Richard W. Nuckols - Teaching Statement

Teaching and advising are an integral part of being a faculty member. I have considerable experience in formal teaching for my career stage. During my graduate studies at UNC Chapel Hill and NC State, I worked as a teaching assistant for junior-level mechanics of materials and for sophomore and junior engineering design. The mechanics course involved a traditional environment of lecture and lab. I worked with the instructor to develop course content, gave content lectures, and created and instructed the laboratory course plan. The engineering design course was very different in that the majority of my role was to provide guidance and mentorship on mechanical and electrical design for sophomores and juniors. This course involved many of the tools and techniques found in MakerSpace-type environments. As a post-doc at Harvard University, I have served as a senior design capstone project mentor and have given several guest lectures related to neuromechanics and assistive devices.

As the future director of a research lab, I believe that mentoring and advising students and young researchers will be one of my most important roles. To a large extent, a research lab will only be as effective as the students and researchers that are working in it and I see it as my role to provide direction, instill good scientific practices, and support my students. Diversity of students will always be supported and promoted as this will improve perspectives, motivations, and ideas. I have experience in mentoring and advising high-school, undergraduate, graduate students and fellow post-docs in both formal and informal academic settings. In my research group at NC State, I provided direction to younger graduate students within my expertise in experimental design, data collection techniques, and electromechanical design in support of our group's collective work. In my current role as post-doctoral research associate, I am actively involved in mentoring and advising graduate students and other post-docs. More informally, during my time at Harvard I have taken a proactive role to promote interaction between faculty, graduate students, and other post-doctoral scholars in order to foster a culture that values interdisciplinary scientific inquiry and critical thinking. For example, I have coordinated a weekly meeting to discuss and disseminate internal projects/findings and relevant external literature across > 30 researchers. I also collaborate across labs at Harvard, Boston University and Spaulding Rehabilitation Network and in all our project team meetings, place high importance on collaboration, discussion, and asking questions.

These experiences during my PhD and post-doctoral education have shaped my strategies for effective mentoring and teaching. My students should feel confident that they have the strategies, skills, and knowledge to solve messy, ill-defined, real problems. Developing a knowledge base and an engineering toolkit is an important part of a student's curriculum. Equally important is the application of knowledge and learning by doing. Development of a critical thinking framework, often underappreciated, is important for maximizing the effectiveness of a student's education. My goal as an instructor and mentor is to teach the theory and provide an environment in which students develop the skills and strategies to apply that knowledge. As an extension of this philosophy, students should start becoming comfortable with extending their problem-solving skills and understanding of content past well defined problems. By giving the students a fundamental strategy for learning and critical thinking, students will be able to approach these problems and search out the resources needed to make educated and informed decisions. These principles apply as well to my role as a mentor in an academic lab. Academic work should teach problem solving and logical thought when applying the scientific method to generate and test hypotheses.

In addition to developing students' ability to solve problems in engineering, my courses will enable students to develop skills that are important for success as an engineer, academic, and person. Students will be able to develop resiliency and confidence in addressing ill-defined and difficult problems, interpret and critique basic and applied scientific work, think conceptually while incorporating diverse ideas, and communicate ideas both verbally and in writing. Additionally, students will need to interact professionally across disciplines and perspectives as the diversity of people, backgrounds, and ideas in the classroom is crucial to cultivating a vibrant and innovative learning environment. To this point, I will make a strong effort to ensure that my classes and teaching methods support and promote different perspectives and ideas.

To support my aim for developing students that can solve real problems, an undergraduate research experience can be a crucial step to continuing education and helping develop future scientists and engineers. The lab will be intentional about making science interesting and seeking undergraduates of under-represented populations that otherwise may not know about these opportunities or fields of study. Merging senior design projects within graduate research labs is one potential avenue for this process.

I am qualified to teach entry-level courses in engineering mechanics, dynamics, numerical methods, musculoskeletal biomechanics and motor control. I am also interested in developing upper-level undergraduate or graduate courses in biomechanics, biomechatronics, and rehabilitation engineering. The challenges of virtual courses recently faced by teachers and students require additional consideration. As part of my current role, I host and moderate weekly virtual biomechanics and controls meetings in which ~30 members of the lab share recent work and vibrant discussions. While I have never been required to teach virtually, I have been able to experiment with new tools such as collaborative whiteboards (e.g. Limnu) that have been recently employed to teach remote classes. The switch to virtual courses may also promote the use of flipped classrooms where students learn the material asynchronously and the live virtual class becomes a space for discussion and problem practice.

Some potential courses and brief descriptions of their content:

1. An undergraduate lecture-based course (potentially flipped classroom) that explores and applies mechanics principles to musculoskeletal biomechanics. Course content will cover a range of scales (whole-body energetics to muscle contraction mechanics) and fields of application (orthopedic, sports, rehabilitation) In a final project, student teams would be given a project for which they need to apply mechanics principles to develop a mathematical model and numerically simulate a movement task. Students will develop a written report and present orally on their project statement and solution.

2. An undergraduate/graduate level elective course that explores biomechanics and rehabilitation technology. Because this area is diverse and highly collaborative, students would come from life science and clinical programs (kinesiology, physiology, neuroscience, PT, OT) and from engineering programs (biomedical, mechanical, robotics, CS, and electrical engineering). The course could be structured with a design or research focus. When structured as a design course, students will engage with stakeholders (patients, clinicians) to identify problems and develop solutions with a culmination in a final design and presentation. An opportunity along this line is to have an emphasis on equity and inclusion such that the problem identification and solutions focus on problems that are not well served by society. For research focus, the class will focus on surveying classic and cutting-edge research around a relevant topic in the field that has unanswered or controversial questions. Groups of students will be given the opportunity to present each week and class discussion will revolve around reviewing and critiquing papers and developing independent hypotheses related to selected topics.

3. A graduate level course in neuromechanics, robotics, and human-robot interaction. Students will study the mechanics, energetics, and control of human locomotion, the design and control for robotic locomotion (bipedal and wearable), and the two-way interaction between the human and robot. Topics would include actuators (muscles vs. electrical or pneumatic actuators), sensors and transducers, and control (bioderived, Human-in-the-Loop, feedback/feedforward). The course would offer opportunity to compare artificial and biological systems and cover bioinspired systems. The course will also cover the potential use of technologies for gaining insight into fundamental principles of locomotion physiology.