Need Assessment for Graduate Teaching Assistant Training: Identifying Important But Under-Prepared Roles

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Abstract

This paper describes a need assessment survey that was developed to gain the perspectives of students, faculty, and graduate teaching assistants (GTAs) as a precursor to developing a training program. On the first portion of the instrument, volunteers from all groups rated the importance they placed on each of 24 GTA roles and responsibilities. Additionally, GTAs and faculty rated the GTAs' competence on each of these categories. Results showed that faculty ranked GTA competence lower than the GTAs did on all categories. On the importance ratings, GTAs placed significantly higher importance on all categories of GTA roles and responsibilities than faculty and students did. Both GTAs and faculty reported high discrepancy between importance and competence in the categories of 'instructional practices' and 'engagement with students'. Faculty reported high discrepancy between importance and competence in the 'TA Preparedness' category while GTAs did not. The diverse needs, viewpoints, and perspectives of the three groups that were captured by this survey provide interesting insight and valuable data for designing a GTA training program.

Introduction

Concerns about recruitment and retention of students in engineering disciplines have resulted in numerous calls for reform in engineering education[1-3]. Regardless of the chosen response to such calls, it is clear that quality education requires the presence of instructors who have learned to teach effectively. Unfortunately, because we often rely on "on-the-job" training, faculty become skilled at teaching after receiving their doctoral degrees and "practicing" on students. For this reason, institutions commonly establish teaching effectiveness centers dedicated to faculty development. Moreover, and of greater concern to us, much undergraduate teaching, especially during laboratories which may constitute 50% or more of the time that students are in the classroom, is performed by Graduate Teaching Assistants (GTAs) who may receive no training in pedagogy prior to their first teaching experience. Given the importance of instruction in determining students willingness to pursue undergraduate degrees in engineering[4] and the critical role the first year laboratory can play for students making the transition from high school to college[5], the pedagogical knowledge and skills of GTAs becomes even more critical. Sadly, while one would predict that the inexperienced would be aware of their lack of skill and pedagogical knowledge and would seek assistance, this does not always appear to be the case. Perhaps this indicates that GTAs are performing at the expected level for their profession. We

conducted the research described here to ascertain, through surveys of faculty, GTAs, and students, what characteristics are considered to be most important in successful engineering GTAs and what are the perceptions of GTAs' competency levels. This study was undertaken in preparation for the development and implementation of a GTA training program, both to set the objectives of the program and to establish a baseline for measuring the impact of the program in the future.

Background and Rationale

It is logical to think that variations within courses between sections or semesters can affect students and programs. When engineering courses are taught by different faculty members and graduate teaching assistants using different teaching approaches, students' course satisfaction and learning outcomes vary considerably among courses. While oversight of course content often exists, students taking the same class under different instructors often have significantly different levels of conceptual understanding and skills gained from that course. This can impact subsequent courses that require pre-requisite knowledge. Variations in teaching quality among faculty can be addressed through professional development programs that introduce instructors to the best practices and latest developments in pedagogy and course design. However, although graduate teaching assistants play an important role in engineering student learning, many higher education institutions do not have professional development program for GTAs in place[6]. Therefore, another solution to the observed variability might be to provide all GTAs with the same professional development training so that labs and discussion section are consistent across semesters and instructors. While extensive GTA training programs have their merits[7-8], there exists the question about whether programs less costly in time or money could be sufficiently beneficial. To test this, one starting point would be with an evaluation of the expectations for GTAs and the degree to which they meet expectations without training. As the nation tries to improve STEM education on many different fronts, work focusing on GTA training, must not be overlooked.

At doctoral degree granting institutions, GTAs may contribute substantially to undergraduate education[9]. Many engineering courses have large lab components predominantly taught by GTAs. For a typical 3 credit-hour class, there are two 50-minute lectures, and two hours of lab per week. Because GTAs interact as much with students as do faculty, training in classroom management and pedagogy for these less experienced GTAs may have greater impact on student learning and retention than similar efforts aimed at more experienced faculty, who may be set in their ways or may already be more accomplished instructors. A training program may reduce the negative impact of having GTAs who do not see themselves as teachers, or who are not aware of their roles and responsibilities. Because GTA selections are often made from the viewpoint of which professors want graduate students for their research program and which graduate students 'need' funding, irrespective of whether they are qualified or prepared to be GTAs, teaching quality among beginning GTAs can be extremely uneven. GTAs often receive no or little systematic training[10-13], and are unprepared to take on their teaching responsibilities due to lack

of exposure to the best practices in teaching and classroom management[14-15]. At the institution under study, international GTAs must pass an exam and receive some training on culture and communication, and all GTAs are expected to take some safety training. However, no or little coordination of the selection and training of GTAs exists.

