Perspectives on Teaching from Early-Career Scientists
Graduate Students as Teachers

By Suchinta Arif and Melanie Duc Bo Massey

Many graduate students spend a part of their time teaching at the university level. While there is an abundance of advice from older, more established faculty, the perspective and teaching styles of graduate students are lacking in the literature. After talking with several graduate student teachers across different universities, we identified three factors as pivotal in our teaching approach: breaking down student-professor barriers, fostering creativity, and incorporating inclusion in the classroom. In this article, we highlight how these three factors shaped our teaching style and experience. With this article, we aim to provide insight into how a younger generation of graduate student teachers are teaching effectively at the university level.

The concept of teacher in postsecondary settings typically does not evoke the image of young or early-career scientists, who are likely students themselves. However, many graduate students take on this role through teaching positions that become available during their graduate studies. Graduate students have the potential to excel in teaching at the university level. For example, one study found that undergraduates are more likely to major in a subject if that subject was taught by a graduate student in their first year (Bettinger et al., 2016). Graduate students are also influential in teaching undergraduate science, technology, engineering, and math (STEM) students, especially given that they often are engaged in more contact with students during tutorials and laboratory sessions (Fagen & Suedkemp Wells, 2004). In our experience, and as we have learned in discussions with our peers, graduate student teachers can indeed be effective teachers who provide positive teaching environments that are conducive to creative thinking and learning.

After many discussions on teaching approaches and philosophies with 10 other graduate student teachers across eight different Canadian and U.S. universities, we found that younger teachers aim to foster stronger student-teacher relationships, creativity, and inclusion in the classroom. In this article, we aim to expand on these three key areas, from the perspective and direct experience of a nascent generation of teachers and supplemented by literature from the field. Whereas we readily access pedagogical advice from experienced teachers, our own advice is often overlooked by others—a serious issue in postsecondary education, given that graduate student teachers with high teaching self-efficacy contribute to better undergraduate outcomes (DeChenne et al., 2012). By highlighting the voices of graduate student teachers, we hope to empower and inform our fellow young scientists.

Breaking down student-professor barriers

Student-professor relationships can appear drastically different when comparing younger graduate student instructors to more experienced or older professors. The often-intimidating student-professor barriers that exist with established professors can be broken down easily with a younger teacher (Park, 2002; Muzaka, 2009). Despite drawbacks, such as challenges in maintaining classroom authority (Melnick & Meister, 2008), in our experience there are important benefits that emerge from our ability to relate to our students on many levels (e.g., generational, cultural, level of experience), all of which ultimately enhance students’ learning experience.

Increased relatability and a lower level of intimidation allowed us to foster strong student-teacher relationships. This was a general theme highlighted throughout our course evaluations, with students consistently commenting on the relatability of graduate student teachers. Many
of the adjectives used to describe graduate student teachers, in our experience, have focused on approachability, kindness, and enthusiasm (Figure 1). This is important because stronger student-teacher connectedness can result in more participation during class discussions, enhanced critical thinking, and better academic performance (Konishi et al., 2010; Micari & Pazos, 2012; Karpouza & Emvalotis, 2019).

Taken together, these benefits also helped us create a more adaptive learning style tailored to our students’ needs. For example, in a third-year ecosystem course, a group of students felt comfortable enough to express their desire for more participatory classroom discussions. The class then evolved from one in which information was disseminated to the students through a one-way instructor presentation to one in which the lecture was predominantly participatory, often including open-ended questions for the students. Student participation was high, and students often challenged the professor’s opinions and thought processes, showing that they were not intimidated. One student in this scenario reported the following on a student evaluation: “She [the instructor] doesn’t act like she’s above all the students—she encourages you to challenge ideas and ask questions.” The student added that these skills were “severely lacking in many [older] professors.” In a laboratory setting, relatability to our students led to a transformation from previously monotonous laboratory exercises to ones that were more immersive and enjoyable for the students. For example, in a molecular biology lab, we designed a lab exercise, inspired by a viral YouTube video, in which students baked a tiny cake. This exercise generated student excitement and interest and also provided a challenging technical learning experience in which students converted ingredient measurements, measured dimensions to calculate area and volume, and calibrated micropipettes before using them to deliver precise volumes.

Overall, the breakdown of a student-professor barrier and the building of stronger student-teacher relationships have allowed us to create low-pressure environments in which students are engaged with the planning and outcomes of their own learning through enriching professor-student dialogue.

**Fostering student learning through creativity**

In our discussions with graduate student teachers, many expressed a strong interest in incorporating creativity into their pedagogical philosophy and assessments. There are several methods we use in the classroom to encourage creative learning, which include emphasizing the early stages of creative learning (Mumford et al., 2012), using analogous models to foster creative thinking (Mayer, 1989), and creating assessments that let students apply prior knowledge to answer challenging, novel problems (Mumford et al., 2012). Although these pedagogical methods are not new to the field per se, we will describe several ways in which we have applied them and discuss how students have responded to them.

