

## **Teaching with Graduate Teaching Assistants: Tips for Promoting High Performance Instructional Teams**

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## Abstract

Many engineering faculty work with graduate teaching assistants (TAs) to conduct their classes. An effective partnership and clear delineation of responsibilities can have a meaningful positive impact on the teaching and learning experience. This paper provides guidelines for working with graduate teaching assistants by applying the five principles of high-performance engineering teams described by Jon R. Katzenbach and Douglas K. Smith,<sup>1</sup> and adapted by Karl Smith and others for collaborative learning:<sup>2</sup> face-to-face promotive interaction, positive interdependence, group and individual accountability, teamwork skills, and group processing. Perspectives are shared from engineering faculty who work with graduate teaching assistants in lecture, laboratory, and professional skills courses, and consideration is paid to small teams (1-3) and large teams (8+) of teaching assistants. Best practices in organization, clarity of expectations, leadership, communication, and emotional intelligence emerge.

## 1. Introduction

### 1.1 Teamwork in Engineering Education

Effective teamwork is a common theme in engineering education. Teamwork skills frequently rank at the top of desired engineering skills lists, along with analysis, problem solving, design, and communication,<sup>3</sup> and the ability to work well in teams appears in the current and proposed future set of ABET Student Outcomes for programs accredited by the Engineering Accreditation Commission.<sup>4</sup> Team projects are a hallmark of engineering curricula, especially in laboratory courses and capstone design courses. Many engineering educators discuss strategies for teaching teamwork skills to their students, especially through collaborative and cooperative learning approaches.<sup>5-7</sup> The research work of Jon R. Katzenbach and Douglas K. Smith provides a particularly useful framework for effective teamwork in multiple disciplines, and it has been applied extensively to teamwork in engineering education. We present these five characteristics here, as they have been applied to collaborative learning in engineering student teamwork:

#### —Promotive interaction

Members do real work, usually face to face. Forming groups with similar availability for work outside of class is one technique to support promotive interaction.

#### —Positive interdependence

The team focuses on a common goal or single product, with complementary contributions. Positive interdependence can be promoted through role-taking, and “jigsaw” activities in which students become experts in complementary areas, for example.

#### —Individual and group accountability

Everyone takes responsibility for their own work and the overall work of the team. Accountability can be promoted through milestone deliverables, frequent group communication, and a grading scheme that has a shared group element, for example.

#### —Teamwork skills

Each member practices effective communication, decision making, problem solving, conflict management, leadership. Instructors can promote the development of teamwork skills by modeling and describing conflict management approaches, and guidelines for clear, direct communication and effective leadership.

#### —Group processing

The team periodically reflects on how well it is working, celebrates, and corrects. Providing time in class for student teams to discuss their group's function and goals can support group processing.

*The premise of this paper is that the same five characteristics of effective teams can be applied to the teaching of engineering courses, specifically to the role of engineering faculty in working with graduate student teaching assistants (TAs).*

## 1.2 Background

Typically, new and seasoned engineering faculty at research institutions can expect to work with graduate teaching assistants for the delivery of one or more courses. However, not much has been written to date on the specific topic of engineering faculty working with graduate teaching assistants to teach courses. A notable exception is Edward Gehringer's 2009 ASEE/PEER conference paper, *Working Effectively with Teaching Assistants*. This paper lists typical duties that teaching assistants may do, shares general tips and strategies gathered via listserv requests from over 25 engineering faculty, and shows two samples of teaching assistant contracts from non-engineering disciplines. Gehringer's recommendations include tips on the selection of teaching assistants, strategies for maintaining the quality of the assistant's grading work, and notes on the importance of communication with teaching assistants.<sup>8</sup>

Past engineering education papers on the topic of graduate teaching assistants have focused on programs that train new teaching assistants. Professional training of graduate student TAs builds teaching skills for future faculty. David A. Torvi reviewed engineering graduate teaching assistant development programs in the Pacific Northwest US and Western Canada in his 1994 *Journal of Engineering Education* paper, finding that 40% of responding engineering departments had some graduate teaching assistant training. The training typically included material on grading student work, facilitating laboratories, teaching methods, and orientation specific for international graduate students. The degree and depth of programs varied widely, with some offering weekly courses, and others one-time workshops offered once per year.<sup>9</sup>

