

Helping Teaching Assistants Foster Student-Centered Learning

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Abstract

We describe the evolution of campus-wide programming to support teaching assistants at the Georgia Institute of Technology towards a more student-centered and process-oriented approach. Stages in this evolutionary process include department-specific content-oriented instruction, a central approach with focus on process skills for teaching, and finally a semi-central approach utilizing inquiry-based learning infused with department-specific content. Additionally, we describe how survey and focus group data can be used to assist transformation in both campus-wide and specific departmental programs preparing teaching assistants for their classroom roles. This evolution then serves as a case study of how formative assessment data can be used to drive a transformation from teacher-centered to learning-centered environments.

Introduction

The Georgia Institute of Technology has been going through an extended process of transforming their programs supporting graduate teaching assistants (GTAs) in their classroom roles to foster a more student-centered and process-oriented approach. We report on the change process and on formative assessment efforts used, in part, to drive this transformation. The program scope is substantial, with 600-700 GTAs employed in any given semester, and 50-75% of these GTAs are involved in leading discussion sections, recitations, and laboratories.

Major factors driving the transformation of these programs include desires to develop the attributes for the program listed in Table 1. The numbers in the second column indicate where these attributes align particularly well with key principles of Process Education (PE). The six (out of 10) key principles of Process Education included in Table 1 are shown here. They are edited for brevity and for specific linkages to the presented program attributes.

1. Educational institutions produce stronger outcomes by aligning institutional, course, and program objectives; by investing in faculty development and curricular innovation; and by embracing an assessment culture.
2. To develop expertise, a learner must develop specific disciplinary knowledge, but also generic, lifelong learning skills.
3. Process educators continuously improve concepts, processes, and tools.
4. Every learner can learn to learn better, regardless of current achievement.
5. Although everyone requires periodic help, the goal is to become a capable, self-sufficient, lifelong learner.

6. Process educators regularly measure accomplishments, model assessment processes, and provide timely feedback.

Additionally, links to the five Process Education pathways from the Compass of Higher Education (institutional development, professional development, learner development, learning & scholarly development, and self-growth) are noted in Column 3 of Table 1. The key principles and the five pathways are both taken from Burke, Lawrence, El-Sayed, and Apple (2009).

It is important to note that the work described in this paper was not specifically rooted in Process Education, though one of the authors is an expert in Process Education. This author had input on the design of some of the data collection tools, and had some minor additional input to program design considerations. In any case, the five pathways of Process Education, along with the key principles of Process Education, can be used to illuminate the transformation process, as they both add meaningful context to the work.

It should also be noted that the listed program goals indicate particular potential for changes in the TA educational experience that are aligned with several attributes of the Transformation of Education described by Beyerlein, Burke, and Hintze (2012). These transformational attributes are *control* of the learning process falling more towards the learner, *delivery* of information being accessed more directly by the learners via active learning, *design* of educational content and experiences to provide a more responsive approach supporting learning, *feedback* for learners and instructors occurring in a robust and assessment-oriented fashion, and *relationships* between all stakeholders in the TA preparation programs being more closely tied together

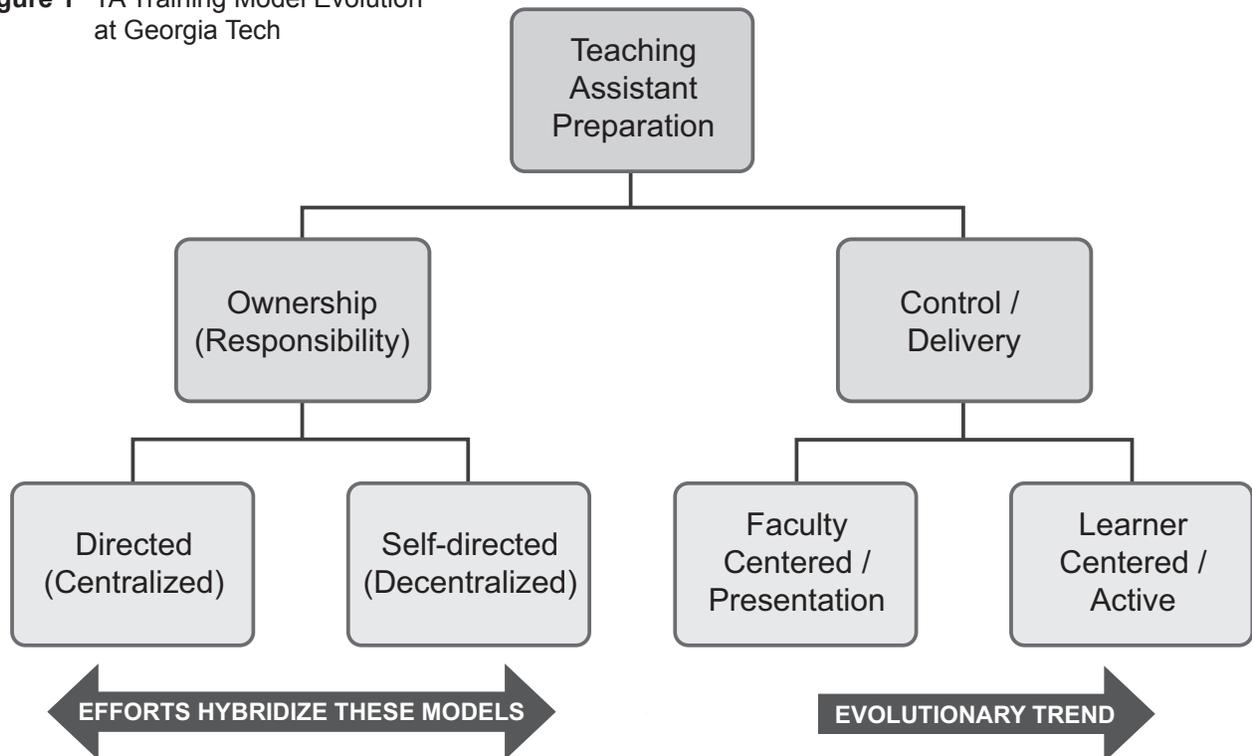
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Table 1 Desired Program Attributes, Process Education Pathways, and Principles of Process Education

Desired Program Attribute	Aligned Principle(s) of Process Education	Aligned Process Education Pathway
<i>Vertical integration</i> of program activities and goals across central administration and departments	6	Institutional Development
<i>A team oriented philosophy</i> where administrators, faculty, and students are active contributors to the program	1	Learning and Scholarly Development
<i>A comprehensive curriculum</i> that includes both general and disciplinary elements	2	Professional Development
<i>Horizontal alignment</i> across program components within and among departments	1	Institutional Development
<i>Ongoing activities</i> that provide continuous support	3	Learner Development
Opportunity for <i>multi-level skills development</i> leading towards instructional autonomy and empowerment as self-growers	4, 5	Learner Development, Self-Growth
<i>A continually evolving program</i> operating within a culture of assessment	1,3	Institutional Development
<i>A culturally embedded system</i> that engenders voluntary extracurricular activities	4	Institutional Development
<i>Publicly accountable processes</i> where outcomes are documented and successes are celebrated	6	Learner Development
<i>Value driven behaviors</i> reflecting program goals throughout implementation	1	Self-Growth

Figure 1 TA Training Model Evolution at Georgia Tech



via significant emotional investment. In general, these changes can be summarized as shown in Figure 1.

Background: Literature Survey

Programs for the development of teaching assistants (TAs) have evolved from simple training for those solely involved in teaching undergraduates to encompassing the educational preparation of “all graduate students for the teaching aspects of their professional careers, whether as faculty or in other walks of life,” (Marincovich et al, 1998). Although our focus leans towards the latter definition of professional educational preparation programs rather than training programs, the literature tends to refer to all programs as “training”, so we use the term “training” somewhat liberally in the following discussion. A thorough summary of the available literature and various programs (up to 1998) is provided in Chapter 1 of *The Professional Development of Graduate Teaching Assistants* (Marincovich, Prostko, & Stout, 1998). Now, in the 21st century, the role of graduate students as teachers of undergraduate students continues to steadily increase as enrollment in American colleges and universities continues to grow (Flora, 2007).

Given this situation, we now summarize what is known about how to build the appropriate knowledge, skills, and disposition for those TAs to be effective in their growing roles across both the administrative and pedagogical aspects of teaching. In 1980, Carroll commented on “the limited extent of empirical research on the effects of [TA] training [programs]” despite the proliferation not only of TA development programs, but also of handbooks, catalogues, and other published support materials, many of which rely on “simply describing innovative ways of conducting such programs.” Abbott, Wulff, and Szego (1989) provide a detailed review of research studies on the effectiveness of TA preparation programs. In their literature review, the authors classified the published research studies into three categories: “(1) reports on components of TA training programs, (2) research on TA characteristics correlated with student ratings or achievement, and (3) articles that reported relationships among self, supervisor’s and/or students’ ratings of TAs.”

Among the reports on components of TA preparation programs were 13 studies that utilized training and non-training groups with pre- and post-testing as measures. Though the studies varied as to what aspects of TA training were being researched, in general, the results revealed that the groups that received training fared ‘better’ than the groups that received no training; better generally being defined by higher ratings. It is noted that the studies reported by Abbott et al. were relatively ‘small’ with the largest study being that of Murray and Smith (1989) which

involved 60 TAs in psychology, English, and geography. Of particular interest to our study was that conducted by Bray and Howard (1980) in which 38 TAs from various departments were divided into training vs. non-training groups with one training group receiving a 10-hour training seminar on topics such as 1) developing goals for teaching and assessing teaching ability, 2) planning and organizing course materials, 3) teaching by instructional objectives, 4) managing classroom interactions, and 5) utilizing feedback effectively. The other training group received video consultations regarding their teaching. In this study, the TAs both self rated and received student ratings regarding TAs’ teaching methods and techniques using pre/post training surveys.

