

## **The Role of Teaching Assistants: A Literature Review on Impacts and Effective Training Practices in First-Year Engineering and Beyond**

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# **The Role of Teaching Assistants: A Literature Review on Impacts and Training in First-Year Engineering and Beyond**

## **Introduction**

This full theory paper presents a systematic literature review of the impact of teaching assistants in First-Year Engineering (FYE) and STEM classes more broadly and examines the training practices employed for teaching assistants (TAs). TAs play a crucial role in the engineering classroom, guiding students through the challenges and rigors of coursework and serving as role models for current students. However, TAs are often understudied, as frequently the focus is on students in the classroom as learners. As TAs are often students themselves, they are also affected by the TA experience. Just as individuals, TAs both form and are formed by the learning environment.

The impact of TA experience is likely shaped by TAs' prior teaching and learning experiences. However, TAs typically receive no formal training in teaching and learning prior to becoming TAs. As with any other position, to be maximally effective in their TA role, they should have some form of “new hire” training or apprenticeship that helps them learn best practices in the classroom. However, the form this training takes can vary widely, just as it does in any position. Additionally, not all training is equally effective; therefore, understanding which types of training are most prevalent and have been shown to work is necessary to train TAs most effectively.

Undergraduate TAs are unique in that they provide a near-peer support system for undergraduate students. This temporal connection between TAs and students is one reason they serve as role models for the enrolled students. The impact of this can contribute to multiple facets of a student's education, but one of particular note is belongingness [1]. Undergraduate TAs can help students feel welcome and comfortable in a new space, such as the classroom. The fact that most FYE students are new to a collegiate environment and find themselves in unfamiliar spaces is likely a significant reason they are so prominent in FYE and introductory STEM classrooms [2], [3], [4]. Because of this prevalence, it is imperative that a complete understanding of their impact in the classroom, the classroom's impact on them, and how to train them be established.

This paper aims to look at what the literature has found previously about these topics by answering the following questions:

- (1) *What methods for developing and training teaching assistants in engineering and STEM classrooms are documented in the literature, and what evidence exists regarding their impacts on teaching and learning?*
- (2) *What impacts of undergraduate teaching assistants in engineering and STEM classrooms are reported in the literature, both on student learning outcomes and on the teaching assistants' own development?*

## Methods

### *Literature Review*

The methods used in this study were based on the systematic literature review process outlined by Borrego et al. [5], where the research team took the following steps:

- (1) identifying scope and research questions,
- (2) defining inclusion/exclusion criteria,
- (3) finding and cataloging sources, and
- (4) critique and appraisal (analysis).

For the first research question (RQ1), the research team chose studies that were clearly related to the training and development of teaching assistants, accessible to the research team, and could include either undergraduate or graduate TAs (given the scarcity of research on the topic). For the second research question (RQ2), given its focus on undergraduates, the papers in the dataset needed to address undergraduate TAs, be accessible to the research team, and be related to a STEM-based program. Studies were excluded if they were not related to TAs in a STEM context or were not directly related to TA training. For the impact question, the research team was more interested in the impact of undergraduate TAs, so studies focusing only on graduate TAs were excluded.

The research team used three main databases to find papers for this literature review: EBSCO, Engineering Village, and Google Scholar. While Google Scholar has a less clearly articulated search algorithm than some other academic databases, the team found it useful for this study, given the size of the paperset in the database. The search strings used a combination of different words in titles and abstracts relating to “engineering”, a word about the position title “teaching assistant” (or similar such as “TA”, “learning assistant”, “teacher’s aide”, or “peer assistant”) and a specific word related to the research question such as “training” or “impact”. A full list of search strings is available in Appendix 1. Once the searches were run and the criteria applied, a total of 43 papers were included in the dataset: 20 on the impact of TA roles and 21 on TA training and development. The full list of papers is in Appendix 2.

### *Thematic Analysis*

After the papers were selected, the research team used thematic analysis to identify themes related to each research question across the respective paper sets. The method used was based on the six phases outlined by Braun and Clarke [6]:

- (1) familiarization,
- (2) coding,
- (3) searching for themes,
- (4) reviewing themes,
- (5) defining/naming themes, and
- (6) reporting.

The analysis results include broader themes related to each research question, followed by the specific themes and quotes from the dataset. After identifying the initial themes, the research

team met to agree that the resulting themes were appropriate and neither too specific nor too broad to warrant combining or splitting.

## **Results**

The results section is broken down into two parts by research question. The first examines TA training and development, while the second explores the impact of TA experiences.

### *RQ1 - Training and Development of TAs*

When evaluating TA training, how to organize and deliver the training are important questions to consider before commencing. Across the literature, the research team saw five themes that emerged from the data in terms of how training is delivered:

- (1) scenario-based training is common,
- (2) equity and inclusivity training is usually included,
- (3) training includes topics beyond the classroom, such as mental and physical health,
- (4) pedagogical training for the TAs, and
- (5) student-centered instruction training was included.

Table 1 below provides the name and description of each theme, along with a representative quote.

When used correctly, these training techniques should have a positive impact on TAs and the classroom. The next set of themes emerged from the literature on the effects of TA training on TAs and their classroom experience. Table 2 outlines the three themes from this analysis.