More recent literature suggests that graduate student teacher training programs are growing. Brent and Felder's 2008 ASEE paper on a professional development program for graduate students at their university described a program to help graduate students develop skills in effective teaching, and a workshop to help prospective faculty find the right academic job and launch their careers. Their pedagogy component includes material on teaching assistant roles and responsibilities, responding to crises, and handling cheating, as well as elective material specific to each teaching assistant's needs, including grading, using technology, facilitating laboratories, and working with diverse teaching and learning styles.<sup>10</sup>

Several universities offer optional teaching certification programs for teaching assistants who wish to delve deeper into their professional development as teachers, excel in their work as graduate teaching assistants, or prepare for the teaching component of their faculty careers. These programs are often offered to graduate students in all disciplines, but may have specific departmental components. A few examples are the Cornell Graduate Teaching Assistant Fellows program,<sup>11</sup> the Northwestern Teaching Certificate program,<sup>12</sup> and the UC Berkeley Certificate in Teaching and Learning in Higher Education program.<sup>13</sup> These certificate programs typically offer regular meetings with other graduate teaching fellows, multiple workshops, opportunities to teach and mentor others, projects to develop courses or course materials, faculty mentorship and feedback on teaching development, and in-depth material about teaching and learning.

With this paper, we intend to add to the toolkit of both new and experienced engineering educators by demonstrating the ways the Katzenbach-Smith model<sup>1,2</sup> for effective teamwork can enhance the effectiveness of the faculty-graduate teaching assistant team in delivery of engineering courses.

### **1.3 Perspective**

The authors are three engineering faculty members who teach a diverse set of courses in the Chemical and Biomolecular Engineering Department at the University of California, Berkeley, a large, public research institute. Our perspective is informed by our experience working as teaching assistants, working with graduate and undergraduate teaching assistants at public and private institutions, and training graduate student teaching assistants. Our collective experience includes working with small teams of graduate students to teach professional skills courses, laboratory courses, and elective courses; working with large numbers of assistants to teach introductory courses; training graduate student teaching assistants, and a recent transition from graduate student instructor to faculty. This paper represents best practices based on our experiences. We find the Katzenbach-Smith model to be an excellent framework for our own integrated experience on effectively working with graduate student teaching assistants.

## **2. Applying the Katzenbach-Smith Model to Instructional Teams**

In the next sections of this paper we step through each of the five characteristics of effective teamwork, and present tips, strategies, insights, and elaborations on how to bring each component of the model to life in your teaching teams.

## **2.1 Promotive Interaction**

Promotive interaction is about committing to face-to-face team work time and embracing the opportunities to move your teaching and planning work forward during these meetings.

**Meet your graduate teaching assistants for an orientation meeting during the month before your course begins.** Just as the first day of class is an important moment for setting the tone and policies for your course, this instructors' orientation meeting is a crucial time to get your instructional team working well together. Share your teaching philosophy and goals for the class with your graduate teaching assistants. Tell them what inspires and motivates you to teach the course, and how you are seeking to improve it based on previous experiences. Ask them why they are teaching this course, what they hope to get out of it, and what their previous teaching experience has been. Invite them to set goals with you: personal goals for the own teaching, as well as group goals for teaching the course.

Share student learning objectives, ABET requirements, and your course syllabus with your graduate teaching assistants at this meeting. Communicate the key course deliverables or assignments, topics, and policies. Describe your typical approach to grading. Coordinate to set up a schedule of regular (weekly) instructor meetings, discussion sections, lab rotations, and/or office hours. Share your expectations: review a teaching assistant contract, or give them a list of responsibilities for the course.

When working with larger teams of graduate teaching assistants, we have had success integrating an ice-breaker into the orientation meeting, for the teaching assistants to get to know one another. For example, create pairs of graduate students and ask each person to learn about their partner and then introduce their partner to the rest of the group. This can set the tone for cooperation and supportive personal interactions and also serves as a model approach for their teaching assistant-led sections.

We also recommend a cultural awareness activity when working with large and diverse groups of graduate students. The Emotional Intelligence and Diversity Institute offers a number of valuable materials in this area. We have had success using a version of the 'Describe, Analyze, Evaluate' activity to emphasize that our instructional team is respectful of differences and accepting of all cultural backgrounds.<sup>14</sup>

**Establish weekly 1-hour meetings with your graduate teaching assistants.** Regular communication with your graduate teaching assistants throughout the semester is important. We

recommend setting a regular time to meet for one hour each week. Our experience has taught us that 30 minutes per week is not enough to discuss the topics, issues, questions, and ideas about the course in sufficient depth. Weekly meetings that follow an organized agenda, with follow up on completion of tasks, will help promote effective team performance.

