"Lightbulb" moments in higher education: Peer-to-peer support in engineering education

Peer-to-peer programs are growing in popularity in higher education (HE) due to institutions' increased interest in engaging students as partners in learning and teaching. This study explores one institution's approach to engaging level 5 and level 6 undergraduate students as teaching assistants (TAs) in engineering to support the first-year transition and academic success. The study focuses on the effect of the pilot program on the peer mentors i.e., the TAs, rather than on the peer mentees. An online questionnaire was designed to investigate TAs' experiences of participating in a student-staff role, and the impact the role had on their academic and non-academic skills development. The findings show that the TA role contributed to enhanced subject understanding and transferable skill development, particularly communication and learning skills. The main attribute valued by TAs was helping others and making a positive impact, contributing to their sense of belonging.

Keywords: Peer-to-peer, engineering, skills, attributes

Higher education (HE) institutions around the world are facing a challenging time in engineering education, as teaching teams are pressed to rethink and redesign program structures, content, and teaching strategies to better respond to industry demands and societal challenges. On the one hand, industry has been shifting from the global North to the global South and from high-income countries to emerging economies, which requires engineering graduates to identify problems and provide solutions for issues such as water and sanitation management and affordable green energies (Graham, 2017). HE institutions therefore need to adjust their learning and teaching practices to foster the development of problem-solving, critical thinking, and communication skills. This may contribute to better equipping graduates to feel confident working in and contributing to diverse and global workplaces, developing solutions that respond to various community needs and demands. On the other hand, in many cases institutions are dealing with high student numbers as well as an increase in non-traditional students, making it difficult for students to develop a sense of belonging and to thrive in higher education. Combined with limited infrastructure and human resources, this makes it a significant challenge implementing learning and teaching strategies that effectively contribute to the development of the necessary skills.

In this context, this paper reports data collected through a pilot program wherein advanced undergraduate engineering students were recruited as teaching assistants (TAs), providing peer support to first-year students in a university in the United Kingdom. The program was developed to support first-year students' academic knowledge, particularly in mathematics, and to provide an opportunity for students in later years to develop transferable skills. The program was also intended to contribute to students' sense of belonging, through the formation of cross-level peer learning communities. The TA initiative stemmed from the success of a large-scale academic mentoring program at the institution. Within this program, experienced peers are recruited, trained, and supported in facilitating the learning of students in the year(s) below in order to increase student success. The program particularly supports underrepresented groups of students in progressing in higher education. The institution has a diverse student population of about 16,000 students, over 50% of whom are from a Black or Minority Ethnic (BME) background. This paper will present and discuss the data collected from TAs, i.e., the peer mentors, during the pilot program implemented in the 2018-2019 academic year. This research aimed at understanding the impact of the pilot on TAs' perceived academic knowledge and skills development and on their sense of belonging.

Peer-to-peer support in Higher Education

Knowledge transfer

Peer-to-peer teaching is fast becoming a key instrument in HE: a growing body of literature has recognized the importance of students as partners in learning and teaching (Healey et al., 2014; Pillay & Laeequddin, 2019). While a variety of definitions of the term peer learning have been suggested, this paper will use the definition by Boud et al. (1999, p. 413): "peer learning refers to the use of teaching and learning strategies in which students learn with and from each other without the immediate intervention of a teacher." Being actively involved in the classroom enables students to shape and enhance learning experiences, which contributes to knowledge transfer, the development of key transferable skills, and a deeper level of learning (Stigmar, 2016). A large literature in STEM (e.g., Blank, et al., 2013; Pillay & Laeequddin, 2019) recognizes the success of peer learning schemes in improving the academic performance of students in higher education.

Different theories align with the concept of peer-to-peer teaching, including the theory of cognitive congruence (Lockspeiser et al., 2008) and Vygotsky's social constructivism (Williams & Reddy, 2016). These theories emphasize the value of peer interactions to help consolidate knowledge and enhance cognitive development. As noted by Lockspeiser et al., (2008), student TAs and student participants may share a similar knowledge base, or cognitive congruence, allowing peers to explain concepts at an appropriate level and using shared language, thus aiding learning. These authors also suggest the existence of a social congruence between tutor and tutees, based on their similar social roles. Williams and Reddy (2016) suggest that the success of peer teaching depends on social interactions between students and a shared culture of knowledge, as underlined by Vygotsky. One concept from Vygotsky's (1978) work is the "zone of proximal development," which describes the difference between what learners can learn on their own and what they can learn in collaboration with more capable peers. However, Lowton-Smith et al. (2019) reported that undergraduate students, as peer learners, felt they would learn more from their lecturer than their peers, given that peer teachers have less expertise. Similarly, Ramaswamy et al. (2001) found that while peer teaching can assist in-depth learning in science and engineering education, the lecturer must be actively involved to help guide and manage the process.