The studies which involved research on TA characteristics correlating to student ratings or achievement, as reported by Abbott et al., involved 8 studies that attempted to correlate personal characteristics of the TAs with their effectiveness as perceived and reported by the students in the classrooms or as evident from actual scores of student exams. Of particular interest to our study were the results of Bos et. al., (1980) which correlated “the TA’s level of experience to the student’s rating of knowledge, organization, and rapport” and “the prior degrees earned by TAs to student ratings of the TAs’ knowledge, clarity, enthusiasm, organization, and preparation.” In addition, a study by O’Hair and Babich (1981) demonstrated that “TAs’ awareness of effective components of classroom behavior was related to the ratings they had earned.” These studies clearly show that TAs may be *perceived* as more effective if the TAs receive educational training that develops awareness of effective components in the classroom. Indeed, we would argue that this educational training (or, more accurately, participation in professional educational programs supporting TAs’ roles in the classroom) will produce better *actual* performance as well. Of the 8 studies reported, the largest group was a study by Tomita and McDowell (1981) that involved 151 TAs from varied departments. However, this study was limited in factors related to the present study. Further, the broadest study in terms of rating TA skills is Jacobs and Friedman (1988), which included student ratings on 13 items. However, it involved only 5 different courses in only two departments

Three decades after the comments by Carroll, the dearth of empirical research continues. Most of the available literature regarding TAs is descriptive and anecdotal (for instance, Curzan and Damour (2006)) or *ethnographic/small-scale* (such as Gorsuch and Sokolowski, (2007)). Much of the most recent literature regarding graduate students pertains to Preparing Future Faculty (PFF). Two good examples of the recent work include Janke and Colbeck (2008) and Wimer (2006).

Evolution of Educational Programming Supporting TAs at Georgia Tech

Historical Context for Existing Program

In 2004, educational programming for TAs was conducted within individual departments, and issues related to undergraduate TAs surfaced in several departments indicating the need for some form of oversight to ensure that common needs were addressed across the campus. A committee was formed to examine institute policies regarding TA educational programs. Their recommendations resulted in the formation of a credit-bearing course for undergraduate TAs. Shortly after this the position supporting TA programming within the Center for the Enhancement of Teaching and Learning was transformed to a full-time position dedicated exclusively to graduate student development, with a strong focus on educational programming for TAs. This person oversaw the creation of a TA advisory committee.

Next, the concept of a parallel structure for graduate and undergraduate TAs began to evolve. This led to the proposal and implementation of a credit-bearing course for graduate TAs in addition to the undergraduate TA course. The course was housed within the Center for the Enhancement of Teaching and Learning and provided a campus-wide “syllabus template” to guide the course when implemented in individual departments.

Initial implementation of existing program

Pilot versions were implemented in 2006 utilizing math, chemistry, biology, and physics. This was followed with a full rollout of multiple sections across different departments in 2007. The goals for this graduate-level course were articulated as shown next.

- Introduction to general principles of effective teaching including classroom management and pedagogical techniques (PE Principle 2)
- Develop discipline-specific teaching and learning skills (pedagogical content knowledge) (PE Principle 2)
- Familiarity with campus resources supporting teaching and learning
- Increased awareness/understanding of institutional policies and procedures relevant to teaching, and in particular relating to academic integrity/ethics (PE Principle 1)

It should be noted that these course goals, as with program goals noted in the introduction and design elements displayed next, bear significant ties to

several key Process Education principles (shown in parentheses).

The design of the course included the following elements:

- Credit-bearing course, 1 hour, Pass/Fail
- Leveraging of existing course and program curricula (PE Principle 3)
 - undergraduate TA course
 - existing departmental TA programs
 - campus-wide TA orientation
 - TA web training modules
- Curriculum flexibility for departmental implementation (PE Principle 1)
- Necessitates development and utilization of *Teaching Handbook* (for faculty and TAs) (PE Principle 1)
- Seen as a first step in graduate student development (for both teaching and other career-related activities) (PE Principle 3)

These design elements led to an initial implementation of the program that was integrated into departments as much as possible, yet organized from a central entity. The advantages of an integrated program are several. First, it ensures that institute goals for TA preparation are satisfied across all units. Second, it ensures that departmental buy-in is generated because local goals are built into the program. Third, it naturally generates program documentation at the university level which enhances transparency and accountability. Finally, it serves as an official incentive for graduate students to participate in GTA programming with transcript-level acknowledgement of their participation.

It should also be noted that the GTA and UTA programs were not designed within the isolated environment of Georgia Tech’s university culture, but rather incorporated many “best practices” identified from research conducted when exploring possibilities for GTA programs. These “best-practices” include an orientation seminar at the beginning of each semester, opportunities for ongoing educational activities and discussion with peers and faculty throughout the semester, and the utilization of mentor GTAs and/or other peer-mentoring structures.

Integration of Existing Program with Additional Professional Development Opportunities

In 2009 the graduate TA preparation course was placed in a new context as the “first step in graduate student development (for both teaching and other career-related activities).” At that time a number of new courses to follow the TA preparation course were approved for

development as a result of a grant obtained to support students as they pursued the pathway toward careers in teaching. This program, called Tech to Teaching, is a three-tier teaching certification program for graduate students at Georgia Tech that includes foundational, intermediate, and advanced courses plus practicum and immersion experiences. Because of the new focus on supporting the career path, the preparation course (or foundation course in Tech to Teaching) now needed to serve as the first step in a real sequence of courses. The Preparing Future Faculty model was used to design a several-course sequence culminating in the opportunity to serve as instructor of record for a course rather than as a teaching assistant. This created

the opportunity to focus on professional development in the TA preparation course with an eye towards additional later opportunities. However, the published course goals were not explicitly adjusted at that time.

New Pilot Program in Biology

Finally, in fall 2012, we piloted a new, more process-oriented approach to the course for new graduate teaching assistants. To understand the significance of the changes that were made, it will be useful to make a comparison to the previous course, as shown in Table 2, in terms of program goals, and in terms of how the delivery of the course is structured. These elements are described in more detail after Table 2.

Table 2 Comparison of existing program to new biology program for TA preparation

<i>Existing Program</i>	<i>New Biology Program</i>
Summary of Program Goals	
(1) ...be able to explain the value of being a TA in terms of their own professional development (marketability: communication skills, time management, administration, project management, interpersonal skills; knowledge of topic; easier transition later) and career goals.	(9) ...Recognize teaching as a set of transferable skills useful for their own future career goals.
(2) ...be able to explain the impacts a TA can have on the intellectual, social and emotional development of GT students.	(10)...Reflect on their teaching practice in order to continually improve.
(3) ...participate in discussions about being a TA and build a community of support among their peers, with the instructor, and with CETL.	
(4)* ...be able to use the knowledge that his/her teaching responsibilities will vary depending on the supervising faculty's expectations to formulate questions in order to communicate with the supervisor about expectations, policies and duties at the start of and throughout the semester.	(8) ...Coordinate responsibilities with their faculty supervisors and co-TAs in a professional manner.
(5)* be able to identify situations which may be in violation of GT policies and procedures and determine the appropriate course of action.	(7) ...Apply GT strategic priorities, policies, and procedures to their teaching contexts.
Structure of Program Delivery	
19 hours total (4 during orientation +15 during for-credit course)	15-20 hours total (10 during 2 day pre-semester TA development workshop, and 5-10 during for-credit course)
Orientation focused primarily on policies and procedures (3 hours) with 1 session about teaching skills (1 hour)	2-day pre-semester workshop focuses on immediate, urgent teaching skills (9-10 hours) with minimal time on policies and procedures (1 hour if at all)
Course curriculum was developed according to instructor's knowledge/preference	Course curriculum is being developed in response to critical areas identified through a needs-assessment process done with each school
Outside of Tech to Teaching path	New program is integrated with the longer-term professional development goals in higher education of Tech to Teaching

Issues with Existing Program

The old TA preparation course, though centrally designed, had been offered in a traditional semester format by a faculty member from the home department. Students would meet for 50 minutes once a week and would receive 1 hour of course credit. Typically, this course was taken concurrently with their first teaching assignment. While the Center for the Enhancement of Teaching and Learning (CETL) provided course instructors with some basic learning goals and general guidelines, it was up to each instructor to determine the specific curriculum according to what she or he thought best. The result was a highly variable course depending on the instructor's knowledge and interest in teaching and learning theory and on the extent of their awareness of the demands of the TA's assignments. Even so, students provided us with feedback that the course was helpful in preparing and supporting them in their TA roles. However, there was room for improvement in making the course more relevant to their needs as first time TAs in their respective disciplines.

In addition to the course, TAs would take a four-hour orientation prior to the beginning of the semester. This orientation was not specifically integrated with the for-credit TA preparation course. It was also multidisciplinary and centrally facilitated by CETL; TAs from across all the schools on campus took it at the same time, typically the week before the semester began. This orientation focused primarily on policies and procedures, including institute rules governing the privacy of student information (FERPA), academic integrity, accommodations for students with disabilities, and restrictions on sexual harassment and romantic relationships between instructional staff and students. While every effort was made to model learner-centered teaching practices during these sessions, the main thrust of this orientation has not been pedagogical. Students have generally shared the feedback that it did little to prepare them for their new role as teaching assistants.

Design Details for the New Biology Program

Beginning in the spring of 2012, we partnered with the School of Biology to develop a new approach to TA preparation. Biology needed a program that better prepared their TAs to facilitate inquiry-based labs, an approach that engages introductory students in the process of scientific inquiry, including experimental design and analysis, rather than following a pre-determined list of steps where the outcome is already

known and students work to confirm it. Under the old for-credit course/orientation model, the TAs were taking a long time to master the basics of facilitating inquiry labs, making it more difficult for their students to accept the different lab format. After a rigorous needs-assessment process (described following), the following learning goals were created:

1. Create a valuable student-centered learning experience.
2. Assess the level of student understanding using inquiry teaching practices and rubrics.
3. Understand that learning new content is a part of teaching and develop strategies for doing so efficiently.
4. Craft explanations about concepts in response to students' level of understanding.
5. Identify and use active learning strategies appropriate to learning goals.
6. Manage group and classroom dynamics including incivilities that may arise.
7. Apply institutional strategic priorities, policies, and procedures to their teaching contexts.
8. Coordinate responsibilities with faculty supervisors and co-TAs in a professional manner.
9. Recognize teaching as a set of transferable skills useful for their own future career goals.
10. Reflect on their teaching practice in order to continually improve.

