Teaching Statement

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Summary

I believe the key "ingredients" to successful teaching are the ability to communicate and inspire students. However, course materials in electrical engineering are often abstract in nature. This stems from **the excessive use of mathematical equations to explain complex theories, and is alienating to the younger generation of students**, i.e. the Generation Z. To gain effective knowledge transfer skills, I attended several workshops offered by the Teaching Learning Laboratory, and audited three courses while I was a Visiting Assistant Professor at the Massachusetts Institute of Technology (MIT) in 2014. Even now, I regularly attend electives in professional teaching that are organized by the Centre for Development of Teaching and Learning at the National University of Singapore (NUS).

Graduate Teaching

During my professorship at NUS, I taught a variety of courses, ranging from sophomore to graduate levels. My first teaching assignment was a graduate-level module, entitled EE5702 - Advanced Power Systems Analysis. The contents are mainly based on electromagnetism and control principles, which are known to be highly theoretical and rely heavily on mathematical formulations. After consulting with my senior colleagues and MIT mentors, I attempted an "illustrative" teaching approach. **Instead of communicating information solely from a theoretical perspective, my lectures emphasised on conceptual reasoning supported by mathematical formulation**. In addition, discussions on related industrial projects and practices were initiated to demonstrate the importance of the taught concepts. From the received feedback, my module inspired several students to design novel control strategies for their ongoing research in power electronics and smart grid. Some of their findings were later published in scientific papers. Moreover, part-time students were able to apply the taught knowledge into their daily work. My contribution to education was recognised by the Faculty of Engineering, and I received the Faculty Teaching Award (Commendation List) in 2017.

Undergraduate Teaching

I also had the opportunity to create one new undergraduate module, entitled EE3506C - Introduction to Electrical Energy Systems. Given the freedom to design the syllabus, I tailored the lecture materials based on 6.007 and 6.061 from MIT. The module first equips the students with the necessary analytical tools (e.g. phasor and linear algebra), followed by the power engineering knowledge (e.g. three-phase power and transformers). Prior to teaching this module, I reviewed the student feedback from the

pre-requisite modules. The common issue raised in these modules was that the taught materials were delivered in a knowledge-bombardment manner, making the concepts difficult to be digested by students. Applying my illustrative teaching approach, students were able to appreciate the origins of the derived equations once the fundamental concepts were explained. The lectures were also supported by many real-life examples along with lab experiments. As a result, **students became excited after knowing what they learnt could make a difference to our society rather than fulfilling a requirement in their academic degree**. The module was a success, and was requested by the department to be offered every semester with a class size between 50 to 150 students since 2018.

Student Competition

Outside teaching, I actively mentored undergraduate students to compete at the International Genetically Engineered Machine (iGEM) competition – a worldwide synthetic biology competition that was initially aimed at undergraduate students. Synthetic biology is applying engineering principles to design biological organisms. Together with colleagues from biomedical engineering and life science, we recruited students and inspired them to develop novel biological organisms that tackle the current environmental problems. Driven by a clear objective, our students were motivated to learn and even self-taught new knowledge and skills. This demonstrates that learning sophisticated theories is not limited by the teaching style, but governed by inspiring the students and their peer interaction. In particular, we taught our students how to prepare proposals and secure sponsorship, deliver effective presentations, and draft viable business models. This knowledge is outside the conventional curriculum of engineering, but is crucial to becoming a successful engineer. Despite synthetic biology not being my core research, this experience has helped strengthen my teaching and communicating skills. The experience further supports my philosophy to inspire students by linking the taught materials to real-world events and problems.

In 2019, our students won the best Foundational Advance Project, and best Synthetic Part Collection among 340 university teams from around the world. They were also nominated for best presentation, poster, and overall finalist. During our post-competition discussion, the students appreciated the interactive mentoring and teaching styles provided by the professors. Specifically, the training on outside-curriculum topics helped the seniors to secure their desired job. Some of the students are even considering to do a start-up based on their work from the iGEM competition.

Although a lot of effort goes into managing the iGEM team, I enjoy working with students and seeing them excel. More importantly, I believe that teaching should not be restricted to lectures and tutorials. As a professor, we need to inspire students to solve real world problems rather than just helping them to fulfill the requirements demanded by an academic degree.

Student Supervision

Perhaps the most rewarding experience of my professorship is the supervision of students. To me, being an effective communicator is the key to successful supervision. I prefer frequent discussions at the start of a new project to ensure the students understand the scope of their research. The initial

guidance will then be gradually relaxed to allow opportunities for students to develop their independent research abilities. Apart from advising graduate students to do impactful research, I also enjoy training undergraduate students to develop their critical thinking in tackling research problems. Each year, I supervise at least 5 final-year projects as well as host summer interns from partner universities such as UIUC (University of Chicago Urbana-Champaign) and University of Pennsylvania. I encourage undergraduate students to speak their minds as their fresh thinking, unbounded by technical literature, can often spark new research ideas. While students with different skill sets are often required to solve complex research problems, I strongly believe that multi-disciplinarity should not be an end in itself. **Bringing together individuals of different ethnicities — with the attendant differences in culture and social perspectives — can further inspire students to think outside their norms**, and more importantly, gain cultural empathy. Therefore, I always recruit students that complement my existing group in both aspects.