Several scholars have found that interaction with peers contributes to retention and success in HE as students engage in informal learning (e.g., Kahu & Nelson, 2018). Experienced peers can provide other students with greater access to information, or hot knowledge, thus increasing their ability to progress and achieve. Malm et al. (2015) reported an increased network of study partners and peer study strategies as positive outcomes of a peer learning initiative in engineering, which, in turn, improved results and retention for first-year students. When involving undergraduates as peer-support for first-year students, a few studies have reported an increase in enhanced levels of self-confidence, knowledge, skills, and calculus ability for the peer-mentored (Ayllo et al., 2019; Boles & Whelan, 2017). Less, however, has been reported on the effects on the peer mentors themselves. It is thus important to study the TAs' own experience as well.

Transferable skills development

There is a wealth of literature that supports the view that student TAs benefit significantly from peer-to-peer teaching, as it assists the consolidation of subject knowledge and transferable skill development (e.g., Engels et al., 2018). Reid and Duke (2015) found that

students' transferable skills and attitudes can be fostered through an informal peer learning environment. Similarly, other studies have observed employability skills development in peer learning experiences, particularly in terms of leadership skills and critical thinking skills (e.g., Carr et al., 2018; Kamas & Preston, 2018). The growing skills gap problem is increasing the emphasis on transferable skill development in HE settings. The Global Skills Gap Report (da Costa et al., 2019) outlines the most important graduate skills that employers are looking for, including problem solving, communication, and teamwork. The report found a mismatch between graduate skills and employer expectations.

Industry and employers demand process skills such as problem-solving and communication, and professional bodies have been emphasizing the need for these skills to be developed in undergraduate programs (e.g., ABET Engineering Accreditation Commission, 2015, The Royal Society, 2018). These skills are closely connected to critical thinking skills, which have been studied in a large and longstanding literature. Ennis (2011) investigated critical thinking in education, and proposed frameworks based on dispositions and abilities. Ennis (2011) suggests dispositions such as considering others' points of view, being clear about the intentions behind what is communicated, being flexible and-open minded, and honest in facing personal biases. Consequently, it is crucial that engineering undergraduate programs provide opportunities for undergraduate students to develop these skills in contextualized learning environments.

Sense of belonging

Learning is a social process, and students are motivated by a need to belong. Peer-assisted learning can create a community between different year groups, as experienced peers are encouraged to help guide and reassure first-year students (May & Danino, 2020). Meeuwisse et al. (2010) state that cooperative learning environments, with peer interaction, can promote a sense of belonging as students have an intrinsic need for relatedness and positive regard from others. Stebleton et al., (2014) acknowledge that meaningful social connections and an integrated university culture can assist student well-being and academic adjustment, which is particularly important during the transitional university years. Studies also suggest that universities play a role in students' self-confidence and self-esteem, considering the number of undergraduate students that see themselves as having low academic competence levels (e.g., Donovan & Erskine-Shaw, 2020).

In a massified and marketized HE system, student-staff partnerships have been widely embraced. According to Healey et al., (2014, p.8) "engaging students as teachers in the learning process is a particularly effective form of partnership." This highlights the need for staff and students to have a dual role within the teaching partnership. At a time when university resources are stretched and class sizes are increasing, peer-to-peer teaching can play an important role in facilitating an interactive classroom environment and stimulating students' metacognitive skills (Stigmar, 2016). However, reduced resources in higher education could result in student TAs being "under-valued or poorly supported in the contexts in which they are employed" (Clarence, 2016, p.39). This could have an adverse effect on students' feelings of belonging, as they might feel unappreciated. Clarence (2018) highlights the need for lecturers to be involved in student TA development and training to form an effective partnership and make tutorials more inclusive.