Once we had the learning goals, we next structured the course assessments and activities according to Fink's process for developing courses for significant learning (2003). In addition to honoring the major needs we had uncovered during the needs assessment process, we wanted to develop a format that would allow the TAs to engage with the material when it was most relevant to their TA assignments. We realized that they needed to learn some skills very early in the semester, even before entering their labs and classrooms for the first time. To meet this need, we decided to redistribute the hours of the old for-credit course and orientation so that approximately half of them occurred during the week before the semester began in an intensive program we called "Jump-Start to Teaching." The remaining 10 hours were distributed throughout the semester, with some weeks being "free" for the TAs. Table 2 displays a list of how we distributed the sessions:

Table 3 Biology for-credit TA preparation course, fall 2012

Jump-Start to Teaching Session (90 minutes each):
1. Setting the Tone on the First Day of Class
2. Experienced TA Panel (60 minutes)
3. Teaching Inquiry Labs
4. Engaging Explanations
5. Microteaching 1
6. Classroom Management
7. Building Professional Relationships

Semester Sessions (50 minutes each):
1. "Teaching What You Don't Know"/Leading
2. Grading Basics
3. Grading Trouble Shooting
4. Group Work
5. Midterm Evaluations
6. Active Learning Principles
7. Active Learning Continued
8. Time Management
9. Microteaching 2
10. Teaching as Professional Development

Research on Existing Program

General Description of Study

This research represents an institutional level case study using mixed methods for assessment. Assessment instruments used to collect data for the research include surveys of students and TAs, along with a focus group interview of TA coordinators and, later, a needs assessment for Biology conducted via interviews and focus groups. The IRB protocol described the research as follows:

This research explores the effectiveness of various aspects of the TA training programs run by CETL in conjunction with individual schools at Georgia Tech. This includes general principles of effective teaching including classroom management and pedagogical techniques, awareness of policies and procedures regarding teaching and learning at Georgia Tech, familiarity with campus resources, the development of discipline-specific skills, and the fostering of positive attitudes and motivation about TA instructional roles.

The research questions being explored are:

1. What aspects of TA preparation produce the greatest impact in terms of pedagogical knowledge, readiness, and motivation for their instructional role?
2. How effective is TA instruction of students perceived to be?
3. How can the Center for the Enhancement of Teaching and Learning (CETL) and individual departments supporting TAs partner effectively?

Subject Recruitment and Data Collection

The first survey was conducted among students (graduate and undergraduate) who were participating in the TA preparation programs/courses on campus. Solicitation of TA participation in the survey occurred through direct e-mail requests sent by departmental TA coordinators. The second survey involved undergraduate students in introductory science, technology, engineering, and mathematics courses which utilized TAs. For this survey, flyers were posted online and around campus to advertise the survey. Additionally, e-mails soliciting participation were sent to all students enrolled in the target courses. Participation in the study was optional, however, as an incentive for participation a raffle of an iPod Shuffle was conducted among those who opted to provide their personal information. Their personal information was not associated with their responses.

For both surveys, the data was collected using Survey Monkey. Survey Monkey is a Safe Harbor Company and only the researchers had access to the data. Consent was obtained at the start of each survey; however, students were assured of the confidentiality of their responses. Their personal information was not associated with their responses and only the researchers had access to the data.

For the focus group, each TA coordinator was individually emailed with a request for their participation in a discussion about TA preparation on campus. The focus group discussion was designed to last approximately 60 minutes and utilized a series of round-robin questions followed by a series of open discussion questions. An audio recording of the discussion was produced and hand-written back-up notes were taken by the focus group facilitator. Following the session the recorded comments of the participants were transcribed for later analysis.

For the needs assessment in Biology, we engaged in a needs assessment process with the broad goal of using

a more inquiry-based, student-centered approach to teaching and learning. The purpose of this needs assessment was to identify the critical areas that should be addressed in the newly imagined program. We collected information for the needs assessment through lab observations, semi-structured interviews, focus groups, and surveys.

Assessment Instrument Content

The instruments used to collect data about TA abilities to facilitate student learning are briefly described here.

Survey of TAs

The survey included 4 demographics questions and TAs were asked to rate 15 aspects pertaining to their role and preparation as TAs. Using a 5-point Likert-type scale from *very weak* to *very strong*, students were asked to rate:

1. Their understanding of typical teaching and learning issues
2. Their ability to implement the techniques that have been addressed
3. Their perception of the level of support they received on a departmental level for their role as TAs

The survey also included 5 open-ended questions asking the students to provide feedback and suggestions regarding the programs they participated in to prepare them for their classroom roles as TAs.

Survey of Students in Courses with TAs

The survey asked students 5 general demographics questions and 17 questions pertaining to each of their TAs in those courses. (Once a student completed the questions pertaining to one TA, they were given the option to respond regarding a different TA.) Among the 17 questions, 5 were for classification/TA demographics. The other questions asked about

1. TA's ability to communicate in English
2. Rating TA skills in 10 aspects of teaching and learning which were featured in the instruction on a 5-point Likert-type scale from *Very Good* to *Very Poor*
3. TA influence on student interest in the subject

Focus Group of TA Coordinators

The focus group discussion centered on three main aspects:

1. How and why departments are using TA preparation programs
2. The impact the TA preparation programs are having
3. Suggestions for improvement or other comments about the TA preparation programs

Needs Assessment in Biology

We spoke to various stakeholder groups, including faculty, TAs, and students enrolled in TA-led lab sections. Each faculty member responsible for supervising one or more TAs in Biology was interviewed and asked about the essential knowledge, skills, and attitudes they needed their TAs to have. Following this open discussion, the faculty members were asked to complete a survey of major TA competencies based on the literature. TAs also completed this survey during a focus group that asked them to reflect on the knowledge, skills, and attitudes they felt were important for TAs based on their experience. In addition, TAs shared their insights about which aspects of the professional educational preparation had been the most or least helpful in supporting these needs. TAs' interactions with students were observed during twelve lab periods. Finally, students' thoughts about their TAs' teaching effectiveness were collected anonymously in mid-semester student evaluations.

Study Results

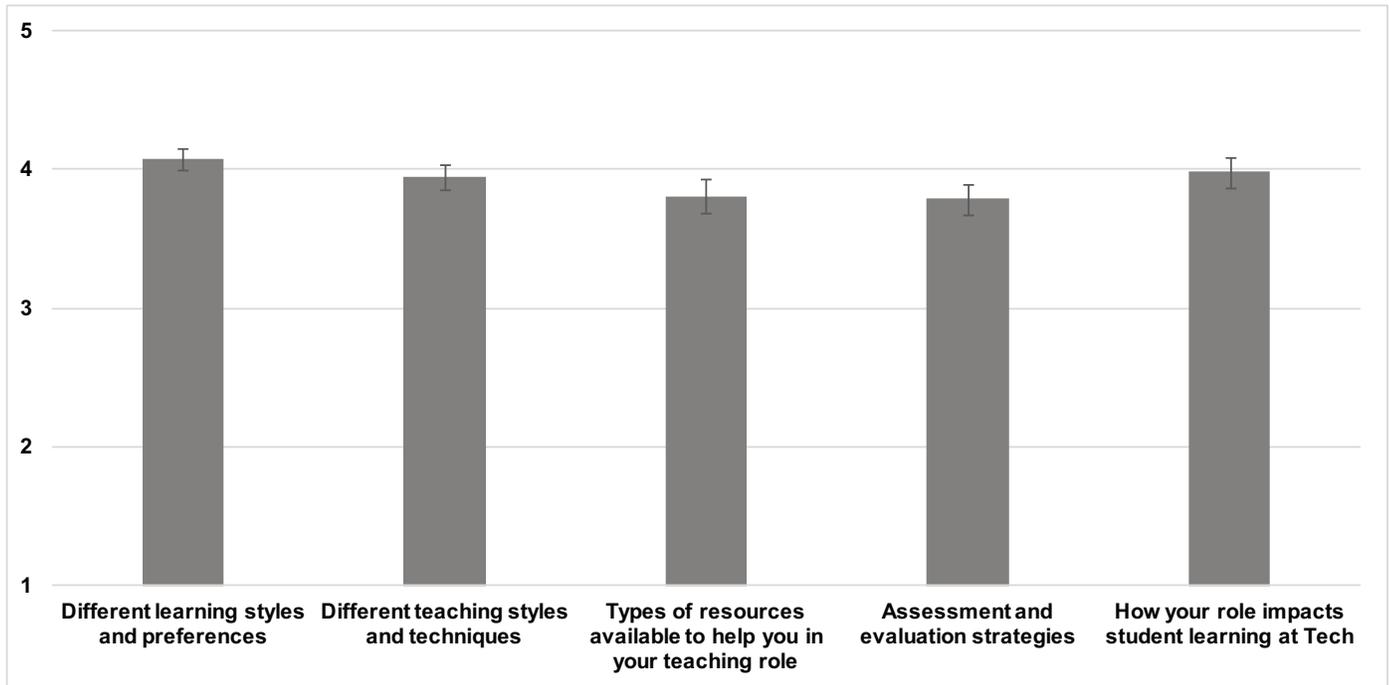
Results from Survey of TAs

The first survey was conducted among students who were participating in the TA preparation programs/courses on campus. We received 53 valid responses corresponding to a 33% response rate. Of those, 34 responses were from graduate TAs and 19 from undergraduate TAs. The breakdown by role was as follows: 24 lab TAs, 16 recitation TAs, 15 graders, 5 other (lecturers, tutors, stockroom, etc). Note that a TA may have multiple roles. Gender was not surveyed. The quantitative items on the survey used a 5-point Likert-type scale from 1 (*very weak*) to 5 (*very strong*). For analysis these responses were converted to numerical values from 1 to 5. The primary descriptive statistic we report is the mean value of responses. In addition, standard error is shown using error bars on the figures and are given by:

$$\text{standard error} = \frac{\sigma}{\sqrt{n}}$$

where σ is the standard deviation and n corresponds to the size of the sample.