Through training, TAs

- (1) develop confidence for their teaching duties,
- (2) increase self-efficacy and preparedness for the different situations, and
- (3) increase levels of competence for teaching others in general.

While some of these results seem self-evident, the literature supports the claim that using training materials for TAs, rather than just having them start without them, produces significant benefits for the TAs and, in turn, the class. The implications of this extend beyond TAs themselves to populations such as new faculty members, who are often not given formal training in pedagogical methods before teaching their first university-level courses [13].

**Table 1. Themes of common components and organization of training programs.**

| <b>Name</b>                        | <b>Description</b>                                                                                                                                 | <b>Quote</b>                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scenario-Based Training            | Repeated use of role play or potential case-based exercises to simulate real-world experiences that TAs could face in their role.                  | "By playing out scenarios before going to teach, the PTAs have an idea and an experience that will inform their teaching that day." [7, p. 7]                                                                                                                                                                                                                                                                             |
| Equity & Inclusivity Training      | Training to ensure TAs have a grasp on how to address and maintain inclusivity in practice, while understanding bias and remaining socially aware. | "In the session, participants were asked to reflect on their social positionality, draw connections to larger systemic issues, and identify strategies for applying an inclusive lens to the classroom space." [8, p. 4]                                                                                                                                                                                                  |
| Holistic Support                   | Training that goes beyond basic needs, supports mental and physical health, emphasizes overall well-being, and fosters a supportive community.     | "...pays special attention to several aspects related to graduate teaching assistant physical and mental health, which is a base for career network development, e.g., community building and social activities." [9, p. 1205]                                                                                                                                                                                            |
| Pedagogical Development            | Emphasizing building basic teaching skills within TAs, ie, "how to be a teacher 101."                                                              | "Therefore, the course contains careful scaffolding with exercises tied closely to teaching practice, in order to create a clear connection between pedagogical and didactical concepts, such as active learning, to the real-life practice of teaching assistants." [10, p. 6]                                                                                                                                           |
| Student-Centered Training Programs | Training focused on keeping the student and student benefits in mind, encouraging a facilitative approach rather than a direct one.                | "It is critical for TAs to understand that there are many different approaches to solving any given open-ended problem, and these may be wholly dissimilar in design to the TAs' own ideas for a good solution. Without that understanding, TAs naturally tend to push, either directly or indirectly, their own conception of the right answer and not support the solutions being produced by the students." [11, p. 3] |

**Table 2. Themes of the positive impacts of training on TAs.**

| Name                              | Description                                                                                                                                           | Quote                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Developing Confidence & Readiness | Training programs increased TA confidence and readiness for TA responsibilities.                                                                      | “The teaching assistants specifically highlight the case-based activities, where they discuss real-life cases, as something that helped them gain an understanding of teaching and learning. They also describe that the course helped them feel more confident in their teaching abilities and gave them the necessary tools to handle any difficulties they encountered.” [10, p. 9] |
| Increased Self-Efficacy           | Training programs aimed at increasing TAs' self-efficacy in their roles were successful.                                                              | “...the GTAs were asked to rate how well they were prepared to teach their own course...an overwhelming majority of GTAs responded that the program had a favorable or neutral impact on their day-one preparedness.” [9, p. 1208]                                                                                                                                                     |
| Increased TA Competence           | Training improved many TAs' pedagogical skills, grading, feedback, etc, giving TAs the training to thrive in their role, creating more competent TAs. | “Thus, from all these results, it can be concluded that the new TA training model helps to achieve high levels of competence among TAs to help students, which is the primary purpose of training.” [12, p. 15]                                                                                                                                                                        |

*RQ2 - Impact of TA experiences*

The impacts that TAs have within academia are extensive, and the themes that emerged from the literature supported that. In terms of the impacts of TAs on students enrolled in the course (i.e., not themselves), four themes emerged from the dataset:

- (1) positive impact on students' sense of identity,
- (2) creating a sense of belonging in the classroom,
- (3) providing additional mentorship to students, and
- (4) fostering a more collaborative learning environment.

Table 3 lists the name and description of each theme, along with a representative quote.

**Table 3. Themes for how TA experiences impact students in the classroom.**

| Name          | Description                                                                                                      | Quote                                                                                                                                                                                                                                    |
|---------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Identity      | Teaching assistants facilitate a stronger sense of self, particularly in their major, for students.              | "... physics students in LA classes at Texas State University were shown to have a stronger student identity than did their peers in classes taught without LAs." [13, p. 5]                                                             |
| Belonging     | Teaching assistants foster a sense of belonging, especially among diverse demographics.                          | "... they also accommodate a variety of learning styles and interests, which can be helpful in attracting and maintaining females and underrepresented ethnic minorities in science, technology, engineering, and math, ... " [14, p. 3] |
| Mentorship    | Teaching assistants can mentor students in different aspects of professional and academic development.           | "Additionally, as students who have already achieved success within a course, they serve as a model for success that students may look to for support." [13, p. 3]                                                                       |
| Collaboration | Teaching assistants help form relationships among students and create a more collaborative learning environment. | "I [teaching assistant] helped with the interactive part of the class, helping students while working in groups to solve problems that were given by the professor in class." [15, p. 4]                                                 |

This interaction is not merely beneficial for the students enrolled in the course; the TA experience has positive impacts on the TAs themselves. The literature analysis also identified themes on how these experiences impact TAs during and after their time in the classroom. Five themes emerged from the dataset:

- (1) opportunities to learn to be a mentee in a professional setting,
- (2) opportunities to mentor the students in the class,
- (3) professional development in both technical and broader skills,
- (4) define their academic identity as engineers or STEM professionals, and
- (5) motivation to continue in their current major choice.