Sense of belonging has been identified as a crucial factor in student success and well-being (Johnson et al., 2007, Morrow & Ackerman, 2012). It has also been identified as a factor that can increase students' feelings of belonging, particularly in underrepresented groups (Liou-Mark et al., 2018; Palmer et al., 2011), and that can help students to learn and work ethically with others in diverse environments (Green, 2019). Research has shown that both

perceived peer and faculty support is also a key factor in students' sense of belonging (Tavares et al., 2021), and that peer mentoring relationships contributed greatly to engineering students' persistence (Davis et al., 2018). Educational institutions should therefore improve opportunities for peer relations to flourish, in order to help increase retention and support underrepresented students in engineering programs in identifying with the engineering educational community (Davis et al., 2018). Peer learning can also strengthen the sense of belonging of those who are in a peer support role: reports from peer support in engineering labs showed that these experiences positively contributed to the identity and belonging of mentors, who act as role models in terms of devotion, leadership, and academic achievement (Lin & Hsu, 2012). It thus seems important to understand TAs' perceptions of whether participating in a peer support program contributes to their sense of belonging.

Method

This study was conducted in a London modern university (post-92) and explored the experiences of student TAs participating in a pilot peer support program. The aim was to understand the impact of this role on their academic knowledge, transferable skills development, and sense of belonging. This study used a survey research design with a mixed methods approach to try to answer two main questions:

a) What skills, if any, did TAs perceive themselves to have developed during the pilot program?

b) What are the main attributes of the peer mentoring experience that TAs value?

The timeline of the study is shown in Figure 1.

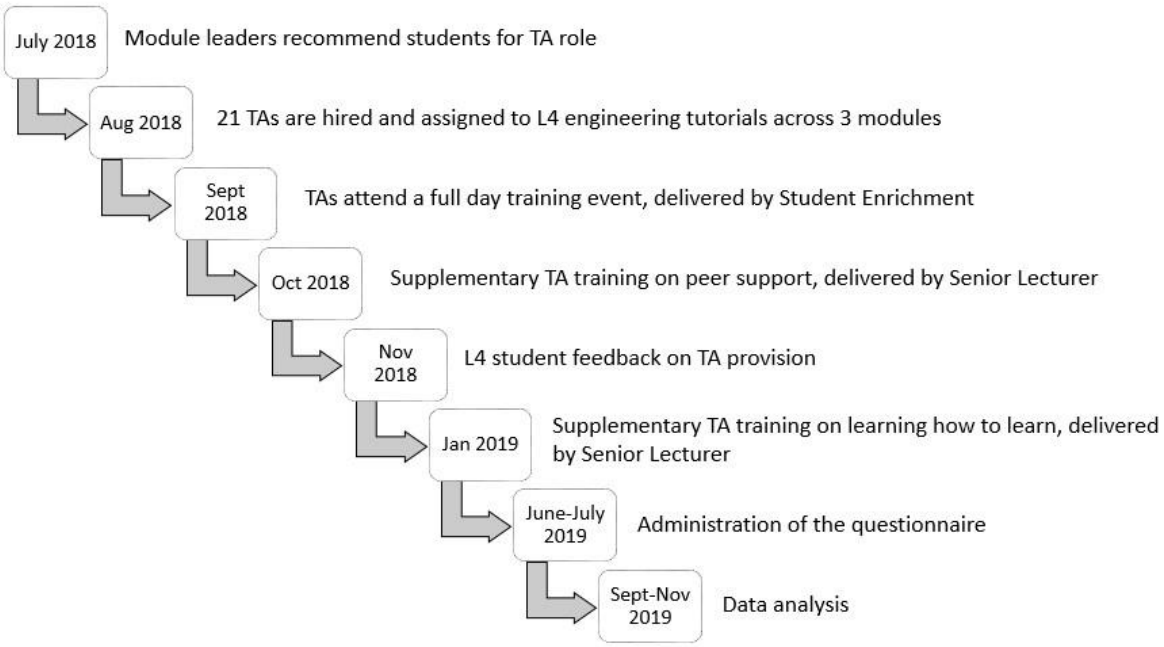

Figure 1. Timeline of the pilot study

Peer support pilot program

The pilot took place between July 2018 and November 2019. TAs were recruited across four programs (Aerospace Engineering, Mechanical Engineering, Civil Engineering, and Mathematics) to ensure that peer support was tailored to the students' needs. Recruitment was

based on academic credentials, as module leaders recommended high-performing students for the TA role, following common practices in similar projects in HE (Lunsford et al., 2017). The module leaders used previous exam results in the classes where TA support would be made available, to ensure that the students were suitable for the position. These students were then invited by email to express their interest in the TA role, and 21 students were subsequently recruited to support three first-year modules. Before acting as TAs, students were trained in academic mentoring (e.g., facilitation techniques). They were also trained in peer support (e.g., providing feedback) and learning how to learn, in the aim of supporting them in their role and developing their metacognition and motivation. The TA role involved supporting the module leader with learning and teaching during scheduled tutorials and ensuring that first-year students understood the content being presented to them and were engaging with the set exercises.