In science and engineering courses, there is a long history of using homework, labs, and discussion sections, which at universities with substantial graduate programs become the primary domain of the GTAs, as a means of providing students with the opportunities to practice and assess their conceptual understandings and higher order cognitive skills. Thus, GTAs become a substantial source of feedback and the primary contact for individualized instruction[16]. Laboratories provide opportunities for "hands-on" experience favored by concrete, transitional and sensory learners[17]. While laboratories help students learn to make data-driven decisions[18], their primary goal in the minds of faculty is to afford students more time to learn concepts[19]. The laboratory environment and the influence of the GTA on that environment have been shown to play a major role in student retention in STEM disciplines[5]. Given the increased responsibilities of GTAs and their impact on student learning, preparing GTAs to be effective teachers is critical in not only retaining undergraduates and improving student learning and engagement, but also in retaining qualified college instructors. Many new engineering undergraduate students make decisions related to their future academic endeavors based on their perceptions of those GTAs. Moreover, the GTAs, if unprepared and untrained as teachers, will be more likely to experience frustration and failure[20], which may affect their own decision to leave academia.

Even with training programs, new GTAs still consider college teaching a challenge[21] when their pressing concerns in relation to teaching are not appropriately addressed in the GTA training program. Thus, identifying and incorporating concerns of GTAs into the development program is a key in enhancing the effectiveness of the training programs for GTAs. Fuller[22] suggested that to ensure effective teacher development programs, it is critical to accurately assess teacher concerns. In addition, teacher training or professional development programs that do not reflect the needs and interests of participants are unlikely to motivate them, which in turn can result in the failure to attain the program's educational goals and objectives. This speaks directly to the importance of need assessment surveys designed to identify what motivates and concerns teachers in advance of developing training programs.

According to Sprague and Nyquist[23], GTAs go through three stages of development in their role as a teacher, which include 'Senior Learners', 'Colleagues in Training', and 'Junior Colleagues'. Nyquist and Wulff[24] suggest that faculty could use these developmental stages to determine how to approach their mentoring of GTAs in relation to teaching roles and assignments. GTAs in different stages of development are considered to have different concerns about teaching issues. Beginning GTAs are viewed as 'Senior Learners' because they have more expertise in the

subject matter than most undergraduate students, but still identify themselves more with students rather than with faculty. These GTAs at the first stage of development are mainly concerned with how to survive and avoid making mistakes and thus tend to focus on issues like getting better evaluations from both students and supervisors. As GTAs gain more teaching experience, they become 'Colleagues in Training' and their concerns tend to switch to issues like teaching skills or teaching methods. Finally, more seasoned GTAs become 'Junior Colleagues' who consider themselves as fellow faculty and become concerned with the impact they may have on student learning and engagement. Most studies on teacher concerns have employed survey methods and most surveys were developed based on Fuller's[22] model. Researchers often revised and extended survey items to reflect unique needs and characteristics of diverse teacher populations and teaching contexts. Mok[25] proposed that teacher concerns are context-specific and therefore different teacher populations in varying educational contexts may evidence different teaching concerns, which should be considered to appropriately address teaching concerns within GTA development programs.

Purpose of the Study

To fulfill the goal of enhancing the teaching effectiveness of GTAs by making the GTA training program efficient and customizable, the need to identify pressing needs and interests of GTAs is clear. Thus, the primary purpose of this study was to develop a need assessment survey that captures varying perspectives and needs of different groups, GTAs, faculty, and students, about engineering GTA training. This survey will lay a solid foundation for the effective and efficient design of engineering GTA training programs.

Three research questions guided this study:

1. To what extent do GTAs and faculty perceive that GTAs are well prepared or competent to perform their roles and responsibilities?
2. To what extent do GTAs, faculty, and students place importance on specific GTA roles and responsibilities?
3. What are the GTA roles and responsibilities with high discrepancy between importance and competence ratings by GTAs and faculty?

