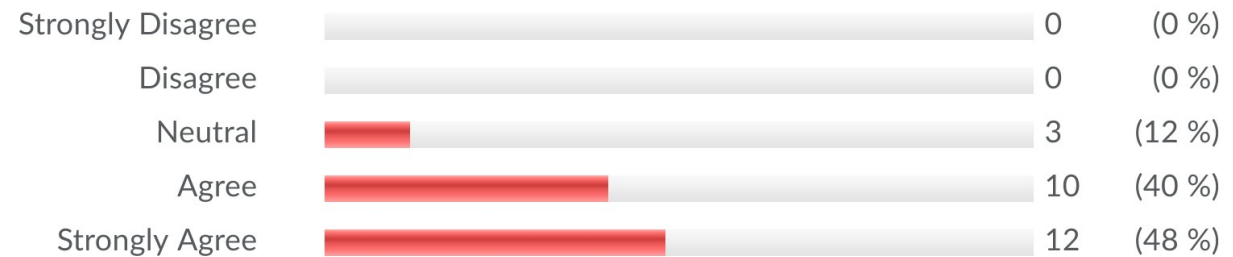
The ELMS component of the course gave me a greater appreciation for PDEs.



The ELMS component of the course contributed significantly to my learning.

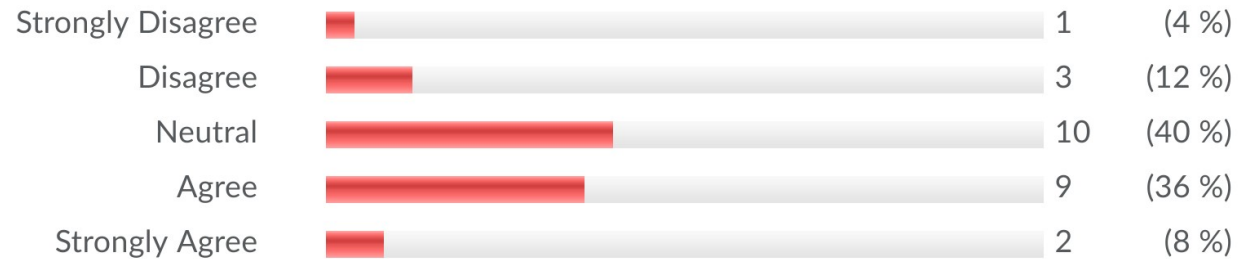


The ELMS component of the course helped me appreciate the importance of computing.