A recent study by Engel, Woolley, Jing, Chabris, and Malone reveals the importance of emotion-reading in team interactions. They compared a collective intelligence factor that characterizes overall team performance in two cases where the team members either met face-to-face or worked together online. They found, “surprisingly, the most important ingredients for a smart team remained constant regardless of its mode of interaction: members who communicated a lot, participated equally and possessed good emotion-reading skills.”<sup>15, 16</sup> Consistent with this study, we have found that the success of the instructional team is enhanced by regularly scheduled cooperative interaction versus a “divide-and-conquer” approach.

Face-to-face meetings offer specific opportunities to build team interactions. Instructors have an opportunity to tell the TAs “What I really want to the students to learn from this is...”, “What students typically struggle with is...” It gives graduate teaching assistants and faculty alike the opportunity to tell stories or describe experiences that move the group collectively toward achieving their goals. Very short, irregular or unpredictable meetings potentially miss these chances for collective growth.

## **2.2 Positive Interdependence and Individual and Group Accountability:**

Positive interdependence refers to the team focus on a common goal, with complementary contributions from team members. Group accountability requires that everyone takes responsibility for the overall work of the team, and can be promoted through milestone deliverables and frequent group communication. Individual accountability requires that everyone takes responsibility for their own work toward achieving both personal and team goals. In this section we discuss these two attributes together because they are highly interconnected.

According to Katzenbach and Smith high performing teams are “a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable.”<sup>1,2</sup> Team members work together to achieve common goals through complementary contributions, holding themselves accountable for their individual contributions as well as for the overall success of the team in achieving its goals.

The group goals for the instructional team generally fall into two categories: student learning: achieving desired objectives and course mechanics: ensuring the course runs smoothly. For most TAs a primary individual goal is their development as instructors.

### **Group goal: student learning**

**Before the course begins, inform TAs of the student learning goals.** The student objectives include learning objectives, ABET requirements and syllabus description of material to be covered, and constitute the common goal for which the instructional team members are accountable. It is important to bring the group of TAs together in this common purpose of doing high-quality work to accomplish the primary goal of teaching students.

**Throughout the course, stress what is important to you as an instructor.** For example, before grading an exam, say, “It is very important to me that each student feels that their exam has been fairly graded.” Or, when approaching a specific topic, “Many students will have difficulty understanding the concept of fugacity, but it is critical that they get it before moving on.”

### **Group goal: course mechanics**

**Begin with a clear list of graduate teaching assistant responsibilities,** which can take the form of a contract and/or workflow plan. Figure 1 shows how responsibilities might be organized in a contract or workflow and how they fit together towards accomplishing the group and individual goals. Include all tasks necessary to ensure that the course runs smoothly throughout the semester. Are TAs responsible for grading homework, grading exams, creating rubrics, developing problems for homework or exams? Are they responsible for troubleshooting equipment problems in the lab? Are they expected to hold office hours? Will they enter grades in the grade book? Will they be collecting samples of student work to submit for ABET requirements? Specify the expected or required time commitment, including starting and ending dates, in addition to the duties.

**Establish a workflow plan** with clearly designated responsibilities. With a large number of TAs, the workflow usually involves creation of subgroups: teams of two or three TAs assigned to discussion sections, lab experiments, or other divided responsibilities. Different approaches to assigning teams are possible. In one approach, the teams stay together for the entire semester across all responsibilities. For example, in a lab class, the same team of two or three TAs might be in charge of one or two experiments for the entire semester. Thus each subgroup of TAs will become experts in specialized, complementary areas of course content. In another approach, the “jigsaw” approach, TA teams will be created as subgroups for different classes of responsibilities so that TAs have an opportunity to work together in different subgroups. For example one subset of TAs would form a team to create homework solutions, while another group would be responsible for posting files online or interfacing with homework graders. The advantages of the latter approach are that by mixing up the teams the TAs can learn from each other and experience working with different small-group dynamics and that the workload will be divided more fairly. However, a complicated workflow is more difficult to plan and track.