Table 4 provides the name and description of each theme, along with a representative quote.

**Table 4. Themes for how TA experiences impact the TAs themselves**

| Name                     | Description                                                                                                            | Quote                                                                                                                                                                                                                                                                          |
|--------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mentee                   | Teaching assistants have the opportunity to be mentees to the professors they work with.                               | "I have made friends through the program that are in the major and can relate to the courses I am taking, and have a [University] professor know me personally." [14, p. 9]                                                                                                    |
| Mentor                   | Teaching assistants gain opportunities to develop as leaders for undergraduate students, providing them with guidance. | "UTAs did mention during conversations held in seminars that many students often came to them for course or professor selection recommendations, as well as career advice." [16, p. 39]                                                                                        |
| Professional development | Teaching assistants gain technical and soft skills that help them professionally.                                      | "Reported student benefits include higher course grades, self-reported better understanding, and improved logic. Reported peer leader benefits included self-reported better communication and facilitation skills, and a deeper understanding of course content." [17, p. 30] |
| Identity                 | A teaching assistant's role helps confirm or define their academic identity.                                           | "... feedback shows that the experience of serving as a UGTA reaffirmed some students' choice major, helped to build the UGTAs' identity as engineers, and helped shape the UGTA's academic and career goals." [14, pp. 9–10]                                                  |
| Motivation               | Teaching assistants are personally fulfilled by their job.                                                             | "... many students wish to participate to build their soft skills, to give back to programs, to help other fellow students, and/or to receive course credit." [17, p. 35]                                                                                                      |

## Discussion

The results from this literature study have implications for classroom teaching and learning and deep connections to the broader educational literature.

### *Methods and Benefits of TA Training*

While there is nothing novel about the discovery that training better prepares people for the jobs they will perform, the literature identified unique components of TA training that were both

common and useful in preparing TAs for their roles. One of particular interest is the use of role-playing or scenario-based training methods to simulate a classroom environment. The education literature has repeatedly shown that learning is best accomplished when embedded in a realistic context [18], [19]. This benefit is best understood through the lens of situated cognition, which holds that all learning is inseparable from the context in which it occurs and is not merely an abstract concept [20], [21]. The emergence of this theme in the literature suggests that training TAs is no different: a realistic context (or as realistic as you can make it through role-playing) can be instrumental in preparing TAs.

The emergence of student-centeredness in TA training is no surprise, as the education literature has long recognized that a student-centric approach is most effective at creating learning environments that foster learning [22], [23]. Additionally, because the TAs are often near-peers of the students they serve, they are among the most well-equipped members of the instructional team to create a student-focused environment, as they have most recently been in the seats dealing with similar challenges. This results in TAs serving as role models for the enrolled students.

One area of the literature that could continue to expand is the development of validated training protocols and materials that can be widely shared across universities. While each university is unique and requires specific training, other aspects of the training needs, such as pedagogical methods and inclusive practice, are shared needs across multiple institutions.

### *Impacts of TAs inside and outside the classroom*

A significant result of this study is that students are deeply impacted by having TAs, specifically undergraduate TAs, in the classroom. This impact ranged from the mentorship received to the collaborative environment and sense of belonging. The literature suggests that aspects such as mentorship and belonging are particularly needed in first-year classes and for certain underrepresented groups, such as first-generation college students [24], [25], [26]. For this reason, the results suggest that undergraduate TAs could be particularly effective in first-year spaces and classrooms.

Additionally, while the study cannot establish a causal relationship, it is worth noting that across common TA training programs, there are undeniable similarities between the training content and the benefits students realize in the classroom. Aspects of the training, such as mental health and equity and inclusivity training, could very well be linked to benefits realized, such as themes of belongingness and identity, which have previously been linked in the literature [1], [27], [28]. Further research would be needed to identify causal links between elements of training and the exact benefits realized from that training.

### **Limitations and Future Work**

The current study has several limitations, but it also leads the research team to a handful of questions to pursue in future research. First, the literature review included exclusion criteria that would limit certain studies from entering the review, such as studies published in languages other than English, journals not captured in our databases, or those that didn't use one of the key terms

included in our search strings. Additionally, while the research team did their due diligence to identify all the titles for which undergraduate and graduate TAs are referred, some titles may have been overlooked and would not have appeared in our keywords.