Figure 2 TA ratings of their understanding of 5 teaching and learning issues. 1=very weak; 5=very strong



First, students were asked to rate their understanding of typical teaching and learning issues. TAs appear generally to feel they have a solid understanding of the areas surveyed, as seen on Figure 2.

For this question we also explore whether TAs perceived that they were better prepared in certain areas of the program than in others and, if so, whether that difference significant. To explore whether the differences seen have any significance, t-tests were carried out for two-sample unequal variances using a two-tailed distribution. T-tests assess whether the means of two groups are statistically different from each other. Results of the t-tests show that we do significantly better on helping students understand learning styles and preferences than we do on helping students understand assessment and evaluation ($p < .05$), and we do marginally better on helping students understand learning styles and preferences than we do on helping students understand the resources they have available for help ($p < .1$).

Figure 3 separates the data from Figure 2 by group - graduate TAs and undergraduate TAs. At first glance, it appears that undergraduates consistently feel more confident in understanding course content than graduate students. However, no statistically significant differences were found between the means obtained for graduate vs. undergraduate TAs.

The next part of the survey asked the TAs to rate their ability to implement the techniques that had been presented in the programming they participated in. The combined results for graduate and undergraduate TAs is presented in Figure 4. Interestingly, students felt most strongly that they could

engage students positively to impact learning. However, they felt much less confident that they could effectively implement alternative pedagogical techniques. This appears to be counterintuitive since the course attempts to introduce alternative pedagogical techniques often specifically aimed to increase the level of student engagement.

Again, t-tests were implemented to explore whether the differences were statistically different from each other. The TAs in our sample were significantly more confident in their ability to engage students than they were in either implementing alternative pedagogical techniques or using resources and information about teaching and learning that might help them better understand and implement those techniques ($p < .05$).

Next, in Figure 5, we separate the results for graduate and undergraduate TAs. The only statistically significant difference between responses for graduate TAs vs. undergraduate TAs was obtained for “ability to implement alternative pedagogical techniques” which had a level of significance of < 0.001 . It is also notable that while Figure 3 indicated the lowest-rated category to be “implement alternative pedagogical techniques,” our data shows that this was primarily due to lower levels of confidence on the part of graduate students, who had significantly lower confidence in their ability than undergraduates in this area. One possible explanation for this result is that the undergraduate population was engaged almost entirely as recitation TAs in one department which had been moving towards utilizing Peer Led Team Learning (PLTL) as the primary delivery technique. Thus many of these undergraduate TAs may have been involved in the PLTL pilot sections where they were

Figure 3 Graduate and undergraduate TA ratings of their understanding of 5 teaching and learning issues. 1=very weak; 5=very strong

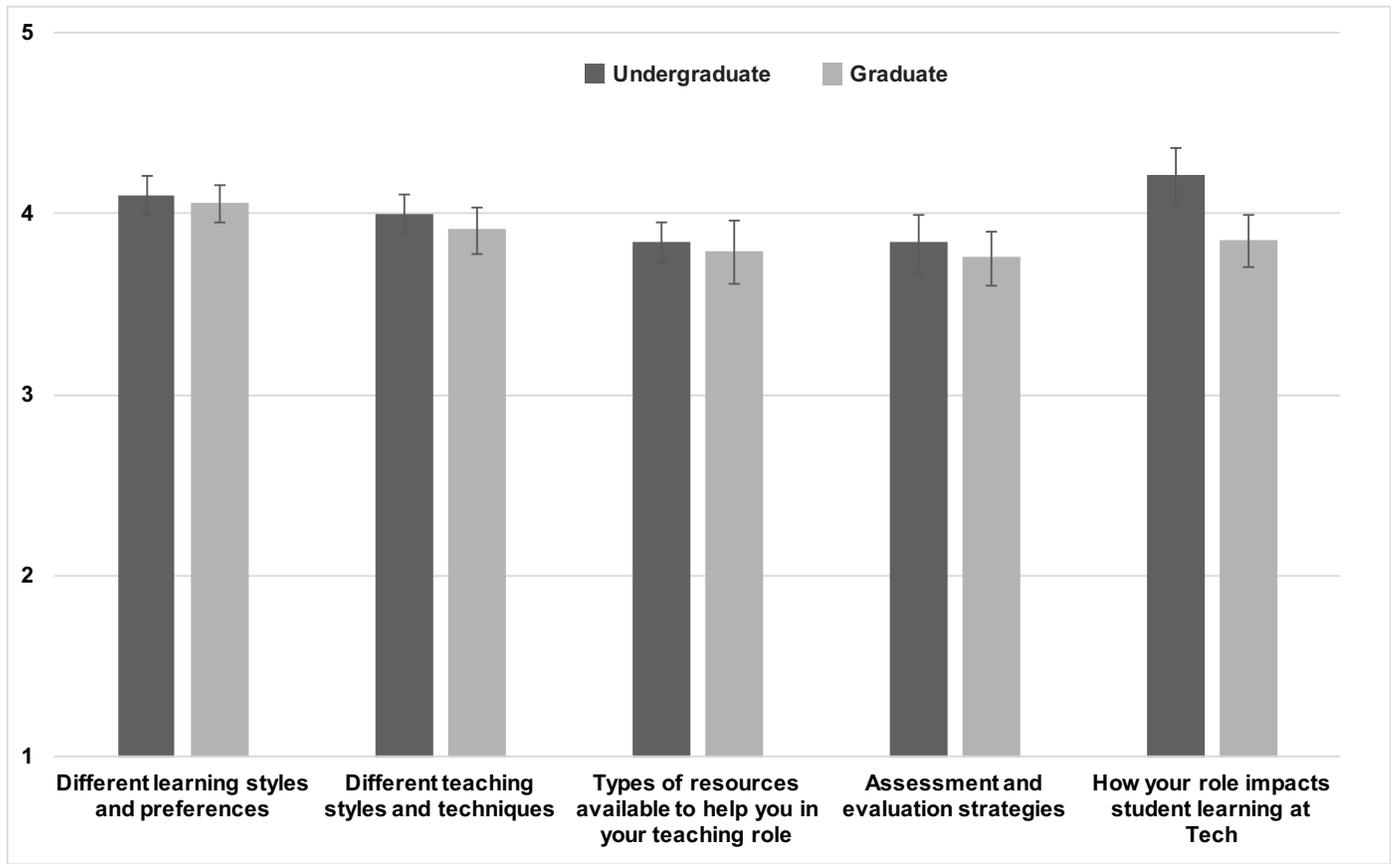


Figure 4 TA ratings of their ability to implement various techniques discussed in the program. 1=very weak; 5=very strong

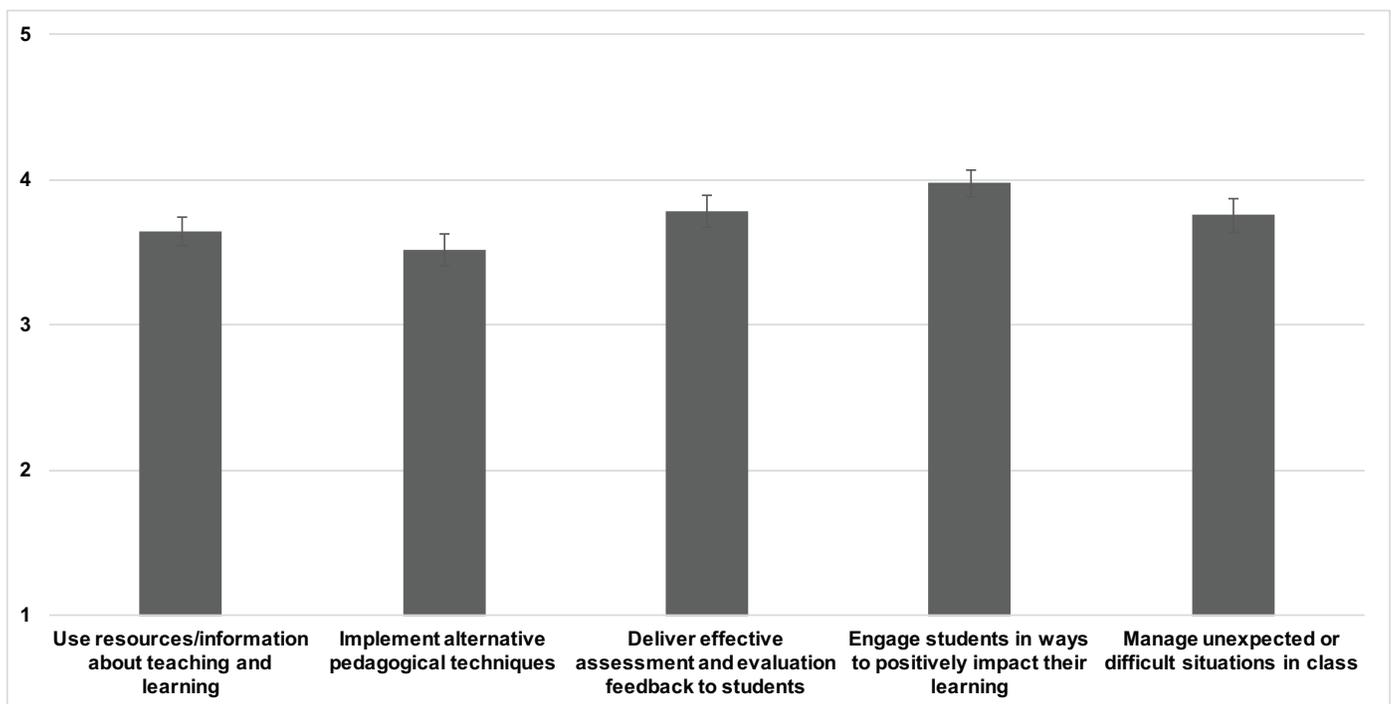
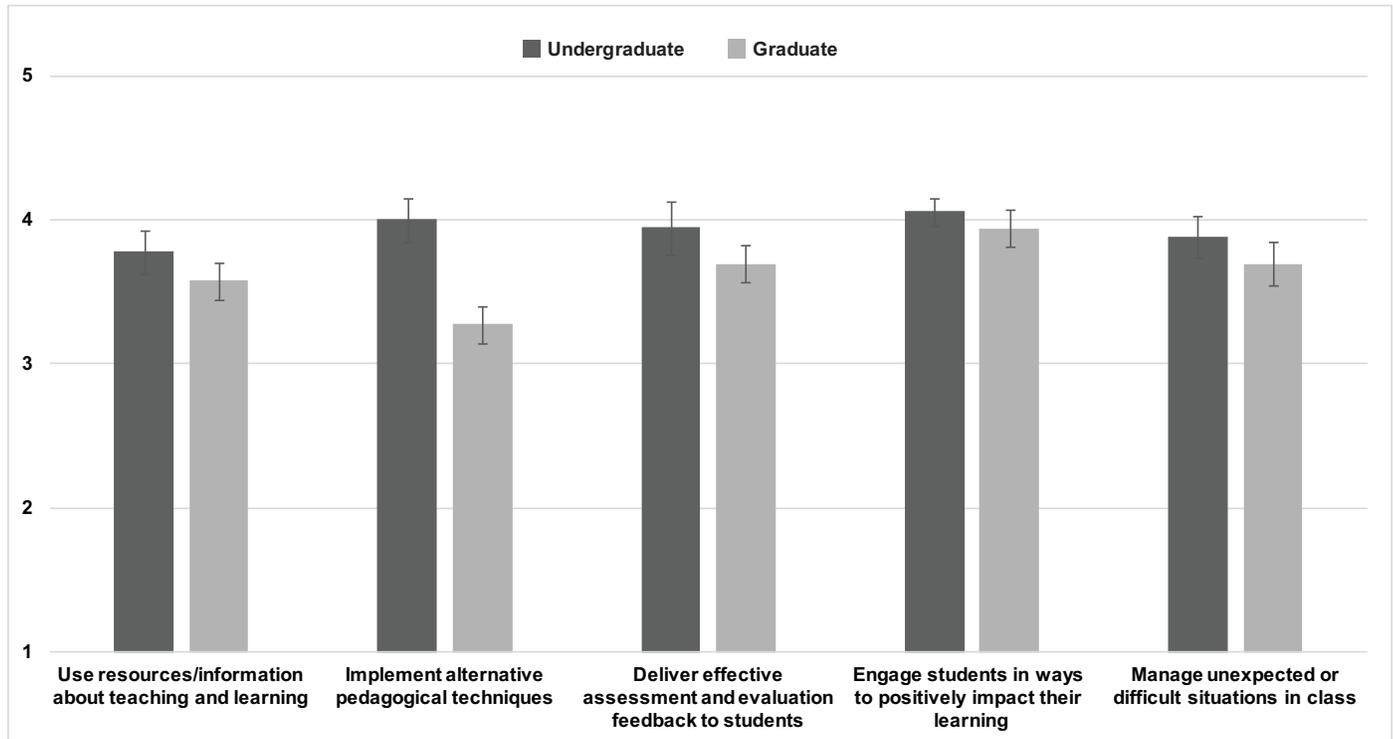