Figure 1. Two examples of a TA contract or description of responsibilities for a lecture course and a laboratory course. Below each responsibility is an indication of which group or individual goals can be accomplished through each.



## **Individual goal: personal development as an instructor**

### **Encourage teaching assistants to establish personal goals at the beginning of the course.**

These might include their personal growth and confidence, teaching objectives, enhanced understanding of material, and fulfillment of duties and responsibilities to the instructional team. Setting personal goals helps the TAs move away from their previous roles as students and into their new roles as instructors. What do they believe constitutes effective teaching? Ask TAs to consider their personal learning style. Does this match their personal teaching style? How do they plan to reach students who have different learning styles? How important is it that they pull their weight as part of the instructional team?

**One way to develop a TAs growth as an instructor is to let each graduate teaching assistant “own” a topic.** Work with them to develop a lesson plan with articulated learning outcomes and associated activities; provide examples. (In our institution’s pedagogy course, students are asked to create or modify existing homework or exam problems for a course.) In a laboratory course, let the TA take on extra responsibility through equipment trouble-shooting or investigation of confusing results. Encourage TA initiatives to improve course content and logistics, for example creating a tutorial for students on software for drawing flow diagrams. Engaging the TAs in the course content improves their morale. They see that as they contribute to the achievement of student learning their value goes beyond what it would be were they simply handling busywork for the instructor.

**Encourage TAs to take on mentorship roles.** As TAs talk to students about their unique experiences and interests, they motivate the students in a one-on-one way and engage with students even when not directly teaching a technical topic. Passing along knowledge empowers TAs and builds self-confidence.

**Promote interdependence.** Katzenback and Smith note that in high-performing teams members are “deeply committed to one another’s personal growth and success.”<sup>1</sup> In an effective instructional team TAs are invested in each other’s personal growth. One way to promote this is to require or suggest that they observe each other lead sections (at our institution this constitutes an assignment in the pedagogy course.) During weekly meetings, invite TAs to share with each other which teaching approaches have worked well for them and where they feel they could improve. Acknowledge that personal objectives will vary for individuals while achieving the learning outcomes for students is a common objective for the instructor-teaching assistant team. By fostering cooperative interactions among the TAs to create a team approach, acknowledging that academic growth is part of the experience of the TAs as well as of the students, and encouraging self-reflection, the instructor facilitates growth, confidence, and autonomy in the TAs that will naturally benefit the students.

## Accountability

**Evaluate progress towards meeting group and individual goals.** The success of the team in achieving the common goal of student learning is measured periodically during the course through student assessments (exams, quizzes, lab reports, etc.). On a more continuous basis, team members (instructors and TAs) share during weekly meetings what worked and didn't work in presenting specific material or running lab sections. This promotes mutual concern for each other's personal growth. Sharing personal stories helps establish connections and trust among team members. In addition, TAs can complete self-evaluations or self-reflections as well as solicit student feedback in the form of evaluations mid-course and at the end of the course. Box 1 lists sample questions for TA self-reflection; encouraging TAs to create their own questions for student evaluations can reinforce their accountability toward progress meeting their individual goals. In addition, you can provide constructive feedback to the TA. The Teaching Assistant Evaluation and Improvement Handbook from the University of Wisconsin-Madison is one handbook for TAs that offers sample evaluation forms for feedback from students and from instructors.<sup>17</sup> The handbook notes that teaching improvement is a continuous, closed loop process; feedback from evaluations informs improvements that can be made and put into action. You can discuss your own teaching goals as a faculty instructor to encourage TAs to adopt a "continuous improvement" philosophy toward teaching.

*Box 1. Sample TA self-reflection questions to encourage both individual and group accountability*

- How many hours per week have you spent on average as a TA for this course?
- Have you contributed to the course through new ideas, development of content (problem selection, homework solutions, lab improvements, etc.)?
- Have you contributed fairly to the mechanics/organization of the course and shared TA responsibilities?
- Comment on your role as a teacher, leading discussion sections and working with students in office hours. What successes have you had and in what areas would you like to improve more?
- What do you enjoy most about being a TA?
- What feedback do you have for the instructor?

As the faculty member, check in with TAs periodically on how much time they are spending; if they are getting paid as part of a contract they have a professional obligation to fulfill the commitment, not drop it to a lower priority compared to their performance in graduate courses, for example. On the other hand it is important to ensure that they are not greatly exceeding the expected time commitment.