First, we emphasize the importance of the early stages of creative learning, which include problem definition, information gathering, and information organization (Mumford et al.,

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**FIGURE 1**

Word cloud generated from adjectives used in student review comments about graduate instructors.

Note. We took all adjectives written in the comments section of 218 undergraduate reviews of graduate student instructors for eight separate biology-focused courses at three Canadian institutions. Only adjectives used at least are shown; the most common adjectives were helpful (20 times), clear (18 times), approachable (16 times), friendly (14 times), and enthusiastic (13 times). Word size and color correlates to usage frequency, with larger and darker words being used more frequently.
to break down complicated student assessments. In the classroom, this could take the form of an essay assignment in which theses or hypotheses are first submitted and reviewed (problem definition), and annotated bibliographies highlighting pertinent information are then submitted and reviewed (information gathering and organization). In lab settings, we have set up long-term, student-led projects in which students first identified a problem they wanted to solve (problem definition), then conducted appropriate background research on the topic and their methodological approach (informational gathering), and finally formulated and submitted a proposal for their intended project (informational organization). We have found that breaking up large assessments into these discrete but achievable steps has resulted in positive feedback, with many students describing our teaching styles as “clear” in student evaluations (Figure 1).

Having students or instructors provide casual feedback during these stages also facilitates creative learning, as students gain deeper insight during the process of reviewing their own or others’ work (Paulus & Nijstad, 2003). Students in our classes have reported engagement with creative back-and-forth in student evaluations; as an example, one student wrote that they benefited from being able to “debate and question” with us as instructors. And when instructors are students themselves, they can create a more open atmosphere for creative discussion and cross-talk (Ambers, 2002).

Second, in a lecture setting, analogical models are an easily applied method to encourage creative learning. Analogical models are a method of representing a system or phenomenon using a more well-known and easily understandable system. For example, before introducing students to a new concept such as the unique anatomy of bird skeletons, we might review human anatomy, with which most students would be familiar. As another example, when teaching an introductory cell biology lecture, we can equate cell structure to how a city functions: The cell membrane acts as a city wall, lysosomes are a city’s recycling plant, and the nucleus acts as a library. By connecting their existing knowledge to the new material, an analogical model builds foundations for new information to be processed and retained. This model also allows for creative comparisons to be made between different phenomena, as well as encourages students to think more broadly about a specific topic at hand.

Finally, it is important to give students the opportunity to think creatively and critically during assessments. One method of doing so is employing conceptual combination. Conceptual combination occurs when students draw on their retained knowledge of various topics and generate new ideas to answer complex questions (Mumford et al., 2012). We often create assessment material that challenges students with questions they have not yet heard and that combines concepts from different units. As an example of a lab assessment, students in one of our molecular biology labs were asked to use previously learned techniques to identify a biological specimen found at a simulated crime scene. They performed several tests on their specimens, then reflected on their findings to identify the perpetrator. Tests such as these allow students to apply knowledge gained from their microbiology labs to a new and engaging problem and serve as a means for students to show their mastery of microbiology concepts as they would be applied to any field. In addition to providing a break from rote memorization, applying conceptual combination skills is highly positively correlated with scores for originality and quality and is more likely to predict success than traditional metrics such as intelligence or divergent thinking (Mumford et al., 1997).

When creativity is implemented in the classroom, students have an increased sense of autonomy over their learning (Jeffrey, 2006). Other benefits are reported by students themselves. Our own students have reported in teaching reviews that they have high engagement: For example, in two of our introductory biology classes that incorporated several of the creative strategies mentioned earlier, students evaluated the instructor’s ability to maintain student interest as excellent (average = 4.85 ± 0.35 out of 5; n = 29 students). Furthermore, our students’ engagement and interest levels while tackling creative challenges in the classroom were qualitatively visible to us as instructors. In an evaluation, one student remarked on their enjoyment of such strategies that “encouraged us [students] to critically think.”

Overall, we believe that creative learning imbues students with the skills needed to break down and tackle novel and complex problems, skills that are important in both their academic careers and their everyday lives. By facilitating creative learning in the science classroom, students can benefit from enhanced productivity, motivation, quality, and originality in their work.

Inclusion in the classroom

A key theme we identified when talking to graduate student instructors is the importance of fostering inclusion in the classroom. Whereas diversity includes demographics such as gender, race, and sexual orientation, inclusion focuses on creating an environment that enables this diversity to thrive. In a classroom setting, inclusion means creating a culture in which all students receive equal opportunity for educational growth and empowerment. To fully harness the benefits of diverse student bodies,
instructors must pursue deliberate strategies to promote inclusion within their classroom (Tienda, 2013), and research has found that younger teachers have more positive attitudes toward inclusivity in classrooms (Cornoldi et al., 1999; Hwang & Evang, 2011).