That said, the results lead the research team to explore multiple areas in future work. One of the most significant gaps in current results is identifying which training methods and practices lead to which benefits for both students and TAs. Furthermore, an analysis of the type of training modalities (pre-semester workshop, pre-semester, semester-long course in parallel with TA responsibilities, in-person vs. virtual training) is warranted. Additionally, how are these benefits context-dependent? Would the benefits realized be substantially different at a midsize private university from a large public land-grant university? Additional quantitative research could be conducted to determine the impact of being a TA on TAs themselves, including analyses of satisfaction with undergraduate studies, the frequency of subsequent leadership roles, recognition and appreciation of student-centered pedagogies in subsequent courses, ease of creating and facilitating relationships with faculty members, etc.

The research team is taking the results of this literature review to build survey and interview instruments for use in upcoming semesters. These instruments will be used to (1) understand the impact that undergraduate TAs have on the student experience at a midsize private university that is highly cohort focused, (2) what the impact of being a TA has on a student at the same university, and (3) how the research team can best create training experiences that allow our TAs to thrive at the institution. Taken together, these directions will allow the research team not only to build on the literature on TAs and their critical role in engineering education but also to continue developing a TA experience that enables both students and TAs to thrive.

## **Conclusion**

TAs play a critical role in the undergraduate experience of both engineering and STEM students. They are a crucial part of the educational environment and the university ecosystem, and a key component that allows higher education to happen at scale. The literature suggests that the benefits of having TAs in the classroom range from mentorship to a sense of belonging. And these experiences not only impact enrolled students but also become key parts of the TAs' experience, as they benefit from becoming mentees to their professor and from professional development for their future careers. However, training is needed to maximize these benefits, and universities should be mindful of how they train their TAs to both meet students' needs and help TAs flourish in their roles.

## References

- [1] A. B. T. Padron, "Near-Peer Course Support and Students' Sense of College Belonging in Large Enrollment Upper-Level Psychology Courses." 2025. [Online]. Available: <http://hdl.handle.net/10150/677588>
- [2] M. Kleinschrodt, J. Lenn, M. Jansons, and J. Potoff, "First Year Engineering Student Success Enhancement Through the Support of Undergraduate Teaching Assistants," in *2020 First-Year Engineering Experience Proceedings*, East Lansing, Michigan: ASEE Conferences, Jul. 2020, p. 35761. doi: 10.18260/1-2--35761.
- [3] R. M. Reck, "The Influence of Teaching Assistants in an Undergraduate Engineering Laboratory Course," in *IEEE Frontiers in Education Conference*, IEEE, 2017.
- [4] K. J. Rodgers, A. K. Horvath, H. Jung, A. S. Fry, H. Diefes-Dux, and M. E. Cardella, "Students' Perceptions of and Responses to Teaching Assistant and Peer Feedback Students' Perceptions of and Responses to Teaching Assistant and Peer Feedback," *Interdiscip. J. Probl.-Based Learn.*, vol. 9, no. 2, pp. 11–24, 2014.
- [5] M. Borrego, M. J. Foster, and J. E. Froyd, "Systematic Literature Reviews in Engineering Education And Other Developing Interdisciplinary Fields," *J. Eng. Educ.*, vol. 103, no. 1, pp. 45–76, 2014, doi: 10.1002/jee.20038.
- [6] V. Braun, V. Clarke, V. Braun, and V. Clarke, "Using thematic analysis in psychology Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 0887, no. 2006, 2006.
- [7] J. Hill, J. Agarwal, and J. Kastner, "Training for Peer Teaching Assistants in Engineering Classrooms: A Review," in *2025 ASEE Annual Conference & Exposition Proceedings*, Montreal, Quebec, Canada: ASEE Conferences, Jun. 2025, p. 57708. doi: 10.18260/1-2--57708.
- [8] I. Paredes *et al.*, "Developing Inclusive Leadership Training for Undergraduate Engineering Teaching Assistants," in *2023 ASEE Annual Conference & Exposition Proceedings*, Baltimore, Maryland: ASEE Conferences, Jun. 2023, p. 44652. doi: 10.18260/1-2--44652.
- [9] V. Dragisich, V. Keller, and M. Zhao, "An Intensive Training Program for Effective Teaching Assistants in Chemistry," *J. Chem. Educ.*, vol. 93, no. 7, pp. 1204–1210, Jul. 2016, doi: 10.1021/acs.jchemed.5b00577.
- [10] A. A. Fornø, "Teaching Engineering Students How to Teach: Training Teaching Assistants for Diverse Responsibilities," 2024, doi: 10.5281/ZENODO.14256839.
- [11] M. Verleger and H. Diefes-Dux, "A Teaching Assistant Training Protocol for Improving Feedback on Open-Ended Engineering Problems in Large Classes," in *2013 ASEE Annual Conference & Exposition Proceedings*, Atlanta, Georgia: ASEE Conferences, Jun. 2013, p. 23.121.1-23.121.12. doi: 10.18260/1-2--19135.
- [12] A. Phillips, K. Kecskemety, and D. Delaine, "First-year Engineering Teaching Assistant Training: Examining Different Training Models and Teaching Assistant Empowerment," in *2018 ASEE Annual Conference & Exposition Proceedings*, Salt Lake City, Utah: ASEE Conferences, Jun. 2018, p. 30522. doi: 10.18260/1-2--30522.
- [13] T. J. Sloan, "How Learning Assistants Impact Undergraduate STEM Students." 2020. [Online]. Available: [https://etd.ohiolink.edu/acprod/odb\\_etd/ws/send\\_file/send?accession=bgsu157790710654608&disposition=inline](https://etd.ohiolink.edu/acprod/odb_etd/ws/send_file/send?accession=bgsu157790710654608&disposition=inline)
- [14] C. Robinson and J. Collofello, "Utilizing Undergraduate Teaching Assistants in Active Learning Environments," in *2012 ASEE Annual Conference & Exposition Proceedings*, San