Research design

Survey research design involves the collection of primary data from a well-defined population using a questionnaire (Nardi, 2018). In this study a survey was used to collect both qualitative and quantitative data regarding TAs' experiences of their role using a mix of numerically rated items and open-ended questions (Singleton and Straits, 2009). A concurrent mixed methods approach uses both qualitative and quantitative data collected at the same time and combined at the interpretation stage (Leech and Onwuegbuzie, 2009), providing an integrative understanding of the TAs' experience in the peer support program. The quantitative data concern TAs' perception of the program's contribution to their development of skills identified in the literature and sense of belonging. The qualitative data provides information on TAs' views of their role, its impacts on them and the attributes of the peer mentoring process that they most valued. By administering an online questionnaire, the researchers aimed to obtain a higher response rate in a short period of time with limited resources.

The questionnaire consisted of open and closed questions, divided into the following sections: overall experience, perceived effects on academic knowledge, perceived transferable skills development, and sense of belonging. These areas simultaneously enabled the collection of data to answer the research questions and an evaluation of the institutional pilot program from the TAs' perspective. The questionnaire was piloted with students and validated by a panel of experts, who rated the validity and representativeness of the definition of the items, the clarity of the instructions, and the appropriateness of the response format. The panelists were asked to assess the questionnaire items on a Likert scale ranging from 1 (irrelevant) to 4 (extremely relevant), which was then used to calculate the content validity index (CVI) for each item and for the instrument as whole, i.e., I-CVI (item-level content validity index), S-CVI/Ave (scale-level content validity index based on the average method) and S-CVI/UA (scale-level content validity index based on the universal agreement method), which should be at least 0.83 (Polit and Beck, 2006). Overall, the questionnaire was rated as relevant and clear, with a satisfactory level of content validity (I-CVI=0.92, S-CVI/Ave = 0.92 and S-CVI/UA= 0.83).

Study population

The population of the study was based on purposive sampling, as the questionnaire was sent to the 21 students who participated in the pilot program as TAs. The questionnaire was distributed by email in June 2019 after the program ended. These 21 students were from level 5 and 6 (9 female and 12 male), from Aerospace Engineering (5), Mechanical Engineering (4), Civil Engineering (7), and Mathematics (5). A participation information sheet was provided at the beginning of the questionnaire, and all participants gave their informed consent to take part

in the study before submitting the online questionnaire. Out of the 21 students, 14 responded to the questionnaire. Descriptive statistical analysis was then performed on the closed questions using Microsoft Excel 2016, while a content and thematic analysis was conducted on the open questions.

Data analysis

The content analysis conducted drew on several frameworks and reports from the literature and from the wider HE sector, such as the university's graduate attributes and academic framework, critical thinking (Ennis, 2011), 21st-century skills (Joynes et al., 2019), the 2019 Global Skills Gap Report (da Costa et al., 2019), and graduate employability (Tomlinson, 2017). This allowed the researchers to identify common skills across these frameworks and reports that are considered crucial for undergraduate students to develop (Table 1). After identifying these skills, the researchers analyzed the open questions by coding students' responses and recorded the frequency of individual words and phrases, allowing them to analyze the data against the research questions.

Table 1. Skills characterization

Skill	Characterization
Critical thinking	Interpretation, explanation, analysis, curiosity, induction, and deduction Problem solving (e.g., strategizing, creativity, evaluating and selecting alternatives)
Communication	Expressing ideas, employing appropriate rhetorical strategies in discussion and presentation (oral and written)
Collaboration	Teamwork, collaborative learning
Learning	Self-reflection, self-assessment, self-improvement, metacognition, independent learning, and knowledge construction
Academic or technical skills	Explicit subject and subject-specific skills
Information and data management	Consider and reason from premises, reasons, assumptions, positions, and other propositions with which they disagree or about which they are in doubt, without letting the disagreement or doubt interfere with their thinking
Adaptability	Ability to adapt to changed circumstances or contexts

Leadership and entrepreneurship	Drive to innovate, management skills, research and development, business tenacity and achievement.
Organization and management	Effectively and efficiently manage time, resources, and tasks to meet deadlines and achieve goals.
Resilience	Ability to recover well in the face of adversity or significant sources of stress