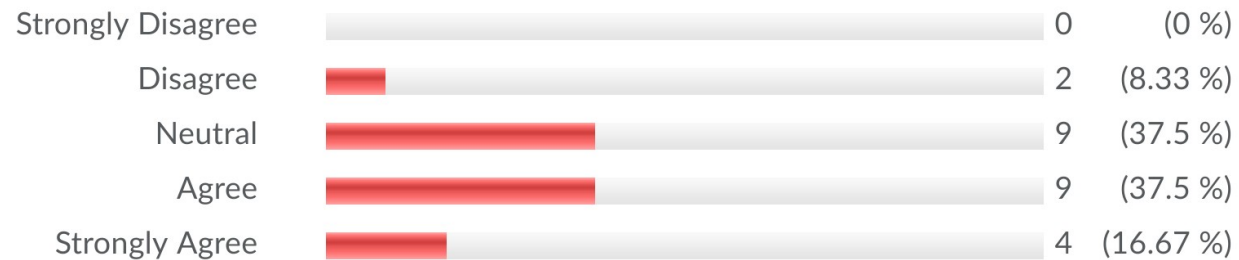


7. Survey

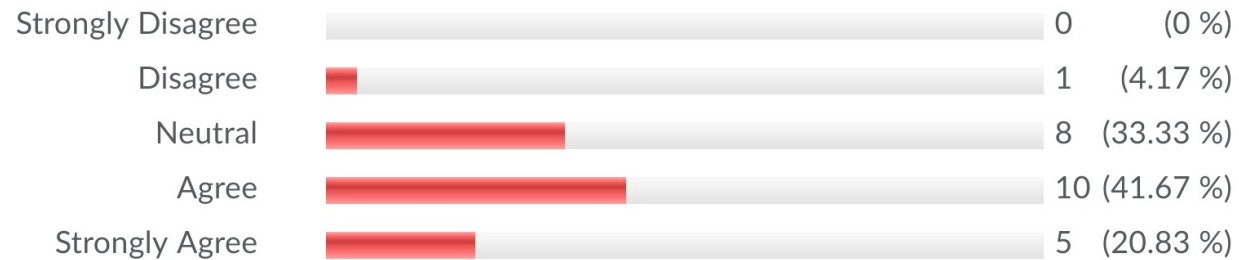
The first tutorial that gave us an introduction to Scientific Writing was helpful.



The second tutorial that gave us an introduction to LaTeX was helpful.

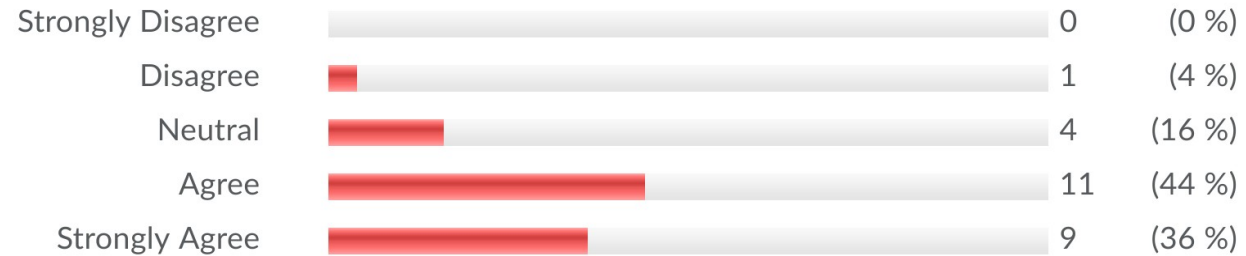


The third tutorial that gave us an introduction to Python and Firedrake was helpful.

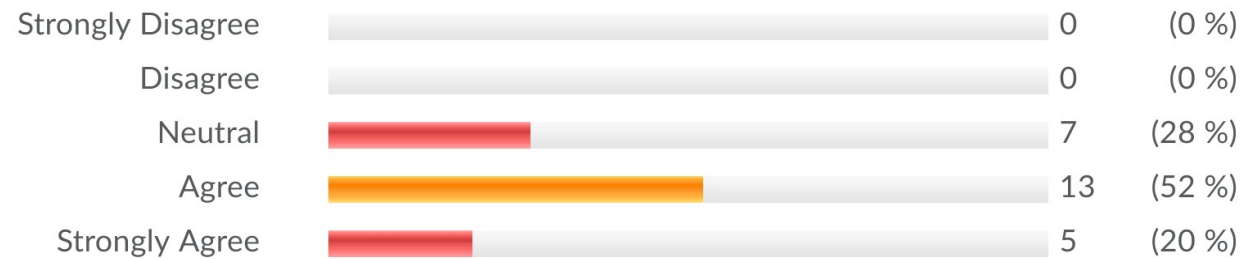


7. Survey

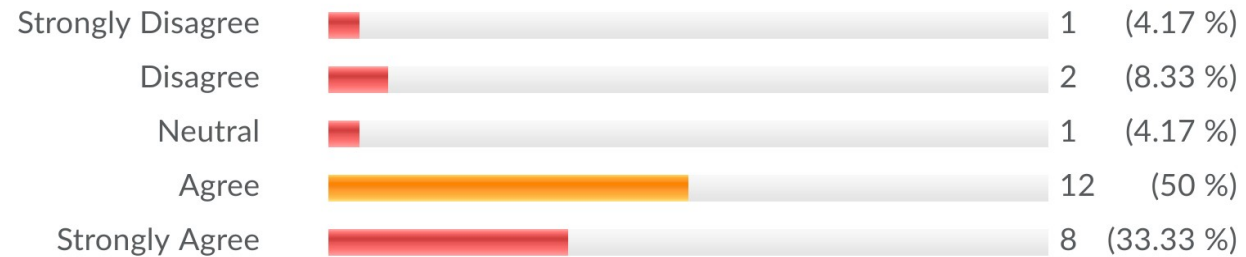
I received sufficient help in getting started using the ELMS software.