- Antonio, Texas: ASEE Conferences, Jun. 2012, p. 25.1455.1-25.1455.11. doi: 10.18260/1-2--22212.
- [15] H. Gallegos, K. Wendell, and J. Swenson, "WIP An Interview Study of Faculty, Course Assistant, and Student Insight within Teaching and Learning Assistant Programs for Undergraduate Engineering Courses," in *2018 ASEE Annual Conference & Exposition Proceedings*, Salt Lake City, Utah: ASEE Conferences, Jun. 2018, p. 31244. doi: 10.18260/1-2--31244.
- [16] S. B. Philipp, T. R. Tretter, and C. V. Rich, "Partnership for Persistence: Influence of Undergraduate Teaching Assistants in a Gateway Course for Stem Majors." 2016.
- [17] S. L. Pettit, "Development of Learning Assistants to Improve Student Success," *Chem. Eng. Educ.*, vol. 58, no. 1, 2024, doi: 10.18260/2-1-370.660-132217.
- [18] J. A. Lyon and A. J. Magana, "The use of engineering model-building activities to elicit computational thinking : A design-based research study," *J. Eng. Educ.*, pp. 1–23, 2021, doi: 10.1002/jee.20372.
- [19] H. A. Diefes-Dux, T. Moore, J. Zawojewski, P. K. Imbrie, and D. Follman, "A framework for posing open-ended engineering problems: Model-eliciting activities," presented at the Proceedings of the 34th ASEE/IEEE Frontiers in Education Conference, Savannah, GA, 2004. doi: 10.1109/FIE.2004.1408556.
- [20] J. S. Brown, A. Collins, and P. Duguid, "Situated Cognition and the Culture of Learning," *Educ. Res.*, vol. 18, no. 1, pp. 32–42, 1989, doi: 10.3102/0013189X018001032.
- [21] Q. Cutts, S. Esper, M. Fecho, S. R. Foster, and B. Simon, "The abstraction transition taxonomy: Developing desired learning outcomes through the lens of situated cognition," presented at the ICER 2012, ACM, 2012, pp. 166–166.
- [22] G. B. Wright, "Student-Centered Learning in Higher Education," *Int. J. Teach. Learn. High. Educ.*, vol. 23, no. 3, pp. 92–97, 2011.
- [23] K. Kaput, "Evidence for Student-Centered Learning," Education Evolving, 2018.
- [24] J. C. Garvey, K. W. Guyotte, K. S. Latopolski, L. A. Sanders, and M. A. Flint, "Belongingness in Residence Halls: Examining Spaces and Contexts for First-Year Students Across Race and Gender," vol. 30, no. 2.
- [25] I. Salusky, L. Monjaras-Gaytan, G. Ulerio, N. Forbes, G. Perron, and E. Raposa, "The Formation and Role of Social Belonging in On-Campus Integration of Diverse First-Generation College Students," *J. Coll. Stud. Retent. Res. Theory Pract.*, 2022, doi: 10.1177/15210251221092709.
- [26] C. King, J. Griffith, M. Murphy, and null null, "Story Sharing for First-Generation College Students Attending a Regional Comprehensive University: Campus Outreach to Validate Students and Develop Forms of Capital," *Teach. J. State Compr. Univ.*, 2017, doi: 10.58809/qffh2531.
- [27] A. L. Canlas and M. R. Williams, "Meeting Belongingness Needs: An Inclusive Leadership Practitioner's Approach," *Adv. Dev. Hum. Resour.*, vol. 24, no. 4, pp. 225–241, Nov. 2022, doi: 10.1177/15234223221118953.
- [28] S. C. Scogin *et al.*, "Supporting Students from Day 1 of College: The Importance of Relatedness to Inclusivity," *J. Microbiol. Biol. Educ.*, vol. 21, no. 2, p. 40, Jan. 2020, doi: 10.1128/jmbe.v21i2.2015.