The thematic analysis was performed on the qualitative data: Atlas.ti was used to organize and analyze the survey results and discover deeper meanings. This data analysis was guided by the six phases of thematic analysis (Braun and Clarke, 2006). (1) The researchers became familiar with the data from the responses to the open questions before starting the formal coding process by rereading the questionnaire results and noting any initial observations. (2) The word frequency tool was then used to identify patterns in the questionnaire data, and a theoretical thematic analysis was performed. (3) The data were coded against the specific research questions. (4) The different codes were then combined to create overarching themes; (5) which were then reviewed to ensure data were cohesive within the themes and clearly distinctive between the themes. (6) Once refined, the themes were defined and interpreted to help answer the research questions. Seligman's (2011) PERMA model was used as a theoretical lens to help interpret the results. The PERMA model helps to understand which attributes of the peer mentoring experience TAs value the most in relationship to the achievement of well-being and happiness. Seligman suggests that five key elements are needed to enable a fulfilling experience: positive emotion, engagement, relationships, meaning, and accomplishment.

Results

To answer the two main research questions, this study explored the experiences of student TAs to understand the impact of the peer mentoring program on their skills development, as well as the attributes of the peer mentoring experience that they valued the most. All 14 participants said that they would recommend the program to other students. Furthermore, the majority agreed or strongly agreed that their role helped them develop academic knowledge and skills, such as understanding their subject better (n=12) and consolidating their learning (n=13), as shown in Figure 2. However, the figure also shows that some participants disagreed or strongly disagreed that acting as a TA helped them to make connections between subjects (n=4) and prepare for assignments and exams (n=4).

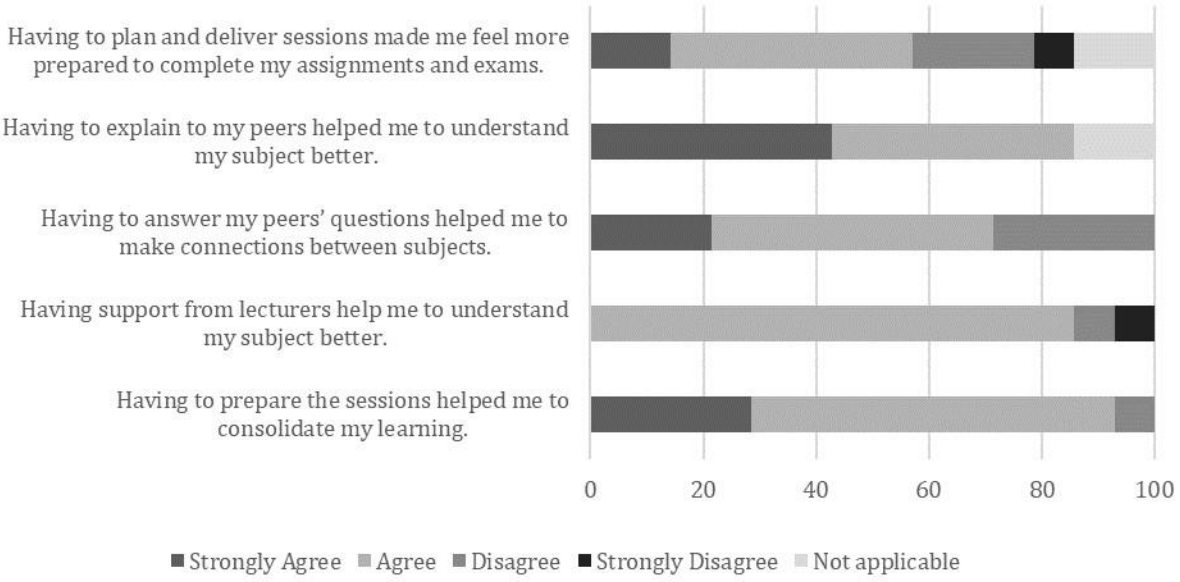

Figure 2. Perceived contributions to academic knowledge development

Most of the participants agreed or strongly agreed that supporting their peers as TAs contributed to their confidence in analyzing a problem to find a solution (n=13), their teamwork skills (n=11), and their ability to express information to a group of peers (n=13), as well as their development of leadership skills (n=12), as shown in Figure 3. In terms of their sense of belonging, all participants considered that the TA role contributed to their feeling part of a group of students and staff committed to learning, while 12 out of 14 considered that it contributed to their feeling of belonging to the university community. In addition, 11 considered that it contributed to their future career prospects, and nine considered that it contributed to their ability to articulate their skills within an interview setting.