Method

Participants

165 students, 54 GTAs, and 18 Faculty from a land-grant university in the Midwest voluntarily participated in the study. Invitations to participate in the online survey were sent out to a list of all undergraduate students with a declared engineering major (approximately 1500), all students who were identified by individual departments as having GTA duties (about 125), and to all engineering faculty members (about 80). The requests to undergraduate students were sent via email through a direct mailing list. The GTAs and faculty were contacted through an established protocol of requesting department heads to forward the invitation email to faculty who would

then forward it to their TAs. Initially, this resulted in 8 TAs and 16 faculty members taking the survey. Subsequently another request was sent out to the faculty, and two more faculty took the survey. For the GTAs, a direct mailing list was compiled, and they were invited to take the survey through email. The second attempt had a much better response, with 46 additional GTAs participating. The GTAs spanned the entire teaching experience range of TAs, from students who were first time TAs to those who had taught for many semesters. Likewise, the students invited to participate were all engineering majors, from freshmen to seniors.

Need Assessment Survey

The authors developed a need assessment survey to capture to what extent GTAs, faculty, and undergraduate engineering students rate the importance of typical GTA roles and responsibilities. The faculty were asked to rate GTAs' competence on these duties and the GTAs were asked to rate their own competence. A 5-point Likert scale was used with 1 representing 'Not at all important' and 5 representing 'Critically important' on the roles and responsibilities questionnaire. A similar scale was used for competence, with 1 representing 'Lack of competence' and 5 representing 'Very competent'. The survey included 24 items, which were later grouped into four categories. The four categories were 1) GTA preparation, 2) Instructional Practices, 3) Engagement with Students, and 4) Classroom Management.

The 'TA preparation' category referred to the extent to which GTAs are familiar with course content and course requirement, and are aware of primary GTA roles and responsibilities. The 'Instructional Practices' category referred to GTAs' ability to effectively communicate with students and explain contents clearly. The 'Engagement with Students' category referred to GTAs' commitment to build a relationship with students and engage and motivate inattentive/uninterested students. The 'Classroom Management' category referred to GTAs' ability to deal with student behavior and classroom disruption issues.

Results

Table 1 shows the competency ratings of faculty and GTAs for each of the 24 items on the survey. On no survey item did faculty rank GTAs' competence higher than the GTAs ranked themselves. Independent t-tests revealed that differences between the competence ratings by GTAs and faculty on all items except "Dressing appropriately" were significantly different at p-value less than .05. Thus, at least among the participants, there was a significant discrepancy between the GTAs' views of their capabilities and the faculty's views.

Despite the discrepancies in the means of competence ratings, consistencies were found in the ranks of competence ratings. Four of the top 5 competence ratings were consistently rated high by all groups: 'Being familiar with the course materials', 'Holding regular office hours', 'Grading student work in a fair and consistent way', and 'Treating students with compassion and

respect' (see Table 1). When analyzed by categories, both faculty and GTAs rated GTA competence on 'TA preparedness' and 'instructional practices' higher than the other two categories, 'engagement with student' and 'classroom management'.