**Have group checks on high-stakes deliverables.** TAs should habitually check each other's work on development of exam problems or student projects, preparation of solution sets, grading of exams, and other important aspects of the course. This is especially important when working with larger teams of instructors, where one TA might assume the others will follow up or correct a mistake. In addition, you can check the TAs' grading for adherence to the rubric, fairness and consistency, and can offer advice or feedback on grading methodology.

**Firmly establish accountability within subgroups.** If TAs divide up specific tasks within subgroups assigned to those tasks, the subgroup should continue to share the responsibility for completing the task. For example, if three TAs are responsible for homework solutions for the week and they divide the task of writing solutions by problem, the entire group should still be held responsible for the delivery and accuracy of the entire solution set, should be held accountable for answering any and all student questions on that problem set and should be able to defend the grading for that problem set. If TAs share leading sections or supervising lab stations, encourage or require them to attend the section that their teammate is directly leading.

**Maintain consistency.** What does the instructor require to be consistent? To what extent do discussion sections need to cover the same content throughout the semester? Should TAs all teach the same example problems in sections? We believe it is important to address these questions at the start of course planning. In the introductory course, we want to expose the students to the same content in each discussion section, so we work from a plan, but the execution of the plan is individualized: each TA brings their unique style and experience to the students, and can grow and develop as a teacher. TAs come from different undergraduate backgrounds. Establish a balance between encouraging them to present their own approach to problem solving based on the methodologies they have previously learned and conforming to the methodologies taught in the class. Ideally, symbols, notation, units, etc. should be consistent throughout the course, and consistent with the textbook.

Access to lesson plans for discussion sections, homework solutions from previous years, etc. can be helpful, but the tradeoff is that TAs lose the benefit of learning to plan their own lessons and the pedagogical value of carrying out what they have planned, including the inherent successes and failures. One approach is to give them materials, assignments, lesson plans used previously and ask them to develop or modify material to create a lesson plan or a homework or exam problem on their own.

### **2.3 Teamwork Skills**

During the semester, team members partake in different types of interactions including one-on-one and group interactions between combinations of TAs, students, and faculty. Successful team performance requires that all members exercise basic teamwork skills such as communication, leadership, decision making, and conflict management.<sup>2</sup> We discuss different methods for you to

foster and model teamwork skills within the group. In this section special attention is paid to your ability to exercise these skills because of your leadership role in the team.

### **Communication**

**Establish communication policies for the instructional team at the beginning of the semester to promote open communication within the group.** Clear communication is fundamental to any team's success. Effective communication between the instructional team and the students in the class is particularly important to course success, which requires that the team members be in communication with each other. An example policy is for you and the TAs to carbon-copy each other on email responses to student emails unless confidentiality demands otherwise. This behavior prevents responses from multiple team members, avoids mixed messages to students, and keeps the team abreast of all issues. It is important for the class and the team that the instructional team delivers a unified message. Utilization of discussion forums within course-management software is helpful in this respect, as such forums enable all students and instructors to view responses to student questions.

### **Leadership**

**Utilize your leadership skills both to manage the team and to model effective teaching.** Although all instructional team members must exercise their leadership skills in different situations, you are the team leader. As a result, you manage the overall team dynamics and mentor individual TAs in emotional matters and professional skills. This sub-section focuses on faculty leadership.

**Evaluate the team morale and act to correct it.** Teaching a semester-long course can be stressful for the instructional team because it requires a significant amount of time and effort and because deadlines occur on a weekly basis for months in a row. Consequently, we find that instructional teams may become overwhelmed or frustrated at some point during the semester. Your ability to gauge TA morale and take corrective action requires many of the listed teamwork skills. Emotional intelligence and empathy enable evaluation of team morale; honest communication and conflict-management skills are needed to identify and address issues. One strategy for keeping open lines of communication is to hold weekly meetings with the instructional team, as mentioned in Section 2.1. However, honest communication between TAs and faculty is challenging because of the inherent power dynamic. We find it helpful to demonstrate early on your openness to constructive feedback from the TAs. Frequent group processing, discussed in Section 2.4, helps to bring out issues.