Figure 5 Graduate and undergraduate TA ratings of their ability to implement various techniques discussed in the program. 1=very weak; 5=very strong



expected to implement “alternative” techniques and had the opportunity to practice whereas many of the graduates did not. This result may then underscore the importance of real-world contexts in which learning can be applied.

Next, the TAs were asked to rate their perception of the level of support they received on a departmental level for their role as TAs. The results are summarized in Figure 6. These results reinforce the program goal of utilizing discipline-specific sections. TAs appear to have felt valued and supported by their departments more than they felt prepared by the actual program, and the results of the t-test confirm this. This result suggests it is important to match program outcomes with program values and expectations.

When looking at Figure 7 comparing graduate and undergraduate TA responses, it appears that the undergraduates perceived the information at a higher level than the graduate students. However, values were not statistically different.

The survey also included 5 open-ended questions asking the TAs to provide feedback and suggestions regarding the TA preparation program. Three major themes were encountered in the comments:

1. Redundancy within the programs is a problem; this was mentioned 17 times.
2. Efficiency, especially with regards to TA orientation, needs to be improved; this was mentioned 5 times.

3. Relevance is a problem; this was noted 10 times. The most common types of comments or themes are summarized next, with the number of times an individual theme was cited shown in parentheses:

- Apparent agreement on what we are doing well or can do more of to improve
 - *Specific techniques* on teaching are helpful (6)
 - *More technical depth* is helpful (8)
 - *Microteaching* is beneficial (5)
 - *Learning styles* are helpful (5)
- Possible agreement on what we are doing well or can do more of to improve
 - More *teaching action*, less talk about it (3)
 - Put *honor code* stuff first (3)
 - Focus on preparing future *faculty/teacher prep* (3)
 - Remove *buzzwords*, educational jargon (3)
 - *Sharing* ideas with others helpful (3)

Given the information just presented, an assessment of the overall results from the survey of TAs is provided here:

- Strengths
 - TAs are valuing learners as individuals (different learning styles and needs, etc.) which is a foundational need before one can consider further enhancing a student-centered inquiry-based approach

Figure 6 TA ratings of their perception of the level of support they received on a departmental level for their role as a TA. 1=very weak; 5=very strong

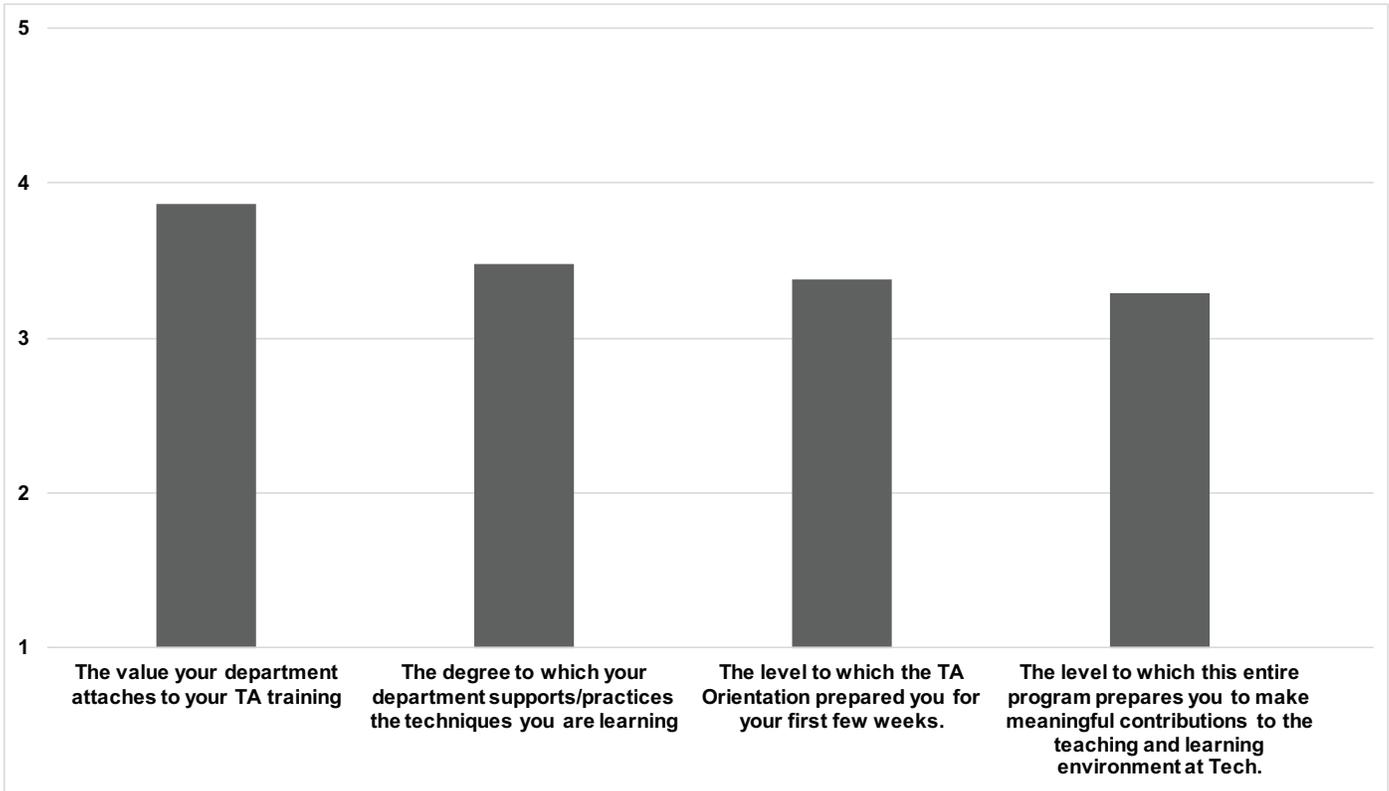
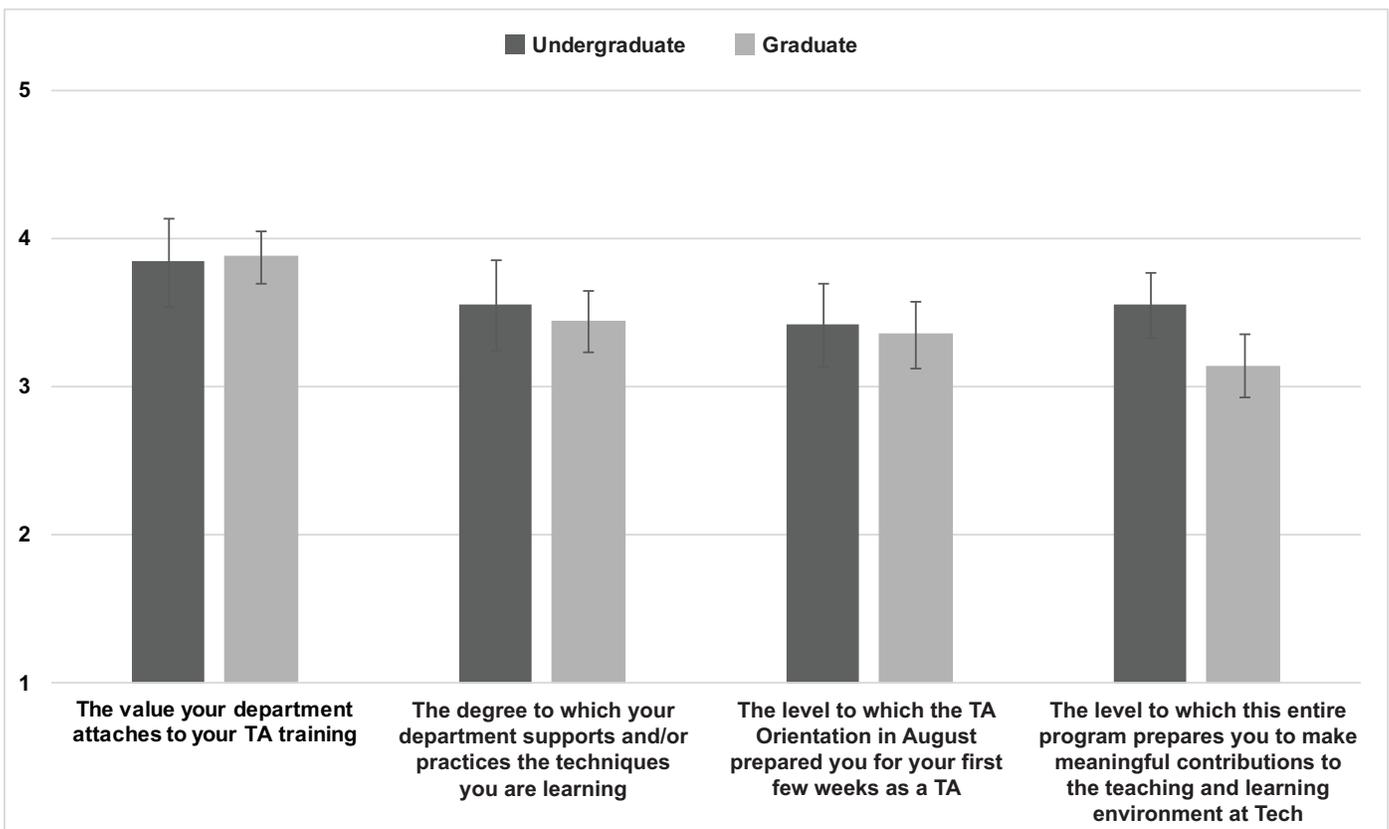


