INCLUSIVE ENGINEERING CLASSROOMS: STUDENT TEACHING ASSISTANTS' PERSPECTIVES (RESEARCH)

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ABSTRACT

Inclusive teaching is the intentional practice of recognising biases, working to mitigate their impact, and ensuring that students have equitable learning opportunities. In addition to improving students' sense of belonging and self-efficacy,

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inclusive teaching improves retention, improves academic performance, and reduces achievement gaps. In many large enrollment introductory classrooms, student teaching assistants (TAs) contribute to the classroom climate in addition to the teachers and the students.

In this qualitative study, 262 TAs were asked about their teaching strengths, areas that need improvement, obstacles, and ideas about their role in reducing incidents of discrimination or harassment. We coded their open-ended responses using a framework proposed by Dewsbury (2020) to map ideas about inclusive practices that these TAs are bringing into the classrooms.

Our analysis suggests that TAs can be powerful forces in building inclusive classrooms, given the coherency with Dewsbury's inclusive teaching competencies. Following training, the importance they accorded to content knowledge decreased and active learning increased, coherent with increased focus on supporting students' learning. Positive classroom climate dominated TAs' ideas about decreasing discrimination in the classroom, however this did not feature among the teaching strengths they listed and many TAs cited a need to improve their skills in this area. However, empathising with students was also cited less often in the post survey, suggesting unintentional impact of the training that is counter to inclusive teaching. This suggests that TA training should be explicit about how inclusive teaching to fully exploit potential for TAs to foster inclusive classrooms.

1 INTRODUCTION

An inclusive classroom welcomes all students and ensures that everyone has access to an equitable learning environment and opportunities to succeed. Inclusive teaching is, therefore, the intentional and deliberate practice of making classrooms conducive for all students to learn. It involves, among other aspects, recognising personal and systemic biases, working to mitigate their impact, and ensuring that all students have equitable learning opportunities (Brame 2019).

1.1 Inclusive teaching leads to student gains

The detrimental effects of 'exclusive' teaching and 'chilly' classrooms in higher education and in engineering education are well documented. Inhospitable learning environments can lead to inequitable learning outcomes and opportunities (Aeby et al. 2019; Dececchi, Timperon, and Dececchi 1998), low sense of self-efficacy on disciplinary representative tasks (True-Funk et al. 2021), achievement gaps (Chang et al. 2011; Eddy, Brownell, and Wenderoth 2014), and student attrition (Geisinger and Raman 2013; Seymour and Hunter 2019).

On the contrary, inclusive teaching and inclusive classrooms benefit both students and teachers. They have been shown to improve student morale (Canning et al. 2019; Cooper et al. 2017), boost students' self-efficacy and intrinsic motivation (Freeman, Anderman, and Jensen 2007), and increase their sense of belonging - in the specific course, in the discipline and in science in general (Brown et al. 2015; Schinske et al. 2016; Zumbrunn et al. 2014).

The fundamental point is that inclusive education improves student learning outcomes. It improves academic performance and reduces achievement gaps

(Schinske et al. 2016), especially for minoritised students (Theobald et al. 2020) and those with lower prior academic achievement (Hardebolle et al. 2022).

1.2 Theoretical framework for inclusive teaching

In this paper, we use an inclusive teaching framework proposed by Dewsbury (2020) to explore the contributions of teaching assistants. The model consists of five competencies (Self-awareness, Empathy, Classroom climate, Pedagogy, and Network leverage) and the relationships between them. Dewsbury argues that inclusive classrooms originate with the teacher and their **self-awareness** of the philosophies that guide their actions and choices. This awareness can increase the teacher's **empathy** towards their students. Since the classroom is made of both teachers and students, a better understanding of both the parties then leads to inclusive **pedagogical choices** and a 'warm' **classroom climate**. Finally, by intentionally leveraging **support networks** and a wider diversity of resources, the students' learning experience in this one course becomes further integrated with their larger educational experience.