## Appendices

### Appendix 1. Search Strings by Database

| Database                 | Search String                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Google Scholar           | <ol style="list-style-type: none"> <li>1) allintitle: undergraduate ("UGTA" OR "TA" OR "Teaching Assistant" OR "teacher's aide" OR "peer assistant" OR "learning assistant") ("impact" OR "effects")</li> <li>2) undergraduate, STEM ("UGTA" OR "TA" OR "Teaching Assistant" OR "teacher's aide" OR "peer assistant" OR "learning assistant") ("perspective" OR "effect" OR "influence")</li> <li>3) allintitle: undergraduate ("UGTA" OR "TA" OR "Teaching Assistant" OR "teacher's aide" OR "peer assistant" OR "learning assistant") ("significance" OR "impact")</li> <li>4) (effectiveness of undergraduate teaching assistants)</li> <li>5) allintitle:engineering undergraduate teaching assistants</li> <li>6) allintitle: engineering undergraduate learning assistants</li> <li>7) ("engineering" "undergraduate learning assistants")</li> <li>8) (engineering undergraduate learning assistants)</li> <li>9) allintitle: engineering ("TA" OR "Teaching Assistant" OR "teacher's aide" OR "peer assistant") ("training" OR "onboarding")</li> <li>10) allintitle: engineering ("peer mentor" OR "teaching assistant" OR "teaching associate" OR "instructional assistant" OR "course assistant") ("orientation" OR "professional development" OR "preparation" OR "workshop")</li> <li>11) allintitle: engineering ("learning assistant" OR "TA" OR "Teaching Assistant" OR "teacher's aide" OR "peer assistant") ("training" OR "onboarding")</li> </ol> |
| EBSCO - Education Source | <ol style="list-style-type: none"> <li>1) engineering AND (TA or teaching assistant or teacher's aide) AND (training or onboarding or development)</li> <li>2) TI(engineering AND (TA or teaching assistant or teacher's aide) AND (training or onboarding or development))</li> <li>3) TI(engineering) AND (learning assistant or TA or teaching assistant or teacher's aide) AND (training or onboarding or development)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Engineering Village      | <ol style="list-style-type: none"> <li>1) engineering AND (TA or teaching assistant or teacher's aide) AND (training or onboarding or development)</li> <li>2) TI(engineering AND (TA or teaching assistant or teacher's aide) AND (training or onboarding or development))</li> <li>3) TI(engineering) AND (learning assistant or TA or teaching assistant or teacher's aide) AND (training or onboarding or development)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Appendix 2. Papers included in the review for research around the impact of TAs

- [1] H. Gallegos, K. B. Wendell, and Jessica, "WIP An Interview Study of Faculty, Course Assistant, and Student Insight within Teaching and Learning Assistant Programs for Undergraduate Engineering Courses," *Asee.org*, Jun. 23, 2018.  
<https://peer.asee.org/wip-an-interview-study-of-faculty-course-assistant-and-student-insight-within-teaching-and-learning-assistant-programs-for-undergraduate-engineering-courses> (accessed Feb. 19, 2026).
- [2] T. J. Sloan, "How Learning Assistants Impact Undergraduate STEM Students," *Ohiolink.edu*, 2020.  
[https://etd.ohiolink.edu/acprod/odb\\_etd/etd/r/1501/10?clear=10&p10\\_accession\\_num=bgsu157790710654608](https://etd.ohiolink.edu/acprod/odb_etd/etd/r/1501/10?clear=10&p10_accession_num=bgsu157790710654608)
- [3] C. Robinson and J. Collofello, "Utilizing Undergraduate Teaching Assistants in Active Learning Environments," in *2012 ASEE Annual Conference & Exposition Proceedings*, San Antonio, Texas: ASEE Conferences, Jun. 2012, p. 25.1455.1-25.1455.11. doi: 10.18260/1-2--22212.
- [4] S. L. Pettit, "Development of Learning Assistants to Improve Student Success," *Chem. Eng. Educ.*, vol. 58, no. 1, 2024, doi: 10.18260/2-1-370.660-132217.
- [5] S. B. Philipp, T. R. Tretter, and C. V. Rich, "Partnership for Persistence: Influence of Undergraduate Teaching Assistants in a Gateway Course for Stem Majors." 2016.
- [6] S. B. Philipp, T. R. Tretter, and C. V. Rich, "Undergraduate Teaching Assistant Impact on Student Academic Achievement," *The Electronic Journal for Research in Science & Mathematics Education*, vol. 20, no. 2, 2016, Available:  
<https://ejrsme.icrsme.com/article/view/15784>
- [7] M. Gilbert and D. A. B. Weikle, "A Pilot Study on the Impact of Teaching Assistant Led CS1 Study Sessions using Peer Instruction," *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, pp. 1287–1287, Feb. 2020, doi: <https://doi.org/10.1145/3328778.3372602>.
- [8] K. B. Wendell, D. Matson, H. Gallegos, and L. Chiesa, "Board 53: Work in Progress: Learning Assistant 'Noticing' in Undergraduate Engineering Science Courses," *Asee.org*, Jun. 15, 2019.  
<https://peer.asee.org/board-53-work-in-progress-learning-assistant-noticing-in-undergraduate-engineering-science-courses> (accessed Feb. 19, 2026).
- [9] A. Borem and C. Smith, "Developing and Supporting STEM Undergraduate Teaching Assistants as Partners in Teaching," 2020 IEEE Frontiers in Education Conference (FIE), Uppsala, Sweden, 2020, pp. 1-9, doi: 10.1109/FIE44824.2020.9274088.
- [10] Lakshmy Mohandas, N. Mentzer, A. Jaiswal, and S. Farrington, "Effectiveness of Undergraduate Teaching Assistants in a First-Year Design Course," *Asee.org*, Jun. 22, 2020.  
<https://peer.asee.org/effectiveness-of-undergraduate-teaching-assistants-in-a-first-year-design-course>
- [11] M. Kleinschrodt, J. Lenn, M. Jansons, and J. Potoff, "First Year Engineering Student Success Enhancement Through the Support of Undergraduate Teaching Assistants," *Asee.org*, Jul. 26, 2020.  
<https://peer.asee.org/first-year-engineering-student-success-enhancement-through-the-support-of-undergraduate-teaching-assistants> (accessed Feb. 19, 2026).

