Teaching Statement

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I started teaching mathematics as an instructor during Winter 2012 as a graduate student at the University of Delaware. Since then, I have taught multiple courses at the University of Georgia and the University of Zimbabwe, including the calculus sequence, ordinary and partial differential equations, and numerical analysis. I am currently supervising five senior thesis projects on topics ranging from financial mathematics, finite element methods, and applied optimization. I have interacted with a diverse range of students in the United States and Zimbabwe, from first year business students taking mathematics to fulfill a quantitative requirement, to graduate students taking a course in my research area of numerical analysis. Through teaching, I have developed the following ideas.

1. Understanding student backgrounds

When I am assigned to teach a course, especially when I am teaching it for the first time, I first reflect about the background of my students. What are the required prerequisite courses? Are they taking the course to satisfy a quantitative requirement for their major? What are most of the students majoring in? These questions help me to select appropriate course content, readings, books, and teaching approaches. Mathematics is a cumulative subject, where mastery of a topic is a requirement for understanding the next topic. This hierarchical structure is usually an impediment for beginning calculus students who may struggle with basic algebra and precalculus. To measure my students' level of preparation for calculus, I give them an assessment quiz on the first day of the course to measure algebra and precalculus skills. Often students pass this quiz, but I suggest additional practice to those facing challenges.

2. Classroom engagement

Choosing relevant examples

Many students become disengaged from learning mathematics because they regard it as irrelevant or tangential to their true interests. I was once asked by a second year engineering mathematics student during a class on Fourier series: *"I understand how to compute Fourier series, but why should I learn it?"* I explained that sines and cosines can be used to approximate other functions, even discontinuous ones. By their looks, I could see this response was unsatisfactory, until I mentioned about the applications of Fourier series in electrical engineering, signal processing, and acoustics.

To maintain student engagement, it is important to supplement mathematical ideas with relevant examples. When I taught partial differential equations to a group of Mathematical Finance majors, I included the Black Scholes PDE as an example of a parabolic equation. The prototypical example of a parabolic equation is the heat equation, but many students thought they didn't need to learn about the heat equation because it is relevant for science and engineering only. To dispel this myth, I included an example where the Black Scholes equation was first transformed into the heat equation to solve it. I believe it is important to demonstrate the unity of mathematics and applicability of the same mathematical ideas to a wide range of problems.

Instructor enthusiasm

To keep students engaged, I maintain a positive attitude towards teaching mathematics and transmit this enthusiasm to my students. One student commented: *"Dr. Kapita's class was an absolute pleasure. I honestly looked forward to coming to class each and everyday. He is willing to go the extra mile in order to ensure student success, and he truly cares for us. His class made math a very interestic and fun topic. Over all, an exemplary instructor."*

Clear guidelines

When I prepare the course syllabus, I am clear about the scope and schedule of assignments, readings and activities, important dates, grading criteria, and rules concerning absences and make-up tests. I have observed that students who are aggrieved or worried about grades become disengaged from learning. As a result, I provide practice tests and solutions to reduce anxiety before mid-terms, and I promptly return any graded assignments.

"I think that my teacher did a very good job introducing and teaching the mathematical concepts we learned this semester. Also, he was always prompt with providing us feedback/grades, which I greatly appreciated."

4. Technology in teaching

I did not fully appreciate the importance of technology in teaching and learning until I was assigned to teach MTE 201 (Engineering Mathematics) with over 380 students at the University of Zimbabwe. Due to a scarcity of TAs at the institution, I was solely responsible for the instruction. Because of the large number of students, it was impossible for me to hold regular office hours or conduct individual tutoring. For the most part, the class communicated using the mobile app WhatsApp. This allowed me to communicate with the class almost instantaneously. To keep the course content organized, I created a course website using HTML and CSS to host course documents such as assignments, detailed solutions, guidance on exam topics, and lists of important formulae. Since then, I maintain a live syllabus for each of my courses online with daily details about topics, due dates and readings. This is very useful in managing classes, especially very large ones. I am now experimenting with using Sphinx, a software documentation tool, to produce interactive online lecture notes, assignments, and syllabi using Jupyter notebooks and KaTeX, a web-based alternative to LaTeX.