One of the strategies we employ to foster inclusion in our classrooms is to highlight diverse scientific content, materials, and ideas. Case studies, historical figures, research, and scientific theories that we touch on draw from a variety of sociocultural contexts that reflect human diversity. We make a cognizant effort to mention contributions to science coming from non-Western, women-led, and other marginalized identity groups. This approach has three benefits: It exposes students to a larger variety of scientific thought and approaches, accurately represents the history of science and those who have contributed to it, and allows students from marginalized groups to see themselves in our teachings. Examples of some approaches we have taken are listed in Table 1.

Our second approach to creating a more inclusive classroom is through actively learning about inclusion, equity, and equality outside the classroom. We believe that it is our responsibility as educators to be aware of issues affecting different identity groups in our broader society. By learning from relevant literature and news and through social interactions with a diverse group of peers, we aim to stay aware of social and systematic issues that may affect our students. This learning is a continual work in progress, and we hope these efforts limit unconscious bias (Fiarman, 2016), microaggressions (Sue et al., 2009), and damaging responses (Sue et al., 2009) that may otherwise negatively impact students in our classroom. This learning also allows us to better recognize and prevent interpersonal issues around inclusion that may exist between students (e.g., classroom microaggressions; Suárez-Orozco et al., 2015). Students whose courses we have taught in an inclusive atmosphere have reported that their learning environment is “non-hostile” and “safe” in teaching reviews.

Our third approach to inclusion is to maintain a learning environment in which students feel comfortable challenging our unconscious biases (Fiarman, 2016) when they arise. We state explicitly (e.g., at the beginning of the semester) that we are committed to creating and maintaining an inclusive learning environment and that we welcome critiques and commentary on how we can make things better. Students often have difficulty challenging their professors due to the inherent power imbalance that exists as well as the negative ramifications they may experience as a result of challenging their superiors (Sue et al., 2009). We believe that when it comes to social justice and inclusion, these barriers should be broken down. By letting our students know we are open to recommendations, critique, and change, we can open lines of communication and learn about the needs of students from marginalized communities from the students themselves. For example, through conversations with individual students, we have learned that our students appreciate representation (e.g., through diverse faculty members, guest lecturers, and examples of scientists and leadership shown in lectures), varied assignment options (e.g., individuals with social anxiety prefer written or visual assignments over oral ones), inclusive language (e.g., gender-neutral pronouns), and indicators of acceptance from their teachers (e.g., comments that highlight our inclusive views toward the LGBTQ community).

Finally, we believe that our own diverse backgrounds (i.e., as first-generation women of color) play an integral role in fostering inclusivity. Graduate students at universities are often more diverse than older faculty members (Espinosa et al., 2019). Having diversity among faculty members exposes students to a range of intellectual thought, teaching styles, and

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<tr>
<th>Course or topic</th>
<th>Example of inclusive teaching approach</th>
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<tbody>
<tr>
<td>Genetics</td>
<td>Explain the role Rosalind Franklin played in discovering the structure of DNA. Many books and lectures will often give full credit to Watson and Crick, leaving out the key role of Franklin’s work and contributions (Klung, 1968).</td>
</tr>
<tr>
<td>Ecosystems</td>
<td>Provide examples of successful ecosystem-based management strategies that are led by and/or incorporate Indigenous perspectives and aspirations (Tiakiwai et al., 2017).</td>
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<tr>
<td>Environmental studies</td>
<td>Teach environmental studies topics through the lens of an Indigenous community; show media created by Indigenous organizations.</td>
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<tr>
<td>General</td>
<td>Offer guest lectures from individuals who can provide a breadth of perspectives and experience (e.g., female researchers, Indigenous naturalists).</td>
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personal experiences that together offer a breadth of ideas that constitute a dynamic intellectual community. For example, studies have shown that women and people of color more frequently employed active learning in the classroom, encouraged student input, and included perspectives of women and minorities in their coursework (Milem et al., 2005). Diverse faculty members can also inspire students by showing individuals from marginalized identity groups in leadership positions (Collins & Kristonis, 2006). Although tenured faculty positions continue to be dominated by individuals from majority identity groups, our position as diverse graduate student faculty members can hopefully break down this barrier.

Conclusion

The connecting themes between each of our key foci show that we, as early-career, graduate student teachers, have a keen desire to meet the needs of our students—whether we are engaging them in the design of their own learning, encouraging them to apply their knowledge to questions “outside the box,” or facilitating their feelings of inclusion in the academic setting. Ultimately, it is our experience that these approaches—the beneficial outcomes of which are supported by the literature—result in high student participation and interest. We hope this article provides insight into how some graduate student teachers are implementing their pedagogy in classrooms and what benefits these approaches confer.

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References


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