- [12] P. Gruber, J. McLean, and K. Popichak, "An undergraduate learning assistant perspective on career development," *Journal of Microbiology & Biology Education*, vol. 26, no. 2, Aug. 2025, doi: <https://doi.org/10.1128/jmbe.00105-25>.
- [13] "Learning Assistants in Undergraduate Mechanical Engineering: Goals, Discourse, and Community - ProQuest," *Proquest.com*, 2023.  
<https://www.proquest.com/docview/2819937296?pq-origsite=gscholar&fromopenview=true&sourcetype=Dissertations%20&%20Theses> (accessed Feb. 19, 2026).
- [14] Y. Cao, C. Smith, B. D. Lutz, and M. Koretsky, "Cultivating the Next Generation: Outcomes from a Learning Assistant Program in Engineering," *arXiv.org*, 2018.  
<https://arxiv.org/abs/1807.04838>
- [15] J.M. Roshandel, E. Cote, and C. Randles, "Exploring the Professional Relationships between Undergraduate Students and Their Graduate Teaching Assistants and Undergraduate Learning Assistants," *Journal of Chemical Education*, vol. 102, no. 3, pp. 1083–1096, Feb. 2025, doi: <https://doi.org/10.1021/acs.jchemed.4c01172>.
- [16] A. P. Barrasso and K. E. Spilios, "A scoping review of literature assessing the impact of the learning assistant model," *International Journal of STEM Education*, vol. 8, no. 1, Feb. 2021, doi: <https://doi.org/10.1186/s40594-020-00267-8>.
- [17] H. Kornreich-Leshem, R. Benabentos, Z. Hazari, G. Potvin, and L. Kramer, "The cognitive and affective roles of learning assistants in science, technology, engineering, and mathematics college classrooms: An exploration of classroom experiences and students' metacognitive awareness and disciplinary identity," *Science Education*, vol. 106, no. 3, pp. 545–572, Jan. 2022, doi: <https://doi.org/10.1002/sce.21703>.
- [18] C. J. Felege, "The Long-Term Significance of Working as an Undergraduate Teaching Assistant." Order No. 10812567, The University of North Dakota, United States -- North Dakota, 2018.
- [19] M. Thompson, "The effect of Learning Assistants on student learning outcomes and satisfaction in large science and...", *ResearchGate*, Apr. 11, 2015.  
[https://www.researchgate.net/publication/275032656\\_The\\_effect\\_of\\_Learning\\_Assistants\\_on\\_student\\_learning\\_outcomes\\_and\\_satisfaction\\_in\\_large\\_science\\_and\\_engineering\\_courses](https://www.researchgate.net/publication/275032656_The_effect_of_Learning_Assistants_on_student_learning_outcomes_and_satisfaction_in_large_science_and_engineering_courses) (accessed Feb. 19, 2026).
- [20] J. Gurganus, M. R. Blorstad and M. M. Headley, "Training beyond the classroom: Case Study of the Impact of a Undergraduate Teaching Assistantship program," 2022 IEEE IFEEES World Engineering Education Forum - Global Engineering Deans Council (WEEF-GEDC), Cape Town, South Africa, 2022, pp. 1-5, doi: 10.1109/WEEF-GEDC54384.2022.9996214.