Table 1. GTA **Competence** Ratings and Ranks by GTAs, Faculty, and Students

Item Category/Statement (Item #)	**Rating by GTA**	**Rating by Faculty**	***P***
1. GTA Preparedness	4.26	3.55	<.01
• Being familiar with the syllabus (2)	**4.30 (5)**	3.28 (16)	<.01
• Being familiar with course objectives (3)	4.22 (9)	3.33 (14)	<.01
• **Being familiar with the course materials (11)**	**4.32 (4)**	**3.67(3)**	<.01
• Knowing answers to student questions (course content) (18)	4.19 (11)	3.50 (10)	<.01
• Knowing what is expected of the GTA (19)	4.17 (14)	3.50 (9)	.01
• Dressing appropriately (5)	4.08 (18)	**3.65 (5)**	.09
• **Holding regular office hours (9)**	**4.54 (2)**	**3.94 (1)**	.01
2. Instructional practices	4.21	3.48	<.01
• Effectively communicating with students (13)	4.25 (7)	3.44 (12)	<.01
• Explaining contents clearly (14)	4.20 (10)	3.17 (20)	<.01
• Speaking to the class publicly (16)	4.08 (17)	3.35 (13)	<.01
• **Grading student work in a fair and consistent way (12)**	**4.50 (3)**	**3.83 (2)**	<.01
• Making your grading rubric available to the students (7)	4.02 (20)	3.47 (11)	.03
• Preventing academic dishonesty (4)	4.28 (6)	3.56 (7)	.01
3. Engagement with students	4.12	3.26	<.01
• Engaging the students with the learning material (6)	4.06 (19)	2.94 (23)	<.01
• Establishing working relationship with students (1)	4.19 (12)	3.33 (15)	<.01
• **Treating students with compassion and respect (10)**	**4.56 (1)**	**3.67 (4)**	<.01
• Motivating inattentive/uninterested students (17)	3.74 (23)	2.89 (24)	<.01
• Offering feedback on work to the students (8)	4.23 (8)	3.22 (17)	<.01
• Overcoming cultural and language conflicts (15)	4.17 (13)	3.56 (6)	.01
• Getting students to think for themselves and learn to solve problems (20)	4.11 (15)	3.11 (21)	<.01
• Facilitating positive team dynamics and discussions (21)	3.87 (21)	3.00 (22)	<.01
4. Classroom management	3.87	3.29	<.01
• Managing students' disruptive classroom behavior (24)	3.85 (22)	3.18 18)	.02
• Maintaining authority over dominating and aggressive students (22)	3.69 (24)	3.18 (19)	.04
• Avoiding offending a student while trying to simplify a concept (23)	4.09 (16)	3.53 (8)	.03

Note. Numbers in parenthesis indicate the order of rank of importance and competence ratings. The top 5 competence ranks were bolded and bolded statements indicate that both GTAs and faculty rated high on GTA competences.

Table 2 shows degrees to which the roles and responsibilities of engineering GTAs are viewed as being important, from the perspectives of faculty members, students, and the GTAs themselves, including their ratings and the rank order of their rating for each group. Some categories stand out for the discrepancies observed among the three groups. For example, GTAs ranked 'Treating Student with Compassion and Respect' high, but faculty ranked it much lower. Surprisingly, it was not among the top ratings for students either. On the other hand, faculty and GTAs ranked, 'Preventing Academic Dishonesty', very high, whereas students did not consider that an important role of GTAs at all. Table 2 also shows that students perceived 'Knowing answers to student questions (course content)' and 'Facilitating positive team dynamics and discussions' as more important GTA roles than GTAs and faculty members did.

There were some consistencies in the ranks of importance across the three groups: 'Being familiar with the course materials', 'Knowing what is expected of the GTA', 'Explaining contents clearly', and 'Grading student work in a fair and consistent way' were perceived as being relatively more important consistently across the groups while 'Dressing appropriately', 'Motivating inattentive/uninterested students', 'Managing students' disruptive classroom behavior', and 'Maintaining authority over dominating and aggressive students' were identified as being relatively less important. Surprisingly, both GTAs and faculty identified 'motivating and engaging students' as being relatively less important GTA duties and reported that GTAs are not well-prepared to do so.

When the survey data were analyzed by the categories, GTAs placed significantly higher importance on all categories of GTA roles and responsibilities than faculty and students did (see Table 3). There were also notable discrepancies between the GTA and faculty ratings of GTAs competence; GTAs seemed to overestimate their competencies as teachers compared to ratings given by faculty across all categories of teaching responsibilities. Many top ranked items in terms of importance fell into 'Instructional Practices' category, but this category showed largest discrepancy between importance and competence ratings by both GTAs and faculty.

Table 2. **Importance** Ratings and Ranks of GTA responsibilities by GTAs, Faculty, and Students

