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Published in:

Book of Proceedings for the 52nd Annual Conference of the European Society for Engineering Education

Link to article, DOI:

[10.5281/zenodo.14256839](https://doi.org/10.5281/zenodo.14256839)

Publication date:

2025

Document Version

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):

Fornø, A. A. (2025). Teaching Engineering Students How to Teach: Training Teaching Assistants for Diverse Responsibilities. In J. D. Zufferey, G. Langie, R. Tormey, & B. V. Nagy (Eds.), *Book of Proceedings for the 52nd Annual Conference of the European Society for Engineering Education: Educating Responsible Engineers* (pp. 1448-1457). SEFI. <https://doi.org/10.5281/zenodo.14256839>

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Teaching Engineering Students How to Teach: Training Teaching Assistants for Diverse Responsibilities

DOI: 10.5281/zenodo.14256839

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Conference Key Areas: *Building the capacity and strengthening the educational competencies of engineering educators and Engineering skills, professional skills, and transversal skills*

Keywords: *Teaching assistants, active learning, scaffolding learning processes, teacher training, teaching self-efficacy*

ABSTRACT

Teaching assistants are widely used at universities around the world, and they are an important part of the teaching and learning ecosystem at their institutions. They help support teachers and facilitate learning processes for students. For many teaching assistants, this work will also represent their first experience with formal teaching. Thus, it is crucial that they receive training within the field of pedagogy and didactics to prepare them for their new teaching responsibilities and ensure a consistent and high quality in their instruction. Since they are relatively inexperienced when they start working as teaching assistants, they both need to develop an understanding of the theories and methods of teaching and learning in higher education, as well as lay the foundation for a professional identity as a teacher, helping them develop sustainable teaching practices and teaching self-efficacy.

This practice paper presents the design of a teaching assistant training course at the Technical University of Denmark, which is focused on developing an understanding

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of teaching and learning in higher education for the new teaching assistants, as well as facilitating their development of teaching self-efficacy.

1 INTRODUCTION

Teaching assistants are an often-used resource at universities to support teachers and help facilitate learning for students (Filz and Gurung 2013; Ren, Krishnamurthi, and Fisler 2019). The responsibilities of a teaching assistant may vary a lot depending on the course they are taking part in teaching and their collaboration with the responsible teacher. Examples of the kind of tasks teaching assistants are given responsibility for could be grading assignments, facilitating learning activities such as laboratory exercises, supervising group projects, or even being given responsibility for parts of lectures. Therefore, they play an important role in teaching and guiding students through their courses and study programmes. A common characteristic of teaching assistants is, that they are usually relatively inexperienced within the field of teaching, especially within the context of higher education. While some teaching assistants may have some more or less formal experience with teaching, for example one-on-one tutoring or similar, most teaching assistants have never stood at the front of a classroom before. Thus, their responsibilities as teaching assistants often represent their first real experience with formal teaching.

Teaching assistants are in a rather unique position as teachers given their close proximity and similarity to the students they teach, because teaching assistants are most often students themselves, and may have recently completed the same course they are now teaching (Pawlak, Irving, and Caballero 2020). Research shows that students are likely to perceive teaching assistants as more approachable, understanding and motivating (Kendall and Schussler 2012; Ren, Krishnamurthi, and Fisler 2019) which means many students may be more likely to approach a teaching assistant for help than a teacher. In other words, teaching assistants are a vital resource for universities to provide not only the much-needed capacity to accommodate the rising numbers of students in higher education (Forbes et al. 2017), but most importantly because they represent a safe and approachable source for support and learning for students. There is a huge potential then to increase student learning through the strategic use of teaching assistants. However, this potential is dependent on the teaching assistants' abilities. This underlines the importance of universities prioritising pedagogical training targeting teaching assistants, so they may be adequately prepared to take on their new teaching responsibilities. This is no simple task, as a training course will have to provide the necessary and specific knowledge and skills relevant to the diverse teaching responsibilities of teaching assistants, while also providing a pedagogical foundation for understanding teaching and learning.