Figure 7 Graduate and undergraduate TA ratings of their perception of the level of support they received on a departmental level for their role as a TA. 1=very weak; 5=very strong



- TAs value the importance of engaging students, which means the TAs will be more open (less resistant) to learning about a variety of pedagogical techniques and tools they can use to help students
- Areas of Improvement
 - TAs would like opportunities to practice using specific “alternative” techniques relevant to TA roles. These opportunities might be implemented as activities to replace items where redundancy is perceived.
 - TAs have little experience with assessment and evaluation as separate concepts. This might be addressed by modeling assessment practices more explicitly during the program.
- Insight
 - The data presented here needs to be considered along with other new data as it becomes available to triangulate among various types of information we receive about TA preparation programming

Results from Survey of Students about TAs

A Multivariable Analysis of Variance (MANOVA) was conducted to seek relationships between variables in this survey. A MANOVA analysis allows us to seek which variables influence the pattern of responses. We are interested in knowing if, as a group, the data sets are different from one another. The MANOVA analysis highlights subgroups that show significant differences within the groups and thus facilitates which data sets to look into more closely. Four main questions were analyzed using this method. Significant results at or below the 0.05 level (95% confidence interval) related to these questions are summarized in the shaded cells of Appendix A, and these results are described in more detail next.

The first question analyzed was “Do student/TA gender combinations differ in terms of how they rate the following educational interactions: influence, overall teaching ability, using activities, and connecting on a personal level?” The results suggest that TA gender significantly influences student responses rating TA usage of activities to get students involved. Female TAs were rated higher (average score 3.53) than their male counterparts (average 3.21), as shown in Figure 8. Female TAs corresponded to 30% of the student responses. Regarding the other dependent variables, no significance was observed with respect to TA gender. In addition, the responses did not reveal a difference based on student (as opposed to TA) gender.

The second question analyzed via MANOVA was “Do GPA and class standing combinations differ in terms of

how students rate the following educational interactions?” In this case, several instances of significant difference are observed. When looking at all dependent variables as a group, the combination of GPA and class as well as GPA alone yielded significant differences in the results. Looking at the dependent variables individually, it is seen that class standing impacted student responses rating TA’s delivery of quality and timely feedback. Examining the data for this dependent variable as shown in Figure 9, it is seen that junior-level students rated the TAs lower (average 3.5) than both freshman-level or sophomore-level students; however, the majority of the courses that employ TAs are freshman and sophomore-level courses and the number of juniors who responded to the survey was lower (8%).

GPA, according to the MANOVA analysis, showed significant differences when it came to student ratings of the dependent variables tested: overall teaching ability, connecting on a personal level, delivery of feedback, as well as the TA’s influence on the students’ interest in the subject. For the first three of these four variables influenced by student GPA, the results show GPA is a significant factor. The mean values with standard error can be seen in Figure 10. Regarding the fourth variable, influence on student interest in the subject, students with higher GPAs appear to respond positively with much higher frequency than students with lower GPAs, as shown in Figure 11. This may indicate a need to help TAs tailor their classroom activities feedback better to students who are struggling. Such a change would align the first principle of Process Education: that every learner can learn to learn better.

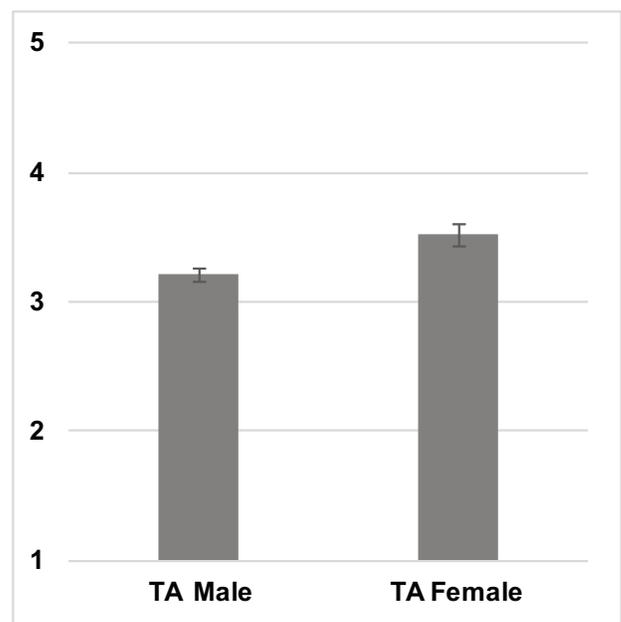


Figure 8 Student responses regarding TA ability to involve students in the learning process via the use of activities, by TA gender. 1=very weak; 5=very strong

Figure 9 Student responses regarding TA ability to provide quality and timely feedback, by student class. 1=very weak; 5=very strong