### Appendix 3. Papers included in the review for research around the training of TAs

- [1] J. Michael, J. Agarwal, and J. Kastner, "Training for Peer Teaching Assistants in Engineering Classrooms: A Review," *Asee.org*, Jun. 22, 2025.  
<https://peer.asee.org/training-for-peer-teaching-assistants-in-engineering-classrooms-a-review>
- [2] M. Verleger and J. Velasquez, "An engineering teaching assistant orientation program: Guidelines, reactions, and lessons learned from a one day intensive training program," in *Proc. 37th Annu. Frontiers in Education Conf. (FIE)*, Milwaukee, WI, USA, 2007, pp. S4G-3–S4G-7, doi: 10.1109/FIE.2007.4417912.
- [3] I. Paredes, K. Burns, J. Bringardner, R. Li, A. Palav, E. R. Hume, V. Bill, and C. Woods, "Developing inclusive leadership training for undergraduate engineering teaching assistants," in *Proc. 2023 ASEE Annu. Conf. & Expo.*, Baltimore, MD, USA, June 2023, doi: 10.18260/1-2--44652.
- [4] A. Fornø, "Teaching engineering students how to teach: Training teaching assistants for diverse responsibilities," in *Proc. 52nd Annu. Conf. SEFI*, Lausanne, Switzerland, 2024, doi: 10.5281/zenodo.14256839.
- [5] T. Kunberger, C. Geiger, and J. Greene, "Development of a training workshop for undergraduate mentor TAs in an introductory engineering course," in *Proc. ASEE Annu. Conf. & Expo.*, 2017, doi: 10.18260/1-2--28164.
- [6] V. Dragisich, V. Keller, and M. Zhao, "An intensive training program for effective teaching assistants in chemistry," *J. Chem. Educ.*, vol. 93, no. 7, pp. 1204–1210, 2016, doi: 10.1021/acs.jchemed.5b00577.
- [7] P. Cho and W. W. Predebon, "A teaching assistant training program with a focus on teaching improvement and graduate student development," in *Proc. ASEE Annu. Conf.*, Washington, D.C., Jun. 1996, doi: 10.18260/1-2--6311.
- [8] M. A. Verleger and H. A. Diefes-Dux, "A teaching assistant training protocol for improving feedback on open-ended engineering problems in large classes," in *Proc. ASEE Annu. Conf. & Expo.*, Atlanta, GA, USA, June 2013, doi: 10.18260/1-2--19135.
- [9] T. Pinder-Grover, "Active learning in engineering: Perspectives from graduate student instructors," in *Proc. ASEE Annu. Conf. & Expo.*, 2013.
- [10] M. Di Benedetti, S. Plumb, and S. B. M. Beck, "Effective use of peer teaching and self-reflection for the pedagogical training of graduate teaching assistants in engineering," *Eur. J. Eng. Educ.*, vol. 48, no. 1, pp. 59–74, 2023, doi: 10.1080/03043797.2022.2054313.
- [11] G. Akcayir, M. V. Jamieson, K. Basaraba, D. Buchanan, Q. Jin, M. Kim, J. McFeetors, and K. Rose, "Engineering educator identity development in a socially and culturally embedded discipline specific graduate teaching assistant professional development program," in *Proc. ASEE Annu. Conf. & Expo.*, Portland, OR, USA, June 2024, doi: 10.18260/1-2--47281.
- [12] F. Karim, S. Motavas, and D. E. Feduik, "Engineering teaching assistant training: Increased engagement using varied delivery methods," in *Proc. ASEE Annu. Conf. & Expo.*, San Antonio, TX, USA, June 2012, pp. 25.560.1–25.560.18, doi: 10.18260/1-2--21317.
- [13] C. J. Fong, J. Gilmore, T. Pinder-Grover, and M. Hatcher, "Examining the impact of four teaching development programmes for engineering teaching assistants," *J. Further Higher Educ.*, vol. 43, no. 3, pp. 363–380, 2019, doi: 10.1080/0309877X.2017.1361517.
- [14] J. Gilmore, M. A. Maher, D. F. Feldon, and B. Timmerman, "Exploration of factors related to the development of science, technology, engineering, and mathematics graduate teaching

- assistants' teaching orientations," *Stud. Higher Educ.*, vol. 39, no. 10, pp. 1910–1928, 2014, doi: 10.1080/03075079.2013.806459.
- [15] T. L. Lutz, J. M. Paris, and M. A. Verleger, "First-year engineering teaching assistant training: Examining different training models and teaching assistant empowerment," in *Proc. ASEE Annu. Conf. & Expo.*, 2018, doi: 10.18260/1-2--30969.
- [16] Y. W. Chen, H. H. Choi, B. E. Johnson, M. A. Beckman, and L. Anderson, "Board 85: Integrated engineering leadership initiative for teaching excellence (iELITE) year two: Assessment of intermediate-term outcome for graduate teaching assistant training," in *Proc. ASEE Annu. Conf. & Expo.*, Tampa, FL, USA, June 2019, doi: 10.18260/1-2--32445.
- [17] K.-P. Mark, D. R. Thadani, D. S. Calonge, C. F. K. Pun, and P. H. P. Chiu, "In-service teaching assistant training (InsTAT) for engineering and computer science graduate students in Hong Kong: A blended-learning approach," in *Proc. Frontiers Educ. Conf. (FIE)*, Rapid City, SD, USA, 2011, pp. F2E-1–F2E-6, doi: 10.1109/FIE.2011.6142930.
- [18] D. A. Torvi, "Engineering graduate teaching assistant instructional programs: Training tomorrow's faculty members," *J. Eng. Educ.*, vol. 83, pp. 376–382, 1994, doi: 10.1002/j.2168-9830.1994.tb00134.x.
- [19] J. Boudreau and H. Anis, "Teaching assistant training in engineering design," in *Proc. Canadian Engineering Education Assoc. (CEEAA)*, 2019, doi: 10.24908/pceea.vi0.13746.
- [20] D. Liu, "The factors of enhancing Graduate Teaching Assistants' Technological Pedagogical Content Knowledge (TPACK) performance in engineering curriculum teaching," *Discover Education*, vol. 1, no. 1, p. 17, 2022, doi: 10.1007/s44217-022-00017-8.
- [21] R. J. Rajarathinam, J. E. Katz, S. Shehab, B. E. Johnson, Y. W. Chen, M. Pool, and K. M. Chochola, "The impact of a graduate teaching and leadership course on engineering graduate teaching assistants' learning of pedagogy," in *Proc. 2024 ASEE Annual Conf. & Exposition*, Portland, OR, USA, Jun. 2024, doi: 10.18260/1-2--48105.