Another instance where I use my programming skills is to create visualizations. I believe that a relevant picture is oftentimes worth more than a rigorous proof when teaching mathematics. As a result, I write computer animations to demonstrate some key concepts visually. For example, I wrote a program in Python for MTE201 to demonstrate graphically the convergence of Fourier series for different types of functions.
(https://github.com/shelvean/fourier/blob/main/demo_Fourier.py)

5. Teaching Numerical Analysis

Teaching numerical analysis presents a unique set of challenges compared with other math courses. This is because numerical analysis draws from the fields of computer science, mathematics, and applied sciences. The challenge is to balance computer programming, mathematical analysis, and meaningful applications.

A major challenge is that many students taking a first course in numerical analysis haven't learned how to program. At the University of Georgia, this was resolved by requiring students to take at least one course in computer science prior to or concurrently with the course.

Another challenge is the choice of programming language. In my case, I am faced with choosing between MATLAB, Python, and Octave. The competing demands include cost, ease of learning, availability of numeric libraries, and free cloud support. An instructor must balance the time it will take to learn a programming language against the time spent learning numerical methods. MATLAB and Octave are easier to learn compared with Python because Python requires addition of external libraries such as `numpy, scipy` and `matplotlib`. Another challenge faced by beginning students in learning Python is the different treatment of numeric types such as integers, decimals, vectors, and matrices which are handled by MATLAB/Octave relatively uniformly. MATLAB requires a license that costs money. Python and Octave are free and open source. Python is more popular than Octave and used widely in scientific computing and data science. As a result, I prefer to teach using MATLAB when the license is freely available to students, and Python otherwise.

Teaching Experience

University of Zimbabwe, Harare, Zimbabwe

Lecturer

- Semester 2 2022, November/December. MTSCSC546 (**Numerical Methods for Partial Differential Equations**) - 10 students.
  Graduate level course for the M.Sc. in Computational Science and Mathematical Modelling.
- Semester 2 2022, September/October. HMTH407/HFM307 (**Partial Differential Equations 1**) - 48 students.
  Third and fourth year course for the B.Sc. Hons in Mathematics and Computational Science and B.Sc. Hons in Financial Mathematics.
- Semester 2 2022, August/September. MTE201 (**Engineering Mathematics 201**) - 381 students.
  Second year mathematics course required by all the engineering B.Sc. programmes.

  Topics: ordinary differential equations, Fourier methods for partial differential equations, vector calculus, engineering statistics.
- Semester 1 2022, June/July. HMTHCS212/HFM213 (**Numerical Methods**) - 70 students.
  Second year course for the B.Sc. Hons in Mathematics and Computational Science and B.Sc. Hons in Financial Mathematics.
- I am currently supervising the honors projects of 5 undergraduates on topics ranging from financial mathematics, applied optimization, and numerical methods for PDEs.

University of Georgia, Athens GA, United States

Instructor

- Spring 2019. MATH4500/MATH6500 (**Numerical Analysis 1**) - 24 students.
  Fourth year undergraduate and first year graduate level first course on numerical methods.
- Spring 2019. MATH2700 (**Elementary Differential Equations**) - 41 students.
  Second year undergraduate course for engineering and science majors.
- Fall 2019, Fall 2018, Spring 2018, Fall 2017. MATH2250 (**Calculus I for Science and Engineering**) - 2 sections of 19 students per section.
  First year course required for mathematics, science and engineering majors.
- Fall 2017. MATH1113 (**PreCalculus**) - 19 students.
  First year mathematics course for non-science majors.

University of Delaware, Newark DE, United States

Instructor

- Winter 2015. MATH243 (**Analytic Geometry and Calculus C**) - 35 students.
  Second year course for science and engineering majors.
- Winters 2012, 2013, 2014. MATH221 (**Calculus I for Business and Economics**) - 35 students per section.
  First year course for business programmes.