Training of teaching assistants is generally under-researched, and though there are some examples to be found on the topic, many of these are often either aimed at specific disciplines (e.g. Marbach-Ad et al. 2012, or Mirza et al. 2019, or Reeves et al. 2016) or specific tasks, such as laboratory exercises (e.g. Dragisich, Keller, and Zhao 2016, or Nikolic et al. 2015). Other examples provide a framework for training teaching assistants, where the course design may require a lot of time and resources and/or big structural changes at the university in order to implement the model (e.g. Odden et al. 2023). While these very specific disciplinary course and extensive models of training may be meaningful in certain contexts, they require many resources to adapt and implement, which makes it difficult to transfer these frameworks to new teaching contexts. This practice paper, however, presents a

detailed description of a course design that is easily adaptable and can help increase the proficiency of teaching assistants without using an enormous amount of resources.

This practice paper aims at providing an outline of a universally adaptable framework for a training course for inexperienced teaching assistants, called The Teaching Assistants' Education. The training course presented here has been designed as a universal crash course in pedagogy and didactics, providing an understanding of theories of learning, diverse methods for teaching and strengthening teaching assistants' teaching self-efficacy to prepare teaching assistants to provide quality teaching. Because teaching assistants can have very diverse responsibilities, the training course is also designed to accommodate teaching assistants with many different types of responsibilities. The universal design also means that the course may be transferred and adapted to different higher education contexts relatively easily, which will be elaborated more on later in the paper.

2 PREPARING THEM FOR THEIR RESPONSIBILITIES: DESIGNING A TRAINING COURSE

The Teaching Assistants' Education has been made mandatory for first-time teaching assistants to participate in, to ensure that every teaching assistant at the university has a foundation on which to base their teaching practices. The course is offered once per semester, and between 100-200 teaching assistants participate each semester. The course introduces them to the theories of teaching and learning as preparation for their new responsibilities as teaching assistants, and the course is specifically designed to provide a foundation that can support the teaching assistants as they begin the journey to develop their professional identity and competencies within teaching. This is also reflected in the learning objectives for the course:

- Describe the role of the teaching assistant in relation to students' learning and identity-building
- Explain the concepts of learning and learning processes
- Give constructive and concrete feedback to scaffold student's learning
- Choose and apply appropriate strategies to handle challenges that can occur in the work of a teaching assistant

The course consists of a full course day (6 hours), *the introduction day*, which is placed right before the beginning of a new semester. Towards the end of the semester, there is a shorter meeting (2 hours), *the follow-up meeting*, where the teaching assistants have a scaffolded discussion revolving around their individual experiences with teaching from the semester. Between the introduction day and the follow-up meeting, the teaching assistants have time to apply their new knowledge and skills in their own teaching, and alongside their work, they are required to reflect on their own practice and write a case based on their experiences, which they have to bring to the follow-up meeting. The training course is thus parallel to their teaching during the semester. Below is an illustration of the training course in relation to the academic semester:

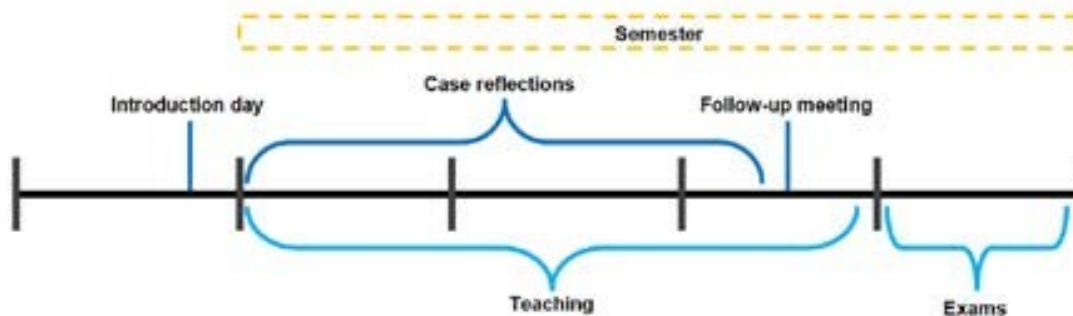


Fig. 1. Overview of the Teaching Assistants' Education

The pedagogical framework for the training course is based on an active learning philosophy and case-based learning. During the course, the teaching assistants are expected to participate in many different activities, where they will reflect on and discuss different topics, both individually, in pairs, in groups and in plenum. The purpose is to create a reflective classroom, where everybody can share experiences, ideas, and questions regarding teaching, learning and the role of teaching assistants. This creates a learner-centred classroom, where the teacher takes on a secondary role, facilitating and scaffolding the learning process of the students, which has been shown to be efficient in achieving learning outcomes (Weimer 2013; Felder and Brent 2016).

To scaffold the learning objectives and prepare the teaching assistants, the course focuses on two main aspects of the teaching assistants' role: the first aspect is about preparing them to scaffold sustainable and constructive learning processes for the students in their classrooms, and the second aspect concerns laying the foundation for their individual development of teaching self-efficacy and curiosity for further professional development. While the teaching assistants usually know which teaching activities, they will be responsible for when they are hired, they are often unprepared for how they can scaffold a constructive learning process for a full classroom. Therefore, they need to learn methods and tools for teaching to help them with the task ahead.

2.1 Understanding Teaching and Learning

Teaching assistants need both specific and cross-curricular competencies (Rico et al. 2013) in order to be able to facilitate learning processes; firstly, they need specific competencies related to their field, so they are familiar with the themes and materials of the course they are teaching. For example, if a teaching assistant helps teach a Computer Science-course where they focus on programming in Python, the teaching assistant will need to be able to, at least to a certain extent, use Python for programming, in order to support the students. Secondly, teaching assistants need cross-curricular competencies within teaching and communication, in order to employ effective teaching practices. Because teaching assistants are usually hired based on their competencies within a specific field or their high performance in a specific course, the field-specific competencies are already present when they begin working with teaching. Therefore, this training course focuses on the cross-curricular competencies within the field of teaching and learning.

In designing the training course, the diverse roles and responsibilities of teaching assistants were considered along with evidence-based teaching methods in STEM-

teaching (Felder and Brent 2016). From this, four core pedagogical topics were inferred: 1) Active learning, 2) (cognitive) learning processes, 3) communication, and 4) formative and summative feedback. While teaching these topics, the course is designed to be exemplary of the same pedagogical principles in order to show how these teaching methods can be implemented in practice. Therefore, as previously mentioned, the course contains lots of varied activities and reflective exercises to scaffold the teaching assistants' learning processes. The course contains very little traditional lecturing, putting focus on the participants rather than on the teacher. The responsibility of the teacher is to support and facilitate the participants' active engagement with the course material through asking questions and providing feedback on the teaching assistants' progress.

This method of instruction has a positive effect on the learning processes of the teaching assistants, who are often curious and motivated to learn about pedagogy and didactics due to its' relevance to their work. However, these concepts can be quite foreign to them, as the teaching assistants are used to working in the field of engineering, which can be quite different from the fields of social science and humanities. As they explain it:

"There is the hard stuff and then there is the soft stuff, and for us the soft stuff is usually the hard stuff." (Teaching assistant during the training course)

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.

2.2 Scaffolding Teaching Self-efficacy and Professional Development

As previously described, teaching assistants play an important role in helping students learn, but at the same time they are rather inexperienced when it comes to teaching. Therefore, a major focus for this training course is motivating the teaching assistants for further professional development.