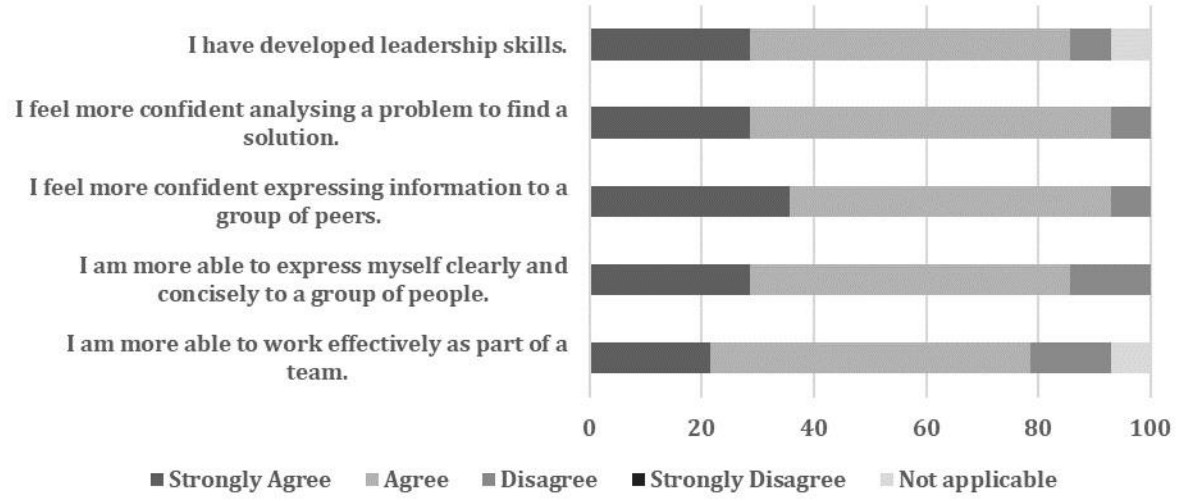

Figure 3. Perceived contributions to transferable skills development

Regarding the participants' perceived skills, the content analysis on responses to the open questions showed that the majority perceived themselves to have developed communication (n=8) and learning skills (n=12), while none mentioned critical thinking,

collaboration, information and data management, or adaptability, as the figures in Table 2 show. Furthermore, very few participants referred to leadership and entrepreneurship (*n*=3), organization and management (*n*=1), or resilience (*n*=1), despite being in a senior peer support role.

Table 2. Number of participants reporting perceived development of transferable skills

Perceived skills development *N*=14	**Frequency of appearance**
Critical thinking	0
Communication	8
Collaboration	0
Learning	12
Academic and technical skills	2
Information and data management	0
Adaptability	0
Leadership and entrepreneurship	3
Organization and management	1
Resilience	1

The second research question aimed to explore the main attributes of the peer mentoring experience that TAs valued. Five overriding themes emerged from the analysis of the qualitative data. The attributes reported by the TAs align with the five elements of Seligman's (2011) PERMA model, as presented in Table 3. In this study, the most significant element of the PERMA model was 'meaning', as the TAs frequently alluded to valuing helping others and making a positive impact. The second most cited elements were 'accomplishment' and 'positive emotion', which implies that the TA role contributed to the participants' passion for learning and teaching, and to feeling good about themselves because of helping others. Several TAs referred to relationship building as a valued attribute, as the role provided an opportunity to enhance their interpersonal skills and communicate effectively with others. Finally, the success of the pilot can be seen in references to eagerness and enthusiasm to engage beyond the requirements of the role, as several TAs reported staying behind after class to continue providing support.

Table 3. PERMA elements and quotations from TAs

PERMA elements	**Attributes**	**Frequency of appearance** *N=14*	**Example students' quotes**

Positive emotion	Being open, positive, and optimistic about new experiences	10	"Loved having a positive impact" "Positive feedback from the students who I supported"
Engagement	Eagerness and enthusiasm to engage beyond the role requirements	4	"Staying longer after a lecture to help a student" "Having students that were so impressed with my assistance, they asked for more help after the class ended"
Relationships	Building interpersonal skills and communicating with others	6	"it helps you to connect with other people" "helps develop our interpersonal skills"
Meaning	Helping others and making a positive impact.	16	"The feeling of satisfaction obtained when teaching the students something new and they understood it." "Good experience to help other students"
Accomplishment	Increased passion about learning and teaching, and improved knowledge	10	"Students have the 'lightbulb' moments when explaining something" "you get to help students with many academic issues and gives you the possibility to test your abilities as well"

Discussion

To answer the research questions, the researchers looked at the main findings on peer mentors' academic knowledge and transferable skills development, as well as the attributes of the peer support experience that they valued the most. The latter helped the researchers to better understand how this program contributed to their sense of belonging.

