Teaching Statement – V.N. Vimal Rao

आचार्यात् पादमादत्ते पादं शिष्यः स्वमेधया। सब्रह्मचारिभ्यः पादं पादं कालक्रमेण च॥ Mahabharata 5:44:9

This saying states that a student's learning is derived from four sources: their teacher, themselves, their peers, and through time. Yet these four sources do not operate independently. My choices as a teacher are inexorably intertwined with the impact each of these sources has on students. My goal is thus to support my students' learning by facilitating a learning environment in which all four sources can contribute to their growth -- I want to impart my knowledge, empower them, foster cooperative learning, and prepare them for future studies (see Johnson et al., 2000, for more on the benefits of cooperative learning; see Bransford & Schwartz, 1999, for more on preparation for future learning). To lay this foundation, I adopt a student-centered approach and utilize autonomy-supportive teaching practices (Reeve & Cheon, 2021). These values and approaches uniquely manifest in my classrooms in three ways: (1) my interactions with individual students, (2) my classroom presence, and (3) my instructional content.

(1) Student Interactions To align my efforts as a teacher with students' efforts to learn, I focus on meeting each student at the limit of their current understanding (i.e., their zone of proximal development; Vygotsky, 1978). For some, this involves extra scaffolding, while others require an extra challenge. In Spring 2021, within the same discussion group, I had one student of each type during an activity on bootstrap resampling. To provide extra scaffolding to one student, I re-explained bootstrapping in a way that emphasized the software representation of a statistical explanation (see Garfield & Ben-Zvi, 2008, Chapter 13, for typical roadblocks in students' learning of statistical inference) and provided a live worked example, before having the student complete the first half of the activity in my presence. To provide an extra challenge to the other student, I suggested they try to re-explain what bootstrapping is and what it achieves in their own 5 minute mock lecture, and practice explaining the key points to their group mates (see Clark & Rossiter, 2008, for the benefits of narrative explication). Tailoring my scaffolding for each student helped me keep both students supported and challenged relative to their current understanding, engaged and moving through the course content at the same pace, and carried the additional benefit of supporting peer-to-peer interactions that supports each students' learning.

(2) Classroom Presence It is impossible to teach my students everything they need to know about practicing statistics within the few weeks they spend in my classroom. However, I can prepare them to face future statistical experiences by teaching them how to approach problems

the way statisticians do, i.e., through a statistical lens (see Goodwin, 1994, for more on professional vision). To teach my students how to think like a statistician, I utilize a cognitive apprenticeship model (Collins et al., 1987). For example, to develop students' critical statistical literacy, I start each class with the five minute "What's not here?" activity. During the first few weeks of the term, I model how to critically consume graphs through think-alouds when viewing new graphs for the first time. This helps teach students the features that they should pay attention to, such as the sample size, the study design, potential sampling bias, potential covariates, etc. Soon, we transition to students sharing visuals and their interpretations with the class, allowing me the opportunity to provide individual feedback. Before long, students reflect on their skills by comparing their reasoning with mine about the same visualization. By the end of the course, students explore and search for visuals in their day-to-day lives, and apply the "What's not here?" lens. In devoting class time to develop students' professional statistical vision, students learn to orient themselves to statistical information and notice important features in data. In their future experiences and exposure to statistics long after they leave my classroom, this vision supports them asking the right questions, which can lead to them to a new understanding.

(3) Instructional Content My research of statistical reasoning and thinking sometimes leads to new classroom activities. While studying graduate students' processing of *p*-values, my colleagues and I found evidence that students' mental representations of the *p*-value continuum was distorted around the traditional .05 boundary for 'statistical significance' (Rao et al., 2021). To train my students to avoid deleterious category- or rule-based approaches that affect their underlying cognition, I have developed (and am currently testing) a series of activities based on categorical learning theories to (1) maximize the learning benefits of categories for novices, (2) ensure students do not leave my course with a warped mental representation of the *p*-value continuum, and (3) protect students from a future warping of their mental representation.

By balancing my role as a teacher with the three other sources of student learning (themselves, their peers, and through time), my students leave my class with a foundation to continue developing as thoughtful statisticians. This is exemplified by one former student telling me one year later that "You taught me that there is so much more to statistics, it's not just 'black and white'. You have to be very mindful when it comes to analysis, *p*-values, and interpretations." Developing this mindset for everyone that steps foot in my classroom is my mission as a teacher.

Selected excerpts from student feedback aligned with my approach to student interactions

"I really appreciated Vimal's flexibility in his teaching and feedback. He was always ready to adjust or re-explain things when we were having trouble with a concept. I appreciated how much effort he put into presenting topics in different ways." from *UMN EPSY 5261 Fall 2020*

"[Vimal] consistently offered detailed explanations, using relevant examples, to help me understand concepts that were tripping me up. I felt encouraged to reach out to him if I had questions, and more importantly felt like my efforts to learn the material were noticed which contributed a great deal to my continued engagement." from *GWU HSCI 2117 Spring 2021*

"He made this class extremely personal and created an environment where discussion and collaboration are encouraged. Being able to ask questions and discuss with breakout rooms has made this class incredibly attainable for me." from *UMN EPSY 5261 Fall 2020*

Selected excerpts from student feedback aligned with my approach to classroom presence

"Professor Rao while commenting on discussion board posts wouldn't just give you the answer out right. He would give you the necessary information to figure it out for yourself and actually think about what the correct answer is." from *GWU HSCI 2117 Summer 2019*

"The way the Professor explained concepts and worked through examples was invaluable to me. The discussion boards were … interesting. I think they provided a safe space for us to make guesses and mistakes, and ultimately I referred back to them for several assignments." from *GWU HSCI 2117 Spring 2021*

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