

आचार्यात् पादमादत्ते पादं शिष्यः स्वमेधया। स ब्रह्मचारिभ्यः 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. These four sources do not operate independently – my choices as a teacher are inexorably intertwined with the impact each source has on students. My goal is thus to support my students' learning by facilitating a learning environment in which all sources can contribute to students' growth. To manifest these values in a learning environment, I adopt a student-centered approach to guide my student interactions and classroom presence.

(1) The Teacher as a Source 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 relative to the curriculum, while others require an extra challenge. In Spring 2021, in a graduate-level activity-based introductory statistics course, I had one student who was confused about the purpose and procedure of bootstrap resampling when computing confidence intervals, and was stuck comparing the 'original sample' to a single 'bootstrap sample'. To provide extra scaffolding to this student, I re-explained bootstrapping in a way that emphasized the software representation of a statistical explanation – I encouraged them to focus on the data generating process, and to see how the software (StatKey) represents and enacts this process (see Garfield & Ben-Zvi, 2008, Chapter 13, for typical roadblocks in students' learning of statistical inference). I then provided a live worked example of the complete procedure, before having them complete the same steps in my presence. By drawing on my knowledge of statistics education research, I was able to help this student past their struggle with a tailored scaffold.

(2) Peers as a Source I believe in cooperative learning environments as an effective pedagogical strategy (Johnson et al., 2000). I spend the first few weeks of any class building a culture where students can feel psychologically safe to ask questions (see Edmondson, 2018, for the importance of psychological safety), sharing my authority as a teacher with them (see Langer-Osuna, 2017, for the role of authority in the classroom), and fostering peer interactions. Often, when students think they have a good understanding of the material, they begin to move faster through the content than their classmates. This once occurred in the same bootstrapping activity I previously mentioned. To provide an extra challenge to a 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

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benefits of narrative explication). Tailoring my interaction with each student based on whether they need additional support or an extra challenge helped me keep both students supported and challenged relative to their current understanding, and engaged and moving through the course content at the same pace. Furthermore, building a cooperative learning environment and sharing my authority with students fostered peer-to-peer interactions promoting each students' learning.

(3) *Time and Self as a Source* 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; see Bransford & Schwartz, 1999, for more on preparation for future learning). 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 class with a five minute "What's not here?" activity. During the first few weeks of the term, I model how to critically consume graphs by thinking-aloud when viewing new graphs for the first time. This teaches students which features 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 statistical vision supports them asking the right questions, which can lead to them to new understanding.

By considering how my interactions, presence, and activities balance 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. One former student told me "You taught me that there is so much more to statistics, it's not just 'black and white'. You have to be 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.

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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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V.N. Vimal Rao -- Student Ratings of Teacher from University of Minnesota (2019 - 2022)

| UMN Course Evals | Weighted Average | Su 2022 5261 OL (n = 17) | Sp 2022 3264 IP (n = 28) | Fa 2021 3264 IP (n = 32) | Fa 2021 5261 IP (n = 10) | Sp 2021 5261 OL (n = 15) | Fa 2020 5261 IP (n = 12) | Sp 2020 5261 OL (n = 23) | Fa 2019 5261 OL (n=17) |
|---|---------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|
| Overall | 5.80 | 5.8 | 5.9 | 5.8 | 5.7 | 5.9 | 5.7 | 5.7 | 5.9 |
| The instructor was: | | | | | | | | | |
| - well prepared for class | 5.74 | 5.7 | 5.9 | 5.8 | 5.3 | 5.8 | 5.6 | | 5.8 |
| - presented the subject matter clearly | 5.66 | 5.6 | 5.8 | 5.8 | 5.3 | 5.9 | 5.2 | 5.6 | 5.8 |
| - provided feedback intended to improve my course performance | 5.85 | 5.9 | 5.8 | 5.7 | 5.9 | 5.9 | 6.0 | | 5.9 |
| - treated me with respect | 5.92 | 5.9 | 6.0 | 5.9 | 5.8 | 5.9 | 6.0 | 5.8 | 6.0 |
| I would recommend the instructor | 5.89 | 5.8 | 5.9 | 5.9 | 6.0 | 5.9 | 5.9 | | 5.9 |
| Interactions with the instructor helped me learn | 5.73 | 5.7 | 5.9 | 5.8 | 5.8 | 5.9 | 5.8 | 5.5 | 5.6 |

1 = strongly disagree

2 = disagree

3 = somewhat disagree

4 = somewhat agree

5 = agree

6 = strongly agree

V.N. Vimal Rao -- Student Ratings of Teacher from George Washington University (2016 - 2022)

| GWU Course Evals | Weighted Average (Last Year) | Weighted Average (All) | Su 2021 (n=17) | Sp 2021 (n=17) | Fa 2020 (n=10) | Su 2020 (n=17) | Sp 2020 B (n=9) | Sp 2020 A (n = 19) | Fa 2019 (n = 11) | Su 2019 A (n=16) | Sp 2019 A (n=7) | Su 2018 (n=5) | Sp 2018 A (n=5) | Sp 2017 (n=5) | Fa 2016 (n=6) | Sp 2016 (n=10) |
|---|------------------------------------|------------------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-----------------------|---------------------|---------------------|--------------------|------------------|--------------------|------------------|------------------|-------------------|
| Overall (1 = poor; 5 = excellent) | 4.93 | 4.83 | 4.9 | 4.9 | 5.0 | 4.8 | 4.8 | 5.0 | 5.0 | 4.8 | 4.9 | 4.8 | 4.6 | 4.4 | 4.7 | 4.4 |
| Instructor characteristics: | | | | | | | | | | | | | | | | |
| - Knowledgeable (1 = not at all; 5 = very) | 4.95 | 4.95 | 5.0 | 4.9 | 4.9 | 4.9 | 5.0 | 5.0 | 5.0 | 5.0 | 4.9 | 5.0 | 5.0 | 5.0 | 4.8 | 4.8 |
| - Enthusiasm (1 = low, 5 = high) | 4.90 | 4.89 | 5.0 | 4.9 | 4.8 | 4.9 | 4.8 | 4.9 | 4.9 | 5.0 | 4.9 | 5.0 | 5.0 | 4.6 | 5.0 | 4.7 |
| - Treats students with respect (1 = strongly disagree; 5 = strongly agree) | 4.95 | 4.94 | 5.0 | 4.9 | 4.9 | 4.9 | 4.9 | 5.0 | 5.0 | 4.9 | 4.9 | 5.0 | 5.0 | 4.6 | 5.0 | 5.0 |
| - Fair grading (1 = not fair, 5 = very fair) | 4.85 | 4.81 | 5.0 | 4.8 | 4.7 | 4.8 | 4.7 | 4.9 | 4.9 | 4.8 | 4.9 | 5.0 | 4.4 | 4.6 | 4.7 | 4.8 |
| - Feedback (1 = not at all; 5 = excellent) | 4.78 | 4.68 | 4.8 | 4.9 | 4.5 | 4.8 | 4.8 | 4.6 | 4.9 | 4.7 | 4.6 | 4.2 | 4.0 | 4.6 | 4.5 | 4.7 |
| - Skill with technology (1 = poor; 5 = excellent) | - | 4.87 | | | 4.7 | 4.9 | 4.9 | 4.9 | 5.0 | 4.9 | 4.7 | 4.8 | | | | |