Perceived academic knowledge and transferable skills

Looking at the main findings on academic knowledge, this pilot showed that taking part in the TA program contributed to TAs' subject understanding and to the consolidation of their subject knowledge, by preparing for sessions and explaining engineering content at an appropriate level to less experienced peers (Lockspeiser et al., 2008). The data show that it contributed to the enhancement of TAs' knowledge by encouraging social interaction and a deeper level of learning.

In terms of making connections between subjects or preparation for assignments and exams, the findings show that some of the participants felt that acting as TAs did not contribute to these two aspects. There may be several reasons for this result. The trend toward siloed and modular curriculum design may limit the applicability of level 4 content and skills to level 5 and 6 assignments and exams (Graham, 2017). This siloed and modular teaching and learning approach may prevent students from recognizing and identifying the commonalities, concepts, relationships, and skills involved, thus preventing them from making the necessary connections between subjects and mobilizing their knowledge across their assignments. This may support claims of the disaggregation of skills and knowledge within engineering programs, where the curriculum (content, design and organization) experienced by engineering students can be a barrier to their success. Linear and cumulative program progression may lead students to experience a one-directional and one-dimensional understanding of concepts, which acts as a deterrent to them responsively transferring knowledge or applying their skills (Boles & Whelan, 2017). Interconnected to these siloed and disaggregated approaches is an embodied culture of teaching and learning for the test rather than for lifelong learning in higher education, which is fed by both students and lecturers.

The data indicate that the program had a positive impact on participants' transferable skills, communication skills, and confidence, supporting previous studies in engineering education (Ayllo et al, 2019; Blank et al., 2013). Both the closed and open questions suggest that communication skills were one of the most prominently developed skills. However, the participants did not report collaboration as a developed skill, contrary to some other studies of this nature (Carr et al., 2018). This may be a result of siloed and disaggregated approaches to learning and teaching, as mentioned above; or the lecturers' pedagogical approach may have been individualized learning, leading TAs to provide support on a one-to-one basis. These findings may also be connected, to some extent, to the fact that TAs did not have many opportunities to work closely with the lecturers and the module teaching team. Further training should be put in place to support TAs, designed by teaching staff and academic developers to address different aspects of learning and teaching (Clarence, 2018), benefiting the peer mentor and consequently, the mentee.

Curiously, the data suggest a possible contradiction in terms of critical thinking and problem solving. More than 90% of the TAs agreed/strongly agreed that they felt more confident analyzing a problem to find a solution following the TA experience, whereas none reported problem solving or critical thinking as a perceived skill developed in their responses to the open questions, which differs from other studies found in the literature (Carr et al., 2018). The reason for this apparent contradiction may be an issue of language, as critical thinking and problem-solving are not part of their lexicon, and they may not have recognized them as the most important transferable skills developed during their experience. Alternatively, the presence of a lecturer in the classroom may have restricted the TAs' need to exercise problem-solving skills (da Costa et al., 2019). Whilst most participants agreed/strongly agreed that they developed leadership skills in their role as a TA in the closed questions, this skill came in at a much lower percentage in the analysis of the open questions. The reason for this discrepancy may be due to power struggles between the lecturer and the TA (Clarence, 2018), as both were supporting student learning within the same environment: the lecturer controlled and led the classroom, limiting leadership opportunities for the TAs. Nonetheless, the results showed a positive impact on the TAs' self-confidence and self-esteem building, which is closely connected with resilience and self-efficacy, which are crucial to succeeding in their program (Ayllo et al, 2019; Donovan, & Erskine-Shaw, 2020) and in STEM work environments (Kamas, & Preston, 2018).

In terms of their future career, some TAs disagreed that the experience contributed to their future career prospects and to their ability to articulate their skills within an interview

setting. We suspect that this may be a result of the program design, as it focused on supporting level 4 students and neglected the opportunity to focus on TAs' own employment skills, which can be revised and further developed within the program. It may also mean that helping others is not seen as an employability skill per se, and this should be clearly articulated within the program design. By reshaping and broadening the focus of the program initiatives, this could be a part of active efforts to improve retention and a sense of shared identity in engineering programs, as suggested by Davis et al., (2018). The lack of specific moments to reflect on their role, skills development, and learning gains might also be a reason for their responses. Reflection should be an integral part of initial TA training, to support personal and professional development throughout the role (Clarence, 2018). Additionally, due to the modularization of course delivery and the focus on short-term results, the students may not consider how their current learning experiences support their future employment prospects. Furthermore, the lack of reporting on adaptability as a main perceived skill may suggest a sense of complacency from the TAs in their role of supporting level 4 students. As adaptability is an important skill to develop in today's uncertain economy, lecturers should be working with TAs as partners (Healey et al., 2014), enabling them to work outside of their comfort zone and develop key transferable skills.