Item Category/Statement (Item #)	GTA Importance	Faculty Importance	Student Importance	*p*
1. TA Preparedness	4.38	4.06	4.08	<.01
• Being familiar with the syllabus (2)	4.47 (11)	4.17 (11)	4.04 (13)	.03
• Being familiar with course objectives (3)	4.45 (14)	4.17 (10)	4.32 (7)	.41
✓Being familiar with the course materials (11)	**4.70 (2)**	4.28 (6)	**4.68 (2)**	.07
❖ Knowing answers to student questions (course content) (18)	4.33 (15)	4.22 (8)	**4.47 (5)**	<.01
✓Knowing what is expected of the GTA (19)	4.56 (6)	**4.22 (3)**	4.29 (8)	<.01
○ Dressing appropriately (5)	3.71 (24)	3.00 (24)	2.48 (24)	<.01
• Holding regular office hours (9)	4.45 (12)	4.11 (12)	4.20 (10)	.16
2. Instructional practices	4.51	4.18	4.16	<.01
✓Effectively communicating with students (13)	**4.67 (3)**	**4.44 (4)**	**4.59 (4)**	.53
✓Explaining contents clearly (14)	**4.66 (4)**	**4.28 (5)**	**4.60 (3)**	.16
• Speaking to the class publicly (16)	4.11 (20)	3.65 (20)	3.99 (14)	<.01
✓Grading student work in a fair and consistent way (12)	**4.81 (1)**	**4.50 (2)**	**4.79 (1)**	.16
• Making your grading rubric available to the students (7)	4.27 (17)	3.53 (21)	3.78 (16)	.01
❖Preventing academic dishonesty (4)	4.56 (7)	**4.61 (1)**	3.62 (17)	<.01
3. Engagement with students	4.37	3.95	3.85	<.01
• Engaging the students with the learning material (6)	4.45 (13)	3.89 (15)	4.07 (12)	.01
• Establishing working relationship with students (1)	4.54 (8)	4.17 (9)	3.93 (15)	<.01
❖ Treating students with compassion and respect (10)	**4.64 (5)**	4.06 (14)	4.28 (9)	.<.01
○ Motivating inattentive/uninterested students (17)	4.00 (22)	3.33 (23)	2.66 (23)	<.01
• Offering feedback on work to the students (8)	4.49 (10)	4.11 (13)	4.46 (6)	.20
• Overcoming cultural and language conflicts (15)	4.22 (19)	3.89 (16)	4.12 (11)	.45
• Getting students to think for themselves and learn to solve problems (20)	4.52 (9)	4.22 (7)	4.20 (10)	<.01
❖ Facilitating positive team dynamics and discussions (21)	4.25 (18)	3.82 (18)	**4.47 (5)**	<.01
4. Classroom management	4.10	3.67	3.31	<.01
○ Managing students' disruptive classroom behavior (24)	4.09 (21)	3.47 (22)	3.12 (22)	<.01
○ Maintaining authority over dominating and aggressive students (22)	3.93 (23)	3.65 (19)	3.47 (20)	<.01
• Avoiding offending a student while trying to simplify a concept (23)	4.29 (16)	3.88 (17)	3.32 (21)	<.01

Note. Numbers in parenthesis indicate the order of rank of importance and competence ratings. The top 5 importance ranks were bolded.

- ✓ indicates high importance ratings across groups.
- ○ indicates low importance ratings across groups.
- ❖ indicates large discrepancy in importance rankings among groups.

Table 3: Paired t-test Discrepancy Scores between Importance and Competence

Item Category	GTA			Faculty		
	Importance	Competence	Discrepancy Scores	Importance	Competence	Discrepancy Scores
1.TA Preparedness	4.38	4.26[a]	.12	4.06	3.55[a]	**.51***
2.Instructional practices	4.51	4.21[b]	**.30****	4.18	3.48[b]	**.70****
3.Engagement with students	4.37	4.12[c]	**.25****	3.95	3.26[c]	**.69****
4.Classroom management	4.10	3.87[d]	.23	3.67	3.29[d]	.38

Note. *p<.05, **p<.01; Discrepancy scores denote the difference scores between importance and competence ratings, which were calculated by subtracting the mean of competence from the mean of importance. Same superscript denotes significant differences (p<.05) between the competence ratings of GTAs and Faculty.

Discussion

Areas for GTA improvement were suggested by the GTA responsibilities which were perceived valuable but in need of improvement. The discrepancy scores between importance and competence ratings by GTAs and faculty were used to identify the primary focus of future GTA training. Two criteria were used to guide the selection of GTA training topics and materials: 1) which responsibilities GTAs perceived as important but in which they felt less competent 2) which responsibilities that faculty supervisors tended to perceive important but for which they provided low ratings for GTA competence. Both GTAs and faculty reported high discrepancy between importance and competence in the categories of instructional practices and engagement with students. Faculty reported high discrepancy between importance and competence in the 'TA Preparedness' category while GTAs did not.