1.3 Undergraduate student teaching assistants contribute to classroom climate

Student teaching assistants (TAs) are employed to support student learning, especially large enrollment first year courses. These TAs are typically senior undergraduates who have previously taken the same classes who engage with the students in small group settings, resulting in significant one-on-one contact. While TAs' involvement in a course is usually not long term, they are highly-engaged with the students during the semester. Consequently, TAs could potentially contribute a great deal to the classroom climate and degree of inclusivity.

Previous studies have shown that TAs have a positive influence on students' academic performance. They have been shown to facilitate higher level cognitive thinking (Knight et al. 2015; Sellami et al. 2017), reduce achievement gaps (Van Dusen, White, and Roualdes 2016), and decrease failure rates (Alzen, Langdon, and Otero 2018), especially in minoritised students (Van Dusen and Nissen 2020). Additionally, having TAs correlates with higher student satisfaction (Talbot et al. 2015).

1.4 Research Questions

This paper looks at TAs' perspectives on their teaching and mentoring practices with an inclusive teaching lens. We specifically ask:
- What strengths, weaknesses and obstacles do TAs perceive for their capabilities to help students to learn? How does their perspective map onto the five elements of the inclusive learning framework?
- What are TAs' perceptions of their role in contributing to an inclusive classroom climate?

2 METHODOLOGY

2.1 Context and participants

At a premier European engineering university, the creation of a unit dedicated to improving learning outcomes for first year students increased the support provided to student teaching assistants (N = 250-300 per year) by the existing teaching support

center. In 2021-2022, the two units collaborated and training for student TAs was revisited to reinforce the emphasis on giving feedback, teaching with questions and on guiding students to use an explicit problem-solving method. The training is facilitated by staff from these two units, and reinforced with trained doctoral assistants. The format of the training is an initial 3h workshop at the beginning of the semester, and two additional 1h sessions during the semester. The initial session includes a brief activity on the role of TAs around respect and discrimination in classrooms and in 2022-2023, additionally, the Equality Office of the institution began offering a webinar to all students about respect and discrimination on campus. With a view to evaluating the impact of the 5h of training, we collected impact data.

Our participants are current TAs, mostly second-year bachelor students who completed the course the previous year, working in teams of about three TAs per maths or physics classroom. Their role is to support first-year students to develop problem-solving skills and to organise their study time to succeed in a highly selective program. Most TAs reported none or limited previous teaching experience.

2.2 Data collection

Data for this paper was collected during the initial workshop of the 2022-2023 teaching assistant training cycle as part of a larger study investigating the impact in terms of TAs pedagogical activities. To assess changes in TAs' ideas about how to support student learning, we used ante and post surveys. In this article, we focus on TAs teaching intentions related to inclusion, as expressed in five open text items (a subset of all the data collected). The ante survey asked TAs about the skills they should improve. The post survey repeated this prompt, and also asked about their strengths, the obstacles they perceive to being a good TA, and their role in reducing harassment in the classroom. The data set was anonymous and did not ask for any demographic information.

3   DATA ANALYSIS & RESULTS

3.1 Data analysis

All 262 TAs attending the September 2022 sessions were issued paper surveys that used a unique identifier to link the ante and post versions. This enabled the data to be anonymised at the point of collection. Responses to the five open-ended prompts (n=223-245, 1 ante and 4 post) were coded with a mixed inductive-deductive approach coding scheme structured with Dewsbury's inclusive teaching framework (2020). Responses to the final prompt on TAs' role in reducing harassment was only coded inductively. Two coders, authors of this paper, coded the full set of data.

3.2 Mapping on to framework

The model proposed by Dewsbury has directional relationships between the five competencies, however our study explored only students' perceptions of the competencies and not interrelationships. Additionally, we split the competency 'pedagogical skills' into three sub-competencies to better reflect the themes from the training session: supporting students' belonging, engagement and active learning. Table 1 lists representative quotes from student responses that highlight their awareness and emphasis of these competencies.