To address this, a part of the training course focuses on communication, scaffolding and problem-solving. Specifically, the training course seeks to support the teaching assistants in developing teaching self-efficacy, which is an important motivator to develop teaching practices for sustainable learning and has even been shown to improve the academic performance of students (Fong, Dillard, and Hatcher 2019). The concept of teaching self-efficacy is here adapted from Tinto (2017), where a model for student persistence is conceptualized, shows a connection between students' self-efficacy, their perception of curriculum and sense of belonging. Tinto describes self-efficacy in students as a belief in one's own ability to rise to (extrinsic) expectations and overcome educational challenges (Tinto 2017). Transferring the concept to teaching assistants, this means feeling confident in one's own abilities to handle challenges that may arise while teaching in a constructive manner and being able to facilitate sustainable learning processes (Fong, Dillard, and Hatcher 2019).

One of the activities during the introduction day that was specifically constructed to support the development of teaching self-efficacy is called *The Toolbox*. The purpose is to make the teaching assistants reflect on how to solve common teaching problems, so that they may be prepared if or when these problems occur in their classrooms. The Toolbox presents 7 different generalized challenges that are

chosen based on cases which have previously been presented at the training course by teaching assistants. An example could be: *“How can you handle frustrated and/or unmotivated students?”*. The teaching assistants are then asked to discuss each challenge and come up with solutions for handling them. Discussing these problems in a case-based way gives them a real-life feeling, and knowing the cases come from other teaching assistants lends credibility to the activity, making it highly appreciated by the teaching assistants:

“As a new TA, I did really appreciate the opportunity to get a “toolbox” for assessing various situations, and be suited to help the students in the best possible way. I felt more prepared for the job as TA.” (Teaching assistant, from the course evaluation)

3 CEMENTING THEIR NEW SKILLS AND ASSESSMENT OF LEARNING GAINS

There is no formal exam for the training course, rather an on-going assessment takes place during the course, where the active and engaged participation of each teaching assistant counts as their exam. In order to pass the course, the teaching assistants will need to participate in all course activities. This is explicitly stated in the beginning of the course, and it is reiterated during the course, that active participation is a requirement. Therefore, passing the course is not only a question of physically being in the classroom, but also being mentally engaged in the contents and activities. The didactic design of the course and the assessment format was developed according to the model of constructive alignment, which necessitates a clear connection between the learning objectives, learning activities and the assessment of a course (Biggs and Tang 2011). The ambition of the assessment format is then to direct teaching assistants’ attention towards the contents and activities of the course, and create a positive washback effect (Tzagari and Cheng 2020), motivating the teaching assistants to be more actively engaged.

Another important part of the assessment of the course is the case-discussions during the follow-up meeting, where each teaching assistant brings along a real-life case. Here, the teaching assistants show how they have used the knowledge and skills they learned during the introduction day in their teaching. During the case-discussions they are invited to analyse and reflect on their own experiences, as well as the experiences of other teaching assistants coming up with different ways of handling each situation, to deepen their understanding and insight into teaching practices. They will also practice active listening and asking questions, as well as engage in meta-discussions about the role and responsibilities of teaching assistants. This case-based activity is aligned with activities from the introduction day as well as their learning objectives, ultimately supporting the student’s development of teaching competencies.

4 KEEPING THE COURSE RELEVANT

Because the tasks and responsibilities of teaching assistants are so diverse and subject to change, the content of the training course and its learning objectives are re-examined every semester using feedback from the course evaluations, as well as the cases from the Toolbox exercise. This ensures that the course is constantly kept up to date on the roles and responsibilities teaching assistants are given at the university and makes sure the content of the course is relevant and useful for future

teaching assistants. Part of the revision process is reading through the cases from the teaching assistants, because it provides a detailed and valuable insight into the practices and challenges of the teaching assistants. During this process, if a new or particularly complex case shows up, they are saved and worked in to the curriculum for the upcoming semester. An example of this is, that two years ago, we received cases regarding teaching when there is a language barrier between the student and the teaching assistant. These cases created awareness of a need to prepare for handling this issue, and the case was then incorporated into the Toolbox exercise. Since the incorporation, there has been fewer teaching assistants reporting the issue.

