Teaching Statement

Kathryn D. Huff (katyhuff@gmail.com)

Five years of experience teaching diverse groups of students as well as a proven drive for designing creative, relevant curriculum have equipped me with an example-driven teaching philosophy and interactive teaching style. Many years as an academic liaison in the national laboratory system have also afforded me an overview of the national nuclear engineering research landscape that will be essential to advising students in their research.

Teaching Experience

Throughout my graduate career, I created my own opportunities to teach scientific computing skills and best practices. This was driven by my recognition of an unmet need for software development training in nuclear engineering. Scientific research (nuclear engineering research in particular) increasingly relies on advanced computer models, simulations, and data manipulation. However, students in science and engineering typically lack formal training in the software skills with which to conduct that work effectively[1, 2, 3].

To address that need, I helped to establish and lead a student organization at the University of Wisconsin called The Hacker Within (THW). With THW and a similar scientific computing organization, Software Carpentry, I have designed and taught curriculum for twelve workshops (two more upcoming) and two classrooms to a total of approximately six hundred students. The workshops varied from two to ten hours per day and from two days to two weeks in length, addressing topics such as the UNIX Shell, version control, databases, Python, C++, unit testing, and mathematical, scientific, and plotting libraries. During this time, I had the opportunity to teach very heterogeneous groups of students. Typical workshop demographics included students at the undergraduate, graduate, and faculty level and traversed disciplines from physics to limnology [4].

These workshops were peer-led short courses providing introductions to best practices in scientific computing and sought to provide time efficient introductions to essential programming languages and tools.

In the Boot Camps, conceptual explanations a few minutes in length preceded similarly short problem solving sprints. During these sprints, both I and my students actively engaged the task. This requires that each student be seated at a computer and ready to actively participate. Based on feedback elicited from each of the Boot Camps and experimentation with various instruction styles, THW converged on the observation that exercise-driven lectures most effectively condense skill oriented material. Lecture videos, notes, and example exercises were also made freely available online to serve as reference material after the course concluded. Details about that process and the need for a computational skill set for nuclear engineering can be found in reference [4].

Teaching Philosophy

My teaching philosophy has evolved based on experimentation with instructional design and teaching style. This evolution was primarily informed by feedback data from those five years bringing scientific computation skills to nuclear engineering classrooms and interdisciplinary workshops [4]. It has come to emphasize dynamic student engagement as well as example-driven, adaptable curriculum. I came to appreciate this philosophy under the notion that engineering instruction should provide students with something on the order of Samuel Johnson's two types of knowledge, "Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it [5]."

It was with this teaching paradigm in hand that I arrived at the interactive teaching style used in the Boot Camps in which, rather than lengthy soliloquy, a tool is described in brief and then immediately employed in a short exercise. In this paradigm, I convey knowledge of the first kind with hands on exercises and an interactive lecture style. At the conclusion of a course, a student with knowledge of the first kind will possess a comfort with identifying and implementing solution methods in preparation for calculating solutions in their work and research. As an instructor, I have found that dynamic, hands-on engagement provides knowledge of the first kind by providing experience with the solution tools and methods in a classroom environment where the support of the instructor is available and swift recall is valued.

Meanwhile, I convey knowledge of the second kind by introducing concepts in well-ordered manner. A student with knowledge of the second kind will leave a course in possession an organized mental map of concepts and ideas from the subject. This kind of knowledge prepares the student to link ideas and seek out appropriate references for specific details when faced with an application for which they lack the first kind of knowledge. In my experience, knowledge of the second kind can only be conveyed with instructional design that reflects the well organized concept map of the instructor. Well organized instructional design, in my experience, benefits greatly from example-driven lecture format, which provides invaluable motivation for linking concepts and categorizing ideas.

Finally, in the interest of keeping curriculum current, I have revisited and updated course material with a short half-life, resulting in relevant curriculum that remains applicable across disciplines. At a time when nuclear energy is at the forefront of worldwide public conversation, I understand that curriculum must flexibly adapt in accordance with technical advancements as well as social and political challenges. I also understand that a teaching institution with high standards of excellence must maintain an adaptable, relevant curriculum to remain at the forefront. I look forward to helping maintain an adaptable curriculum to match the dynamism of the domain and would enjoy driving constant advancement of curriculum at a university.