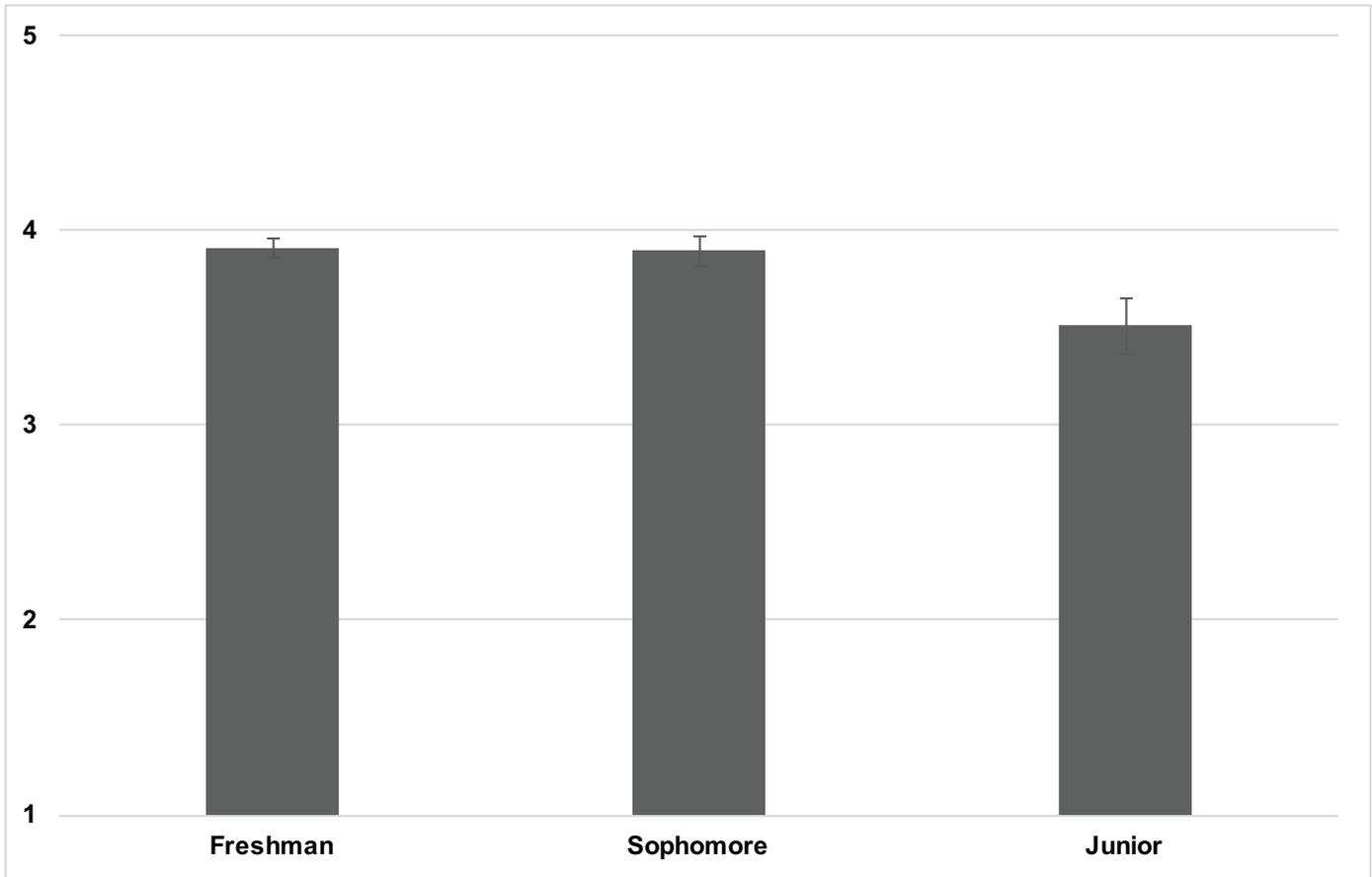
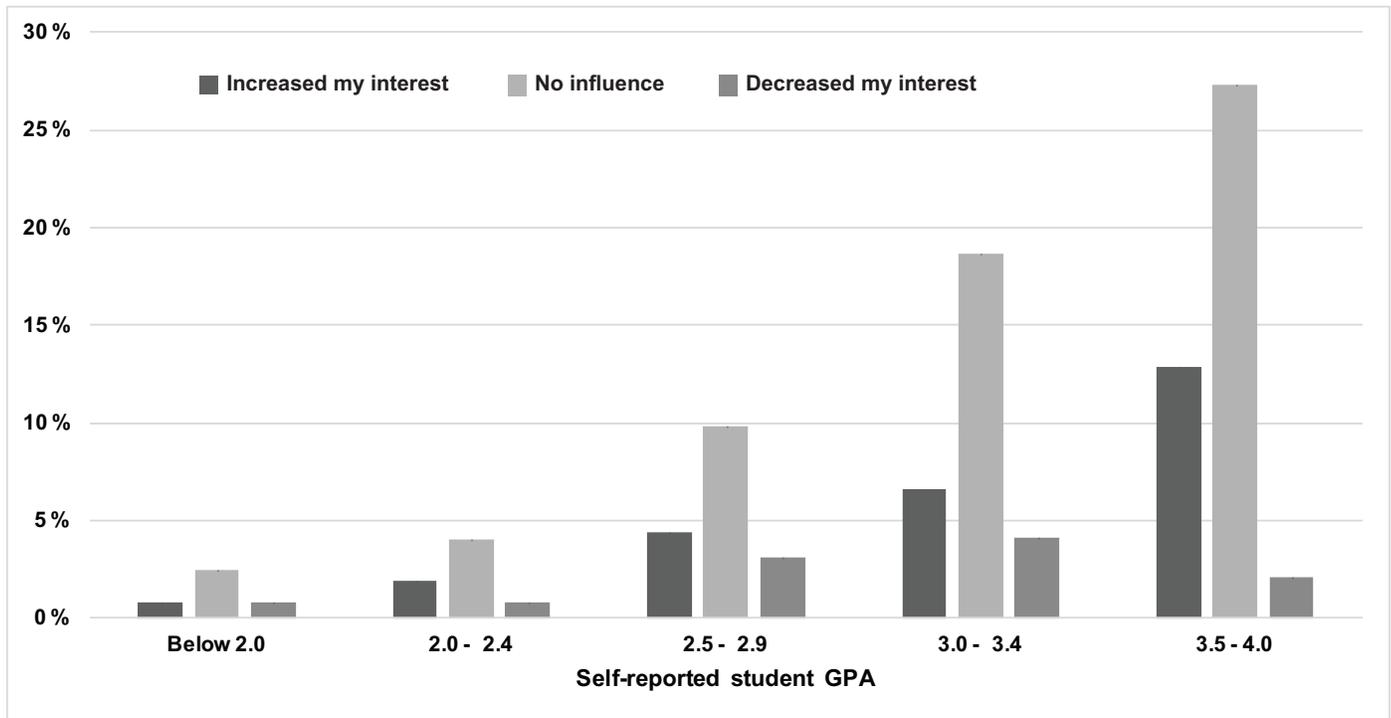


Figure 10 Student responses regarding TA feedback, teaching ability, and connection with students, by student GPA. 1=very weak; 5=very strong



Figure 11 Student responses regarding TA influence on student interest in the subject, by student GPA.



The third question analyzed asked “how does the amount of time spent with the TAs differ in terms of how students rate the following educational interactions: influence, overall teaching ability, connecting on a personal level, and delivering feedback?” In this case, all four items displayed a significant difference. The data is depicted in Figure 12 and it can be observed that in general, the more time spent receiving instruction with a particular TA the higher the average ratings of TA feedback, teaching ability, and connecting to students. However, as shown in Figure 13, there appears to be a limited amount of time spent with TAs beyond which students become somewhat immune to the influence of a TA on their interest in the subject.

Lastly, we analyzed connections between ratings of TA overall teaching ability and the following factors: presentation, organization, subject knowledge, using activities, classroom management, connecting on a personal level, assessing learning needs, delivering feedback, and professionalism. In this case, like in the previous question, the MANOVA analysis revealed that there are significant relationships for each of these factors as contributing to the overall ratings, as one might expect. This is shown in Figure 14, where the x-axis shows the ratings of a TA’s overall teaching ability (5 is best, as usual) and the y-axis represents ratings of each factor (again, 5 is best). It is interesting to note that among the individual factors, the highest ratings go to “Knowledge of the Course Content” no matter what ratings were given to overall teaching ability. This is consistent with a more

traditional view of education, where students are simply vessels to be filled with knowledge, and it appears that (at least at our institution) students may enroll while holding this view. Notably, in direct contrast to the higher ratings for knowledge of content, students also consistently rated TAs’ ability to successfully use activities for learning among the lowest of the factors. This indicates a strong need to implement the more process-oriented, inquiry-based training in the current program.

Conclusions and Recommendations

The evolution of TA preparation programs at Georgia Tech towards a more learner-centered, inquiry-based approach has taken approximately eight years. Under the old course/orientation model, the TAs were taking a long time to master the basics of facilitating inquiry-learning processes to meet specific departmental needs. Now, in the new jump-start model, students learn enough early on so that they can practice these more advanced facilitation techniques right away, they receive feedback throughout the semester during the remainder of the course, and they are introduced to additional new skills and knowledge on a just-in-time-basis as the semester progresses.

As in many Process Education practices, this evolution was driven, in part, by assessment. Data was collected and assessed at two intervals during the program’s evolution. First, surveys and focus groups for TAs, students, and faculty TA coordinators were conducted to guide course development as a transition to a central model was

Figure 12 Student responses regarding TA feedback, teaching ability, and connection with students, by time spent weekly with TA. 1=very weak; 5=very strong

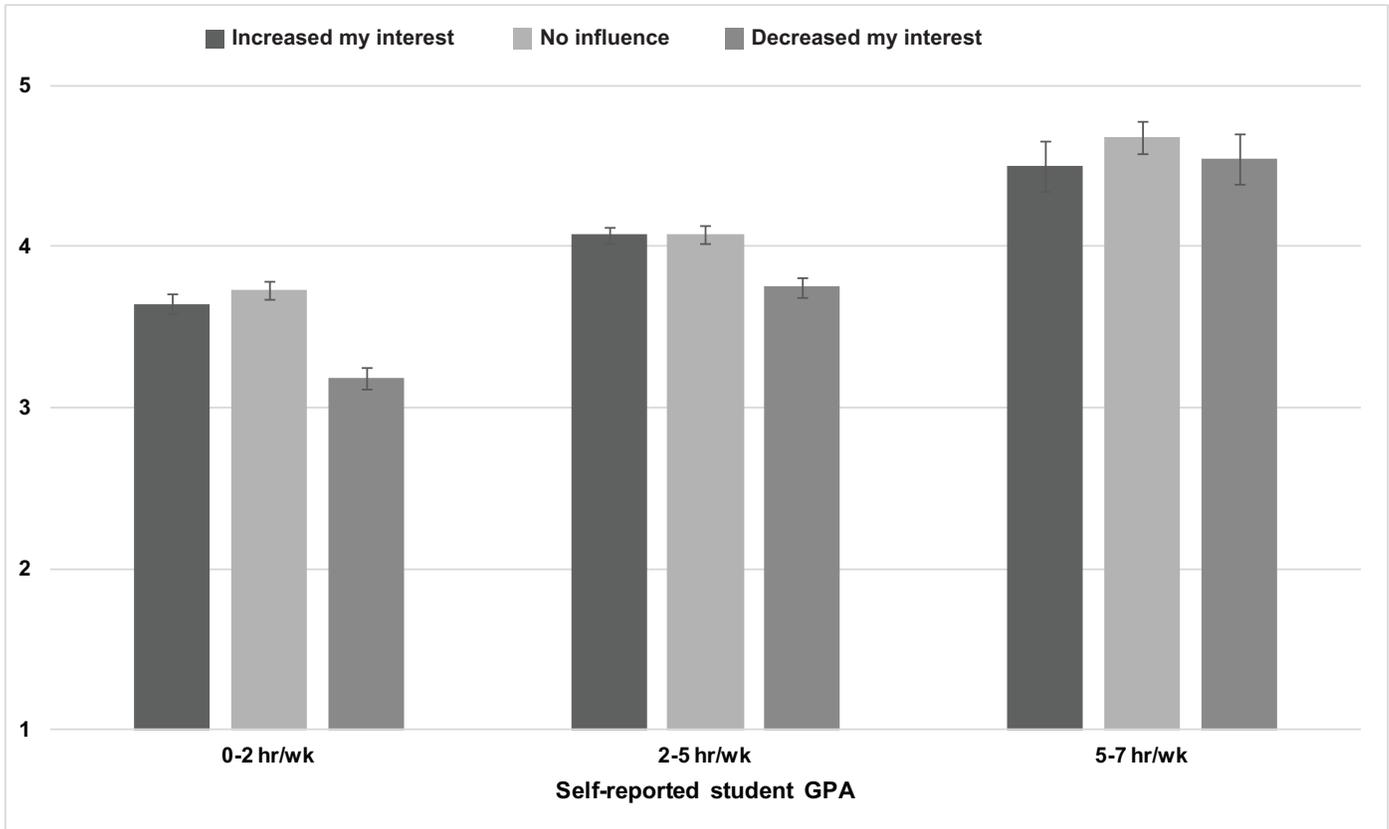


Figure 13 Student responses regarding TA ability to influence student interest in the subject, by time spent weekly with TA.

