Engaging in Pedagogical Development, Applied Scholarship, and Professional Service with SIMIODE

SIAM-ED 2018

Minisymposium on Modeling in Differential Equations Courses – SIMIODE Resources and Community

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George Fox University

July 9, 2018
Outline

1. Motivation
2. Improving Pedagogy
3. Applied Scholarship
4. Professional Service
Goals for Project-Learning Activities

1. Accountability
   - Track/grade individual contribution in posting and presenting

2. Communication
   - Oral presentations

3. Interdisciplinary
   - Applications require investigation beyond course topics

4. Data Integration
   - Generate/access data to analyze
   - Preprocessing
   - Error analysis with model solution

5. New Problems
   - New context, new format for problem statement
Motivation

Modeling-Focused Project Integration

1. Generate data motivated by reality to introduce project
2. Analyze data to develop model
3. Solve and evaluate model
4. Segue into topics motivated by the project
Example Project: 1st order equations

Simulating the Spread of the Common Cold

- Generate data with hands-on simulation
- Analyze data for patterns (DFIELD applet)
- Develop, analyze, and solve ODE models with parameters
- Estimate parameters and evaluate model
- Segue into topics motivated by the project
  - Separable method
  - Slope field and phase line
  - Numerical methods
Attributes of Project-Based Learning

1. Open-ended driving question
   1. Creates a need to know
   2. Inquiry to learn something new

2. Critical thinking, Collaboration, and Communication

3. Student voice and choice

4. Incorporates feedback and revision

5. Publicly presented
Evaluation through Feedback

- Likert scales encourage focused feedback: “Projects for this course...
  - (1) Added new perspectives on the content covered in homework”
  - (2) Helped me understand and engage with course concepts more fully”

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GFU SIMIODE Community
SIMIODE Community

- **User**
  - **Resources**: Modeling Scenarios, Technique Narratives, Online Texts, Sample Syllabus

- **Author**
  - **Standard Submissions**: News, Links to other resources
  - **Peer-reviewed Publications**: Modeling Scenarios, Technique Narratives

- **Promoter**
  - **Conference presentations**: See examples and share your own

- **Organizer**
  - **SCUDEM**: Local host, team coach
  - **SIMIODE Events**: Information on upcoming competitions, workshops, and conference sessions
Modeling-First Pedagogy

- **Resources**
  - Repositories, Journals, Databases

- **Training**
  - SIMIODE Workshops: DEMARC, MINDE, and at SCUDEM
  - Conference Minicourses: MathFest

- **Promotion**
  - SCUDEM
  - Conference sessions: SIAM-ED, MathFest, JMM, etc.
Resources for Projects

- Repositories
  - SIMIODE: Differential Equations ([www.simiode.org](http://www.simiode.org))
  - Project MOSAIC: Calculus ([mosaic-web.org](http://mosaic-web.org))

- Journals
  - CODEE journal: Differential Equations Teaching Resources
  - PRIMUS journal: General Math Teaching Resources
  - MAA Journals: Expository Mathematics and Teaching Resources

- Public Data
  - National Oceanic and Atmospheric Administration (NOAA): [www.noaa.gov](http://www.noaa.gov)
  - Bureau of Economic Analysis (BEA): [www.bea.gov](http://www.bea.gov)
  - World Health Organization (WHO): [www.who.int](http://www.who.int)
Project Implementation Best Practices

- Start small
  - One project in one class
  - Short class-wide project
- Minimize additional workload
  - Reduce evaluation/grading
  - Model group work
  - Course management system
  - Use technology on hand
- Reinforce project purpose
  - Continuity between project and course content
  - Fair division of group work
Example Course Structure

MATH 311: Differential Equations with Linear Algebra (75 minutes, 3 days)

Three 2-Week Projects

- Groups assigned with some choice
- Open-ended problems/problem choice
- Write-up: Series of linked wiki pages
  - Describe the phenomena modeled
  - Derive the model system (assumptions, variables, and initial conditions)
  - Analyze model and solution
- Short oral report in class recorded as a screencast
SIMIODE NSF-Funded Workshops

www.simiode.org/nsfdevworkshop

Next deadline: May 1, 2019

- DEMARC: Differential Equations Model And Resource Creators
  - July 14-20, 2019 at George Fox University in Newberg, OR
- MINDE: Model INstructors in Differential Equations
  - July 20-26, 2019 at George Fox University in Newberg, OR
DEMARC Workshop Overview

A challenging, invigorating, supportive, and innovative faculty development opportunity to create new curricular materials that enhance the teaching and learning of undergraduate differential equations in a modeling-first approach.

- NSF-funded transportation, room and board, and stipend
- Expectations:
  - Create application modules for publication in SIMIODE
  - Serve SIMIODE community as referree
- Training:
  - Personal strategic planning
  - User-driven development
- Collaboration:
  - Activity testing
  - Peer review
Extract Activities from Research

- SIMIODE Modeling Scenarios
- SIMIODE Technique Narratives
- Personal example:


Spur Research with Students

- Involve in open-ended class projects
- Introduce to mathematical research
- Encourage research grant applications
- Personal example:

Improve Pedagogy

- SOTL: Scholarship Of Teaching and Learning
- Personal example:


Professional Service

- Review
  - SIMIODE referee
  - Publication user

- Share
  - Departmental discussions
  - Conference talk

- Host & Organize
  - SCUDEM local host or team coach
  - Organize a conference session

- Train
  - Organize a workshop
Student Competition Using Differential Equations Modeling

*After eight days with a problem, three-member teams of high school/college students present a 2-page executive summary and 10-minute talk on a Saturday at a nearby regional host site.*

Next Competition: SCUDEM III: October 27, 2018
SCUDEM Host Training: MathFest & JMM

(Currently seeking local host sites to add to those shown below)
Thank You

SIMIODE community provides opportunities to **improve your teaching, apply your scholarship, and engage in meaningful service** to the greater mathematical community.