The teaching assistants are asked to give feedback twice during the course. The first time is a short evaluation after the introduction day, where they are asked to write down something they think should be maintained on the course (for example an exercise or a topic) and something that could be developed further. Below are some examples:

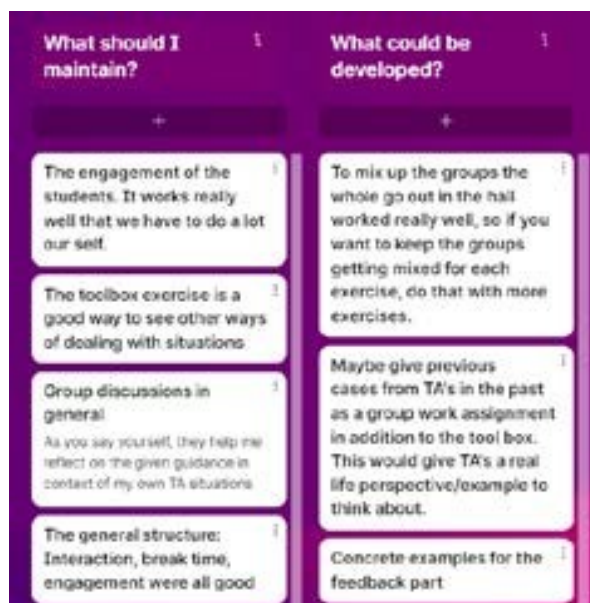


Fig. 2. Excerpt from the short evaluation, Autumn 2023

This feedback serves two purposes: firstly, it immediately brings to light if there is anything that has been unclear during the introduction day that may need to be revisited or if there are some resources lacking that need to be provided for the teaching assistants. In other words, it provides an opportunity to rectify any misunderstandings quickly. Secondly, it provides valuable insight which can be used to develop and improve the course in the future, so that the content can stay relevant to teaching assistants even if their tasks and responsibilities may change.

The teaching assistants are also asked to evaluate the entire course at the end of it in a more thorough evaluation. However, there are usually around two months between the introduction day and the follow-up meeting. Thus, asking for immediate feedback after the first session is also a pragmatic decision, ensuring that feedback is given while their experiences are still fresh in their memory.

5 SUMMARY

The Teaching Assistants' Education has been offered now for more than 10 years and evaluations of the course are usually overwhelmingly positive, with teaching assistants expressing they find the course both useful and relevant. According to the feedback given by the teaching assistants, the training course facilitates positive professional development, enabling them to help further scaffold sustainable learning processes for students in close collaboration with university faculty. 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:

"I always have the results of our discussions from the introduction day in the back of my mind about how to be the best possible TA as I can. For example to be proactive when nobody's asking for help, because I can now say from experience that they often struggle with something even though they don't say it! Also be non-judgemental if they ask a supposedly "dumb" question, and instead just guide them through the problem until they understand, since everybody learns in a different pace." (Teaching assistant, from the course evaluation)

Implementing a training course such as this thus positively impacts the teaching self-efficacy and proficiency of teaching assistants, which in turn should have a positive impact on student learning.

Obviously, how this course design may be adapted to a different higher education context is dependent on many different factors, such as the number of new, inexperienced teaching assistants hired each year at the educational institution in question, as well as the diversity of the tasks teaching assistants are given and the resources available to support them in their professional development. The course design presented in this practice paper is designed to be flexible, so it can adapt to the dynamic landscape of higher education, and therefore it can easily be adapted to fit another context at other universities by modifying the real-life cases and questions the teaching assistants have to work with during the introduction day, as well as adding or subtracting specific teaching methods, according to their relevance for the teaching assistants in question. Considering the particularities of the context, different adaptations may be more or less meaningful. Therefore, it is important to understand the concrete needs of the teaching assistants at a given university. For example, at larger universities, which usually also have a higher number of teaching assistants, it may therefore be more meaningful to offer several, more specialised training courses for teaching assistants that are more targeted at teaching methods related to either specific scientific fields or specific tasks and responsibilities. In other cases, it may be more meaningful to adapt a more universal framework, such as the one presented in this paper, for example if a university has a relatively small number of teaching assistants or a higher diversity in responsibilities for each teaching assistant.

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