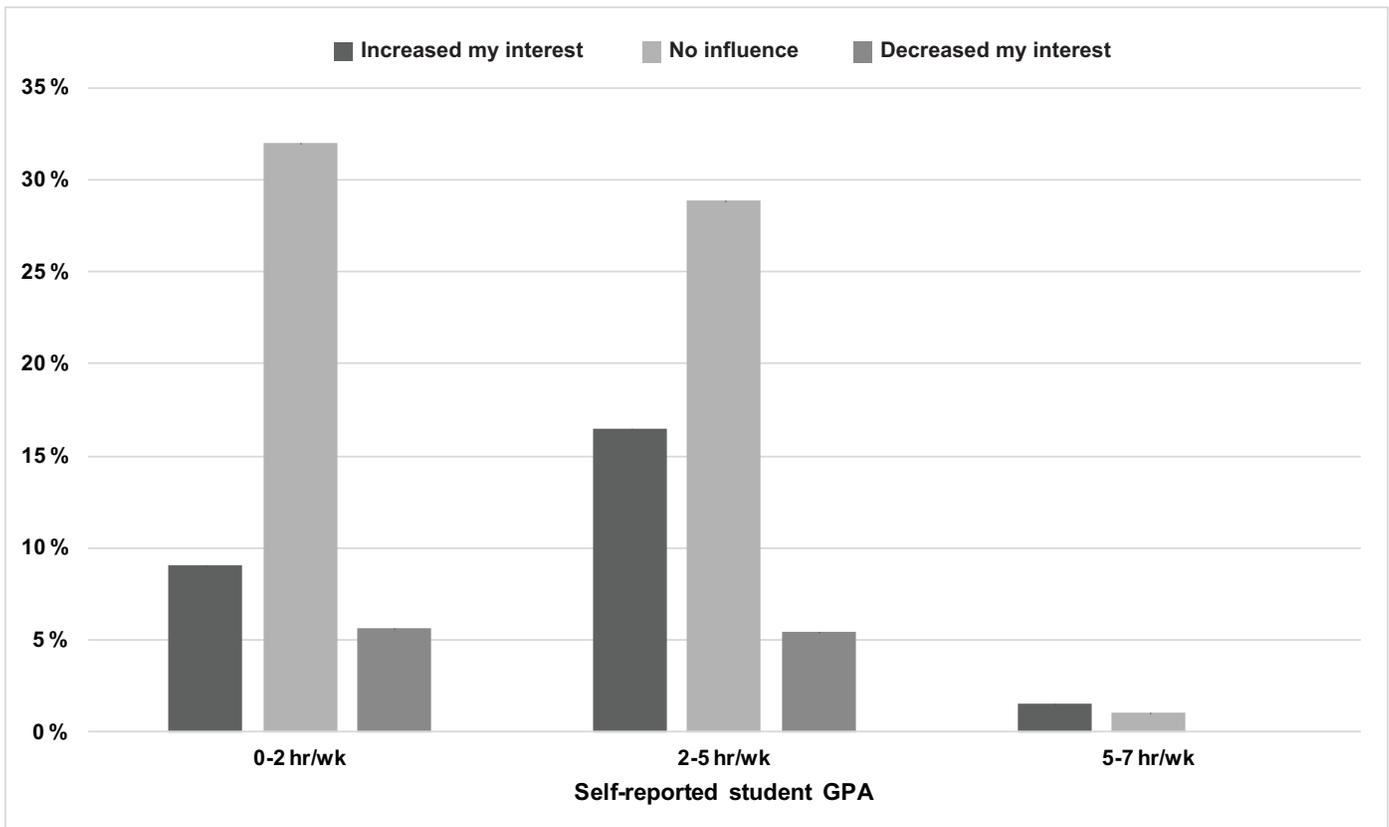
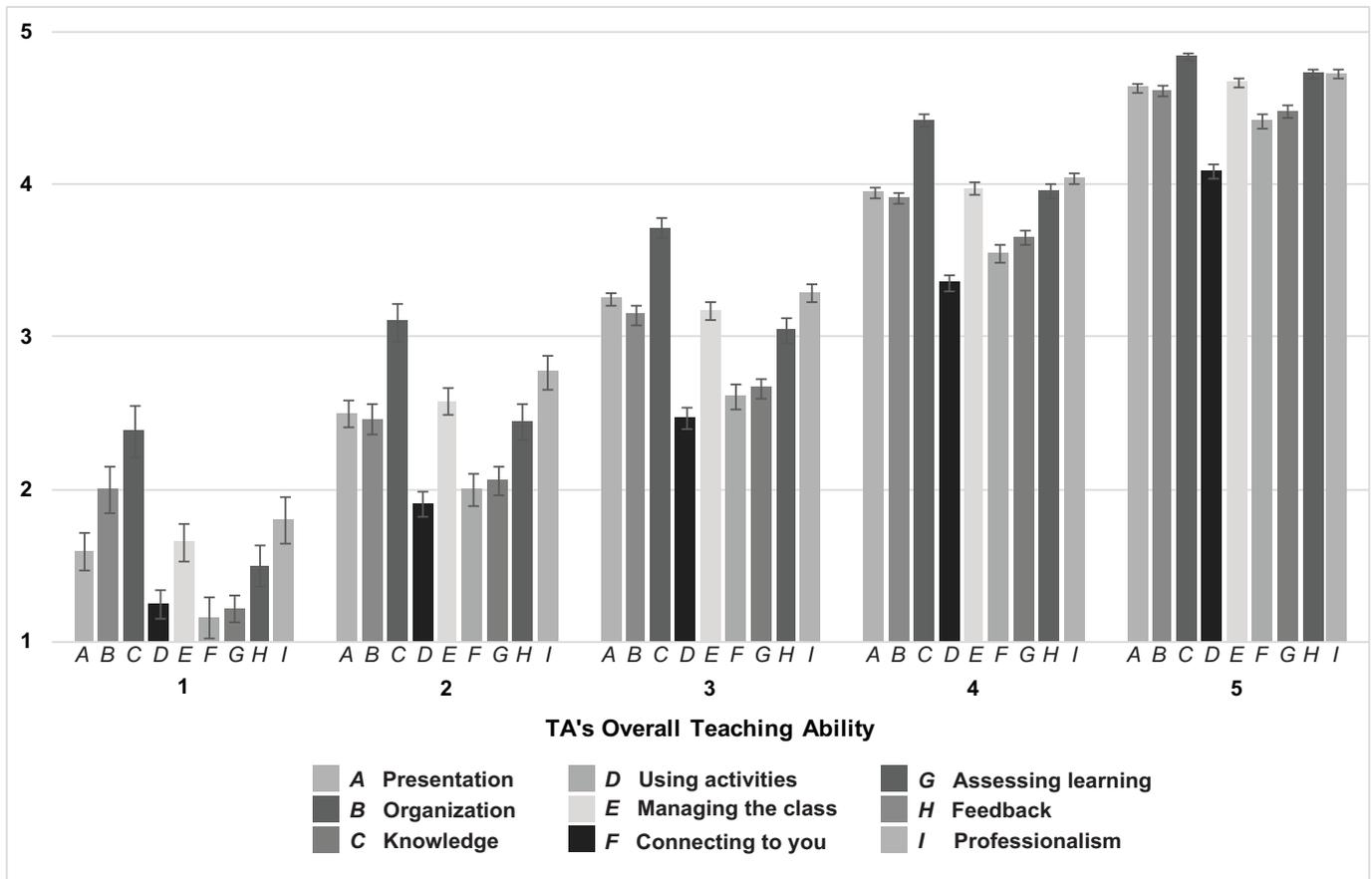


Figure 14 Student responses regarding specific TA teaching related abilities as related to overall teaching ability. 1=very weak; 5=very strong



developed with a variety of learning activities addressing overall institutional goals to individual departmental needs for TAs. This model appears to have been quite successful, as these learning activities have been used directly or adapted successfully in a variety of disciplines across the institution. Second, a needs assessment was conducted for the biology program which led to a more inquiry-based, process-oriented curriculum built from the active learning approach already being utilized. In the needs assessment for biology, we used qualitative analysis techniques to code this data using the major areas of competency from the survey mentioned previously. Some additional codes were created to categorize data that did not fit the existing codes. Codes that appeared with the greatest frequency in each stakeholder group were interpreted as representing the areas of highest need for TA professional educational development. We then based the learning objectives for the course on these critical needs.

These changes embrace a number of key Process Education principles including more ownership of the learning process by learners themselves, and improved alignment of institutional and departmental goals when implementing the new program models. The result is a solid connection between institutional development goals, self-growth for the TAs themselves, and simultaneous professional

development at the department level with overall learner development aligned with institutional values. This indicates that the same outcomes might be achieved more directly and more robustly (and perhaps even over a shorter time period) if the program transformation were explicitly built upon the five Process Education pathways of the Compass of Higher Education from the beginning.

Additionally, when reflecting upon the meaning of the data collected from various stakeholders during this transformational process, we see a number of aspects in the Transformation of Education, and for Process Education in general. For example, students value TAs who are better able to engage them in appropriate learning activities, thus transferring ownership of the learning process towards the student (ownership aspect). Also, when faculty are invested in departmental TA programming, TAs feel more valued (relationship aspect). Finally, when employing an active, inquiry-based curriculum, early anecdotal evidence appears to support the idea that TA satisfaction and performance, and concomitantly student learning, is improving (delivery aspect).

In a future paper, we will seek to answer the question of whether more process-oriented, inquiry-based curriculum improves TA abilities to support student learning. We are

currently analyzing the data collected from the first group of TAs to complete this program and will report our findings when this work is complete. However, early results indicate that TAs found this approach more useful and relevant than the previous format. We are currently expanding this new approach to preparing first-time TAs to additional academic

units. In the meantime, the authors invite the reader taking local action to join the conversation by considering the various elements of this work for potential connections and meaning. We would love to learn about your ideas.

Acknowledgements

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