Table 1: The 7 competencies for inclusive teaching with representative quotes from student teaching assistants

		Strengths, points to improve and obstacles to good teaching identified by TAs	Response to role in reducing harassment/discrimination
TA is **self-aware**		"I am confident" "I would like to be more friendly"	"Be kind and aware and woke"
TA is **empathetic**		"Be more patient"	"Listen, respect, without judging"
TA builds **classroom climate**		"Listening more to the students and optimising time spent with each student"	"Instal notions of respect and have zero tolerance towards those behaviours"
TA has pedagogical skills…	…to support students' **belonging**	"Helping someone who has a totally different approach and understanding their difficulties"	"Make students interact more in order to establish a good environment"
	to support students' **engagement**	"Motivating / giving positive feedback and making the student feel comfortable"	"Students should be able to give feedback to assistants"
	to support **active learning**	"Giving a lot of examples and ask a lot of questions"	-
TA leverages **networks**		"Discuss more with colleagues and prof"	"Be able to solve the problem with another TA, so that one can explain to the bully and the other reassure the victim"

Most ideas in the TA responses mapped onto the seven competencies described in Table 1. Ideas that did not directly map onto the framework but highlighted important aspects of the TAs' skill sets included self-efficacy and subject content knowledge, as shown in Table 2.

Table 2: TAs' ideas outside the inclusive teaching framework, with representative quotes

	Strengths, points to improve and obstacles to good teaching identified by TAs	Response to role in reducing harassment/discrimination
TA has **self-efficacy**	"I consider the subject as my passion"	"Be attentive to what is happening during the session and ready to intervene"
TA has **content knowledge**	"Good preparation and comprehension of the series"	-

3.3 TAs' responses describe a constellation of influences on their approach to teaching

Teaching assistants' responses contained a diversity of ideas relating to the competency elements for building inclusive classrooms (Fig. 1). These ideas do not

appear with the same frequency, and differ in their prominence across the four general prompts given to the students. Ideas about pedagogical skills (including active learning and engagement) and empathy for the students featured prominently in their strengths, obstacles they faced, and aspects they need to improve in their roles as TAs (Fig 1 a-c). With respect to active learning and engagement, TAs' responses reflected themes from the training including using questions to guide cognitive tasks, modelling problem solving methods, facilitating group work, interacting with the students and being encouraging. The value of having empathy for the students was expressed through comments about listening to students, and being patient, kind and understanding. Although with lower frequency, TAs' responses also refer to other competencies including self-awareness (i.e. confidence, experience, asking for feedback) and supporting students belonging (being respectful, raising awareness of potential barriers to inclusivity).

a. Ideas in TA responses (n = 458) to "What are 3 things that you would like to improve to be a better teaching assistant?"

b. Ideas in TA responses (n = 245) to "What are 3 of your personal strengths as a teaching assistant?"

c. Ideas in TA responses (n = 242) to "What obstacles do you anticipate in your role as a teaching assistant?"

d. Ideas in TA responses (n = 227) to "How do you think student-assistants should be involved in reducing incidents of discrimination or harassment on campus?"

Figure 1. Relative frequency of ideas in TAs' responses grouped by the competencies in the inclusive teaching framework. See Tables 1 + 2 for colour legend.

In response to the final prompt about their role in reducing incidents of discrimination or harassment on campus, TAs spoke about actively working to build a supportive classroom climate, as well as leveraging the various support networks available to

them and the students (Fig 1d). They highlighted being inclusive, setting an example, paying attention to classroom dynamics and taking action when needed as important aspects of their role as TAs when it comes to building the classroom climate. Interestingly, TAs brought up the importance of receiving training (including on harassment and discrimination), as well as being aware of the resources available to the students to promote inclusivity and deal with issues of discrimination.

A significant portion of ideas in TAs' responses did not directly map onto the competencies in the inclusive teaching framework. These can be grouped into ideas referring to self-efficacy (motivation, communication skills, time management) and to disciplinary content expertise (subject matter, preparedness for the day's session).