**Appreciate that the TAs are also students.** As team leader and graduate-student mentor, you are responsible for encouraging each member to develop over the course of the semester. As mentioned previously, we observe that graduate-student TAs' personal and teaching skills vary greatly depending on factors such as undergraduate institution or major, previous teaching experience, and number of years into graduate school. Pay particular attention to the age

separation between TA and student. For example, entering graduate students may identify closely with the students in the class. This often leads to beneficial mentorship between the TA and student. On the other hand, young TAs may find it challenging or uncomfortable to exercise authority over students. Additionally, many graduate students, especially younger ones, can experience impostor syndrome.<sup>18</sup> It is crucial that the faculty member is aware of these issues to assist in TA development. We suggest instituting course policies that assign difficult decisions to the faculty member. However, involving TAs in the decision-making process improves their confidence and promotes their development as teachers.

### **Training**

**Train TAs in effective teaching techniques both on the job and through formal pedagogy coursework.** First, we consider the opportunities you have to serve as a role model to the TAs simply through teaching the class. Formal pedagogy coursework also promotes effective teaching skills and professionalism.

**In a lecture class, model lesson preparation, content delivery, and treatment of students for your TAs inside and outside of class.** Modeling active-learning techniques or other best practices provides positive examples for the TAs. Professionalism and respect towards the students are also important aspects of teaching that you model for TAs. We recommend requiring TA attendance at lectures to guarantee uniform expectations about course content and to establish appropriate, professional teaching behavior. Beyond classroom discussion, instructors demonstrate how to deal with situations such as generating content, approaching academic dishonesty, managing conflicts, or addressing student personal issues. Modeling behavior in these situations builds TA confidence, making them more effective, independent team members.

**In a lab class, capitalize on student-instructor interactions to model teaching moments for the TAs.** In the absence of lectures, discussion sections, or office hours, TAs in lab courses often do not need to prepare content. Instead, student-instructor interactions occur in a hands-on working environment and often arise from questions regarding the equipment or physical principles. Exploit these situations to model how to walk students through more subtle topics such as troubleshooting, locating resources, or identifying relevant physical phenomena in an experiment. Graduate-student TAs typically excel at these high-level skills, so encourage them to share with the students.

**Encourage or require professional training of graduate students through formal pedagogy coursework.** Pedagogy courses and certificates are increasingly recognized as vital preparation for their roles as TAs and future faculty members.<sup>19, 20</sup> The University of California, Berkeley requires departments to offer a semester-long training course for first-time TAs. The course format in our department is flexible and usually involves readings, peer teaching evaluations, and class discussion. Books we find useful for the course include *McKeachie's Teaching Tips*<sup>21</sup> and

*What The Best College Teachers Do.*<sup>22</sup> Topics typically covered include setting course policies, assessment of student learning, ethics, theory of learning, best practices for generating and delivering content, utilizing peer and student feedback, and knowledge of pertinent university policies. We find that engagement is highest if graduate students are teaching while taking the course. TAs appreciate opportunities to share teaching experiences -- both positive and negative - with their peers.

## **2.4 Group Processing**

Group processing is the act of periodically reflecting together on how well the instructional team is working together towards its group and individual goals. Effective group processing requires establishing clear goals at the beginning of the semester. Evaluation and reflection can occur in formal or informal settings such as scheduled meetings or impromptu conversations. More important than the chosen method is the commitment to engage in group processing throughout the semester.

**Conduct 360-degree feedback sessions at mid-term and end-of-term.** Engage graduate TAs in soliciting feedback from their students, and discuss the results of your own mid-term and final student feedback with the TAs. Give and receive feedback about your team process and progress toward your individual and group goals. It helps to create an open environment for TAs to provide feedback and comments to the instructor, and giving graduate TAs opportunities to observe and provide constructive feedback to one another develops a web of learning where you can all learn from each other. Informal interactions, such as ordering pizza when grading exams as a group, sharing food at weekly meetings, etc, create opportunities for the instructor to check in one-on-one with individual TAs.

**Reflect with the TAs outside of class.** Regardless of setting, the goal of leading by example is to model the teaching process, thereby both challenging and enabling TAs to perform at a high level. Preparing and reflecting with the TAs outside of class helps encourage them to appreciate how and why you make instructional choices and keeps everyone focused on the goals.

**Don't forget to compliment and express gratitude.** It goes a long way to say, for example, "that was a very thoughtful response you wrote to the student question on the online forum - thank you."