Attributes and sense of belonging

The positive attributes of the peer support experience that the participants in this study most often emphasized were helping others, being passionate about learning and teaching, building interpersonal skills, and acquiring and supporting knowledge and understanding. Furthermore, participants alluded to being open, positive, and optimistic about new experiences, which interestingly are critical thinking dispositions identified by Ennis (2011). Some TAs reported enthusiasm about engaging beyond the role requirements, which shows dedication and a commitment to making the pilot program a success.

All participants felt part of a group of students and staff committed to learning, while almost all (12) reported feeling that they belonged to the university community. This finding, in combination with the main attributes of the peer support experience that students identified (e.g., helping others and making a positive impact), suggests that the program contributed to their sense of belonging, replicating a finding reported in previous studies (e.g., Davis et al., 2018; Liou-Mark et al., 2018). Several TAs also recognized the value of building interpersonal skills and establishing connections with their lecturers and peers, which may be supported by the role of social congruence. These are attributes inherent to being part of a group and feelings of fitting in, and at the same time they consolidate the second most cited transferable skill, which is communication. The data also show the satisfaction derived from helping others and positively contributing to something beyond oneself. For the small percentage of those who did not feel that the experience of peer mentorship contributed to their sense of belonging to the university community, further investigation would be needed to better understand their reasons. It may well be due to insufficient opportunities for collaboration with lecturers, module leaders and other TAs, which may have had an impact on some participants' sense of belonging. It could, however, also simply reflect the fact that these participants already strongly felt part of the university community.

Limitations

This pilot study did not intend to produce any generalization, as its findings may not be readily applicable to other settings. In addition, being limited to a single point in time, this study lacks an understanding of TAs' perceptions throughout the experience, which could have

been done through focus group interviews. Alternatively, focus groups could have been conducted at the end of the program to clarify and shed light on some of the answers to the questionnaire, in particular the data on academic and transferable skills. The small sample size is a further obvious limitation. Moreover, this study was limited by the lack of some TAs' viewpoints, as a third of those invited did not respond to the questionnaire. Finally, future studies could triangulate the data from the mentees (first year), the TAs, and the teaching staff to have a richer data set and optimize and enhance the TA program.

Conclusion

This study set out to investigate TAs' experiences of participating in a student-staff role, and their perceptions of the impact the role had on their development of academic and transferable skills as well as their sense of belonging. The findings have several implications for future practice. First, greater collaboration and inclusivity are needed in the formation of student-staff partnerships: lecturers should work with the TAs as partners, rather than perceiving them as an extra resource during challenging times, as affirmed by Clarence (2018). These collaborations and interest in TAs' professional development could minimize the power differential within student-staff partnerships. Such partnerships with academic staff can also reinforce students' sense of belonging. Continued efforts are needed in terms of the design and delivery of peer learning activities, and student teachers should be involved in this design process to help make the connections between subjects and ensure knowledge is constructed across the academic years. However, Clarence's (2016) note of caution is warranted, as peer teachers could be under-valued and poorly supported during a time of reduced resources.

Second, greater focus should be placed on TAs' own skills development during the program and emphasizing how this assists their current studies and prospective future. A wealth of literature supports the view that peer mentors benefit significantly from peer-to-peer teaching (Carr et al., 2018; Engels et al., 2018; Reid and Duke, 2015). The transferable skills developed during the program should be made explicit to the TAs, and part of their lexicon, by providing regular opportunities for the participants to reflect on their role and identify their learning experiences. Furthermore, one participant sensibly challenged the decision to recruit TAs based on academic credentials, which suggests that the recruitment criteria should encompass more than just test scores. The criterion for the recruitment of student TAs is an intriguing topic which could be usefully explored in further research.

The findings also suggest that such peer support programs can contribute to the development of students' sense of belonging, which is crucial for undergraduate students' learning journey and academic success (Lin & Hsu, 2012). The findings show that what the TAs valued the most were the experiences and opportunities to help others and opportunities for self-growth, which tend to be absent in engineering academic disciplines. A more holistic and integrated approach to learning and teaching can help HE institutions to better prepare students to thrive and to contribute to the development of academic and non-academic settings, including work environments, that are more empathic, supportive, and equitable.

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