3.4 TAs' responses to aspects they need to improve change after the initial workshop

There is an interesting shift in the aspects that TAs listed that they need to improve to be a better teaching assistant at the beginning, and those they listed at the end of the initial training workshop (Fig. 2). Additionally, TAs' responses after the training were more likely to feature ideas relating to self-efficacy and classroom climate. On the other hand, ideas relating to empathy, engagement and content knowledge appeared with less frequency in the post survey as compared to the ante survey. The implications of these observations are discussed in the following section.
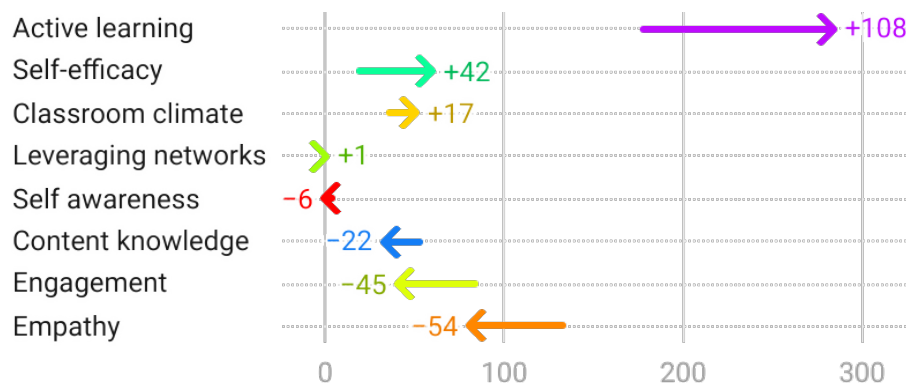

Figure 2: Changes in aspects cited by TAs to improve their teaching between ante and post survey, grouped by inclusive teaching competencies

Created with Datawrapper

4   CONCLUSIONS & IMPLICATIONS

Our data shows that TAs can be powerful forces in building inclusive classrooms. Without any directed intervention of training, they are already aware of, and prioritise multiple competencies of the inclusive classrooms framework. The TAs in our study identified developing their active learning skills as a priority for improving their teaching. Active learning has been shown to increase equity in learning outcomes (Theobald et al. 2020), including reducing achievement gaps, which in turn leads to increased retention especially of minoritised students (Harris et al. 2020).

The TAs also identified developing empathy for their students, and increasing their sense of belonging, as ways to become better TAs. These findings are in line with previous research that has shown that TAs can use their perspective as students

themselves to propose strategies to reduce inequities in classrooms, and to make courses more inclusive (Wendell et al. 2019).

The changes seen in the ideas relating to aspects TAs stated they needed to improve before and after the workshop can be linked to the specific activities of the workshop. The workshop emphasised active learning strategies including teaching without telling (asking questions), giving process level feedback rather than task level feedback, and modelling problem solving strategies. The decrease in the prevalence of concern expressed by TAs to improve their content knowledge is coherent with this explanation. On the other hand, the decrease in ideas relating to empathy and engagement is potentially troubling. One explanation is that the training offered TAs enough support in these dimensions that were no longer priority areas to improve, or it could mean that TAs shifted their priorities away from empathising with students. Since empathy was not a focus of the training, this latter explanation may unfortunately be more plausible.

TAs' responses to the prompt on discrimination reflected many of Dewsbury's inclusive teaching competencies. Classroom climate dominated responses, self-awareness was cited infrequently, and while active learning figured prominently in TAs' answers to previous prompts, it was absent here. This suggests that TAs are not aware of the positive impact active learning has on inclusion. Empathy was also under-represented compared to their previous responses, suggesting TAs consider inclusion more at macro level class climate rather than impact on individuals. This prompt was the only time ideas about leveraging networks appeared.

Although TAs already possess ideas relating to inclusivity, training could help them hone their skills that they can then leverage to build inclusive classrooms. TAs in this study identified their need to further develop skills relating to active learning and empathising with students, both of which will also help with inclusion. Active learning, which was a major focus of the training the TAs received, grew in frequency in their responses while an unintended result was that empathy, which was not addressed in the training, was cited less often in the post survey than the ante survey. Building classroom climate featured often in skills to improve and obstacles but was rarely cited as a strength. This lines up with our previous research that showed that even after a practice-intensive 5 day course, doctoral TAs felt unprepared to foster good classroom climate as instructional choices were not made explicit (Isaac and de Lima 2022). Taken together, it is clear that TAs would benefit from more explicit training on inclusive teaching competencies.

In light of the important role that TAs play accompanying engineering students in their learning, explicitly developing TAs' inclusive teaching competencies is a promising way to make engineering classrooms more inclusive.

Acknowledgements

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