In a similar study of GTAs in a chemistry course in which approximately 50% of the enrollees were engineering majors, Herrington and Nakhleh[16] compared GTA and student rankings of GTA characteristics and found that they considered GTA knowledge and skills more important than their attitudes toward students. Thus being prepared, knowing the subject, and being able to explain concepts and procedures to students were more important than being friendly, enthusiastic, or concerned. A point of disagreement in their study was the ranking of the GTAs responsibility to grade fairly and correctly, with students giving it the number one rating while the GTAs' ratings resulting in it being in the lower half of the characteristics in question. In our study, fair and consistent grading ranked at the top. We were encouraged to see such agreement among our respondents, indicating that GTAs are aware of the needs and expectations of the students and should therefore be amenable to training sessions that would involve calibration of grading standards. In both our study and theirs, GTAs and students agreed that GTAs' role in motivating students ranked low. The faculty in our study did so also. It is interesting to see this since motivation is considered an important factor in student success and one over which instructors have an influence[26]. The agreement among TAs supports research that concluded

that GTAs are ignorant of educational literature about teaching and learning[6] and therefore draw conclusions from personal insight or experience and perhaps consider motivation something intrinsic to the students. That the students concur in both studies may reflect self-centered thinking – a lack of interest in GTAs helping other students who are not motivated rather than helping them – or perhaps a judgment that it is not the GTA but the nature of the subject or course that affects motivation.

The difference between students' opinions of the importance of GTA's role in promoting academic integrity and that of the faculty's and GTAs'opinions is not surprising. It is consistent with other studies[27-28]. Without the proper education about the nature and impact of actions that violate academic integrity and the creation of an environment that promotes academic integrity by all, this gap, and the rate of violations, will continue. While GTAs have already adopted the views of the faculty, there is need to address how TAs can help promote the same views among students.

Students also considered "Facilitating positive team dynamics and discussions" as more important than GTAs or faculty. Insight into this discrepancy may stem from students resistance to group work for any of the reasons identified by[29]. GTAs, especially naive ones, may not be comfortable or knowledgeable about methods of reducing this resistance or may adhere to the same objections because of their past experiences. So, while students, especially those who are skeptical about group work, prefer to work alone, or are suffering from groups with incompatible personalities or differences in motivation, consider this something the teacher should fix, GTAs may not consider this to be their problem or may seek to avoid confrontation. Research indicates that teachers expectations about their success in implementing cooperative learning was the primary factor determining their willingness to do so and professional development has been suggested as the solution[30].

That faculty consider GTAs significantly less competent than GTAs consider themselves presents us with a challenge. Faculty often remain distant from the laboratories that the GTAs teach and therefore do not provide the guidance the GTAs need or desire[6, 31]. Thus faculty are not contributing to the development of the GTAs and helping to narrow this gap. We wonder whether presented with these data faculty will come to the realization and take personal action or will they remain distant and suggest that others (e.g. lab coordinators, Teaching and Learning Centers) be required to take more action. Alternatively, for those faculty who think that teaching ability is an intrinsic trait[26], we would predict no interest or support for programs to help TAs develop skills. For our purposes, we must develop a strategy for using this information to inform TAs of the gap and encourage appropriate reflection on their part so as to motivate them toward mastery learning. This also provides us with a baseline against which to measure changes after the intervention of a TA training program. Overall the pattern of discrepancies in the Importance and Competency scores would indicate that the TAs consider themselves prepared in terms of content knowledge and perceive no problem in managing a college classroom, perhaps because they do not expect there to be an issue at the post-secondary level. However, they appear not to

think they are adequately skilled for implementing instructional strategies they consider important and may therefore perceive a need for additional training or experience for all aspects of teaching. Based on this we would predict that TAs would be amenable to a training program in subject-specific pedagogy.

The result of GTA need assessment will provide valuable information on how to best customize GTA training in a way to maximize its effectiveness and impact. Therefore, evaluation of GTA training will be used to inform the design and development of subsequent GTA trainings. Furthermore, a summary result of need assessments should be shared with future GTAs to motivate and encourage their participation in GTA training.

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