I received sufficient help in preparing the ELMS Exploration (lab report).

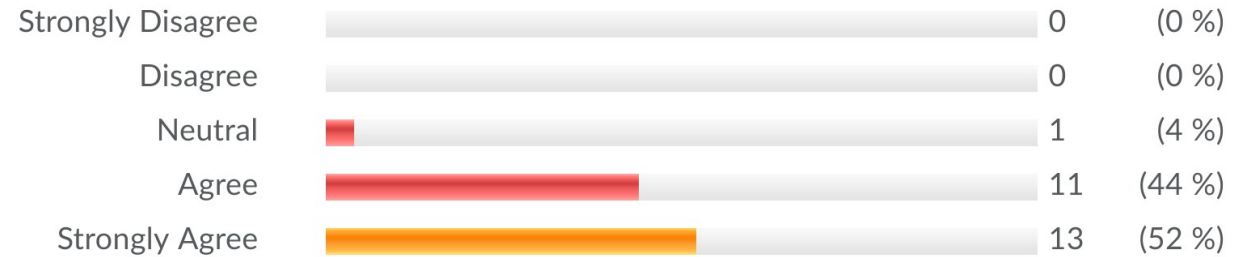


I received sufficient feedback in the marking of my ELMS Exploration (lab report).

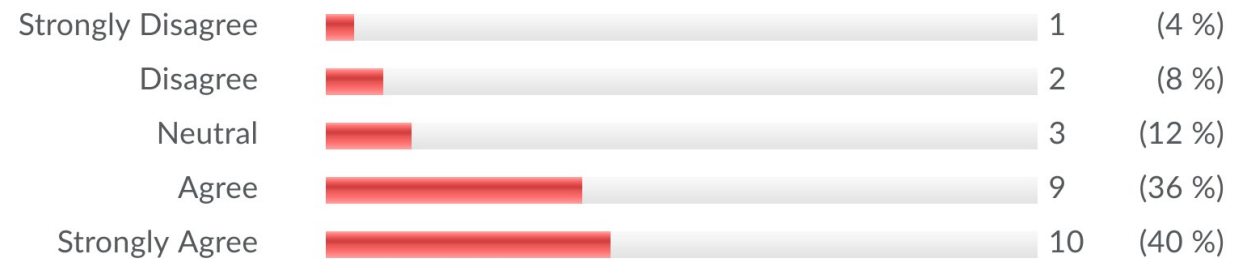


7. Survey

I would recommend this course to a peer in a similar program to mine.



ELMS-like components should be incorporated in more courses.



I valued having the lectures recorded and posted on Learn.



7. Survey

- Challenging parts of the course
 - ELMS took a lot of time
 - Hard to find a question to answer (exploring)
 - Coding
 - Working in a group
 - Writing

7. Survey

- Most appreciated about the course
 - Made a theoretical course hands on
 - Simulations will be an important part of my future
 - Helped visualize solutions easily
 - Appreciated creativity and connection to real-world
 - Brought course content to life
 - Because I am a visual thinker, this helped a lot
 - I learned a lot from simple trial and error

7. Survey

- What changes should we make to ELMS?
 - Scale down the project
 - No group work
 - More guidance and show an example
 - Explain code more
 - Fewer ELMS
 - More connections to reality

7. Survey

- Other thoughts to share
 - Fewer written assignments because of ELMS
 - ELMS are REALLY a step in the right direction for education (partly because of collaboration)
 - Jupyter notebooks can be improved
 - Write ups could help in job applications
 - I enjoyed the course more than I thought I would
 - Attended fewer lectures because they were filmed