## **2.5 Teaching Assistant Feedback Regarding the Five Principles**

In this section we offer direct feedback from TAs we have worked with regarding what makes a successful instructional team, using the framework of the five principles discussed in this paper.

### **2.5.1. Promotive Interaction**

*“I think this was something that happened more towards the beginning of the semester, when we were all meeting together to discuss the laboratory experiments, in particular the specific pitfalls that the students might encounter. Working together as a team with the faculty instructor and the 3 TAs helped build our confidence about the experiments before we went on to teach them to the students. It also allowed us to put ourselves in the students’ shoes so we could come up with challenges they might face while the faculty instructor was there to help us navigate.”*

*“I think a big part is prioritizing the meetings every week. Just an hour a week isn't much, but using the whole thing to go over homework and review the upcoming week's material can be really helpful. When these meetings are not used to the fullest or are skipped entirely, this makes the teaching quality suffer.”*

### **2.5.2 Positive Interdependence**

*“I think the common goal was clear, in that we wanted students to succeed in a) learning how to run the experiments hands-on, b) maintaining safety, and c) applying fundamental chemical engineering equations and concepts for analysis of the experiments. I think what could have made the group interactions even stronger would have been more focus on c) to get the TAs and the instructors on the same page. Most of the suggestions I received from my TA evaluation from the students was that they wanted more help from the TAs on knowing what the professors would expect to see in their technical reports and presentations.”*

### **2.5.3. Individual and Group Accountability**

*“As TAs I think we especially took pride in the success of the students, in each individual lab experiment and in the class as a whole. For example, one TA had a lot of success in helping the students with the brewing experiments, but all of the TAs and the faculty instructor shared in celebrating the success of their final projects, as we all had a small part in the experiments too (like for me, while I wasn't the main brewing TA, I did help with some gas chromatographs and carbohydrate assays).”*

*“In my experience, teaching goes most smoothly when the professor(s) and the TAs are on the same page on the learning goals. This means professors need to spend enough time communicating these learning goals clearly to the TAs, by providing clear lecture notes, and giving specific feedback on material such as each week's HW and discussion notes. And TAs need to take the time to familiarize themselves with the learning goals before teaching discussions and making homework. When this goes well, everybody's work reinforces the others'.”*

#### **2.5.4. Teamwork Skills**

*“Of course communication is important. It was useful when the faculty instructor would stop by at the end of the lab period to see how things were going and if some groups had questions that I could not answer. Giving the TAs input into the decision-making processes also helped us feel like we were part of the instruction process and not just cogs in a lab-class machine. I was happy to take notes about suggestions for improving the lab manuals (or fixing unclear wordings), as I think this helped me feel like I could improve the course for future semesters. I think what made our team successful is that the faculty put a lot of trust in our input.”*

*“When the communication isn't clear from one of the parties, it seems like everyone is telling the students a different thing and this is counterproductive.”*

#### **2.5.5. Group Processing**

*“Reflection is especially important since it gives us a sense of gratification about things that worked well, and points towards ways to improve. This was also especially useful for cases where students were not meeting expectations. For example, it was good to know when a student that was struggling in lab (or was late/not showing up prepared) was also lacking quality in their presentations, or if there was some discrepancy between presentation quality and lab preparation.”*

*“...we could have used some help with each of the five characteristics, particularly Group Processing. Overall, I think that checking in with the instructional team every now and then and using these five characteristics to see what our strengths and weaknesses were would have been very helpful. It's a good list and without the direction this list can provide, it's difficult to pin down exactly where we can improve.”*

### **3. Conclusions**

We hope that the application of these five principles of high-performance teams helps you to make the most of the teaching and learning opportunity of working with graduate teaching assistants. Giving deliberate thought to effective teamwork and management when running your course helps the entire teaching team to do a better job. By embracing team goals, working together, and investing in each other's growth, you go beyond simply making a class function and achieve a higher level of mentorship, inclusion, and education.

Clearly defining roles and responsibilities for TAs facilitates the mechanics of a successful course. We encourage you to go beyond that to create a cooperative and synergistic team effort between the instructors and TAs to accomplish the primary goal of student learning, enhancing



the course, and improving the outcomes for all. The instructor serves as a team leader and a mentor to inaugurate the TAs into the profession of teaching. In turn, the TAs' investments in their own development as instructors as well as in the student learning outcomes result in more efficient execution of the course and more effective outcomes for the students.

## References

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