Teaching Interests

My teaching interests are diverse, including fundamental physics and nuclear engineering as well as computational methods, fuel cycle analysis, waste management, and nuclear energy policy and analysis. My physics and nuclear engineering background have prepared me to confidently teach a number of classes. New courses that I might bring to the department would build primarily upon my research and teaching experience.

My academic background in fundamental physics and nuclear engineering prepares me to teach fundamental nuclear engineering courses such as reactor theory and kinetics. Also, my previous experimental research experiences in accelerator and telescope physics have prepared me to teach a number of additional fundamental courses having to do with accelerator and detector physics. Similarly, my research in computational nuclear fuel cycle and repository analysis have amply prepared me to teach courses offered in nuclear fuel cycle analysis and nuclear waste disposal modeling. The highly computational nature of my current work, some graduate coursework in radiation transport methods, and my experience teaching scientific computation are a good foundation on which to instruct numerical modeling courses.

Finally, my research interests in the impacts of energy policy, as well as a suite of coursework in the Energy Analysis and Policy program at the University of Wisconsin as a graduate student have prepared me to teach courses related to nuclear energy policy, law, and economics.

In addition to supporting the department by teaching fundamental nuclear engineering courses, I am prepared to expand the curriculum in three primary areas of my expertise. These areas include computational methods for nuclear engineering, waste disposal modeling, and energy systems analysis in the context of nuclear energy.

A course on 'Computational Tools for Nuclear Engineering,' for example, could address the need for software devlopment training that has driven my teaching thus far, but would be tailored to a nuclear engineering skill set. Conducted in a computer laboratory, early exercises would motivate use of a suite of software development practices such as version control and unit testing while later exercises and coursework would focus on the use of scientific, mathematical, and plotting libraries common in nuclear engineering simulation and scientific data analysis.

I would be particularly delighted to suggest a pair of courses in the area of fuel cycle policy and analysis. The first, 'Fuel Cycle Modeling and Analysis,' could cover fuel cycle metrics development, and introduce computational modeling techniques for analyzing the impact of technology deployment and policy choices. I envision utilizing the Cyclus framework as a learning tool in this course and employing course exercises that drive toward a module development capstone project. In this capstone project students would synthesize the many lessons of the course toward development of a Cyclus module representative of nuclear technology of their choice.

Another class introducing 'Nuclear Energy Economics and Governance' could cover important economic considerations of nuclear energy as well as relative roles of public utility commissions on the local scale, the DOE and NRC on the national scale and the IAEA on the global scale.

Finally, a more advanced course on 'Computational Modeling of Environmental Impacts' might follow a basic course on waste management. Such a course could cover computational modeling methods for analyzing the environmental impact of used fuel storage and disposal, contaminants, and effluents from an array of nuclear power generation processes.

References

[1] Gillian Losh. The hacker within focuses on scientific computing. `http://www.news.wisc.edu/19236`, April 7 2011.

[2] J. E Hannay, C. MacLeod, J. Singer, H. P Langtangen, D. Pfahl, and G. Wilson. How do scientists develop and use scientific software? In *Proceedings of the 2009 ICSE Workshop on Software Engineering for Computational Science and Engineering*, pages 1–8, 2009.

[3] Prakash Prabhu, Thomas B. Jablin, Arun Raman, Yun Zhang, Jialu Huang, Hanjun Kim, Nick P. Johnson, Feng Liu, Soumyadeep Ghosh, Stephen Beard, Taewook Oh, Matthew Zoufaly, David Walker, and David I. August. A survey of the practice of computational science. In *State of the Practice Reports*, SC '11, pages 19:1–19:12, New York, NY, USA, 2011. ACM.

[4] K.D. Huff, A.M. Scopatz, N.D. Preston, and P.P.H. Wilson. Rapid peer education of a computational nuclear engineering skill suite. In *Proceedings of the 2011 American Nuclear Society Annual Conference*, pages 103–104, 2011.

[5] James Boswell Esq. *Life of Samuel Johnson, LL.D.*, volume 1. George Dearborn, 71 John Street, Corner of Gold, 1791. pp. 526.