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Addressing Challenges of Teamworking and Communication Skills in International Transdisciplinary Projects Contexts

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Abstract. Transdisciplinary engineering involves integrating knowledge, methods, and tools from multiple disciplines to address complex engineering challenges. This approach requires transferable skills being applied across different contexts and fields. It encourages collaboration among diverse experts, including engineers, scientists, social scientists, and stakeholders from communities or industry. Given the increasing need for engineers working in transdisciplinary intercultural teams, nurturing engineering students with strong teamwork and communication skills becomes essential. This paper presents results of a comparative study using qualitative methods to examine pedagogical designs and support mechanisms aimed at enhancing these skills among engineering students. The study is conducted from the perspectives of engineering educators at two institutions: University College London (UCL) and The University of Hong Kong (HKU). Both have diverse undergraduate student populations; however, a higher proportion of students come from a Confucian cultural background in Hong Kong compared to the UK. By comparing experiences of engineering educators in these distinct settings, we aim to identify strategies for optimizing resources and integrating support to develop transferable skills by first identifying contributing factors affecting the upskilling of students. Results indicate that factors such as cultural differences in Western v Eastern education systems and UK economic drivers that adversely impact language and communication levels at admission are where difficulties in upskilling are rooted. This study helps inform the future work where we seek methods to facilitate the transition and integration of Chinese engineering students in the UK, as well as Western students in Hong Kong, enabling success in transdisciplinary learning environments.

Keywords. Transdisciplinary engineering, teamwork, communication, student experience

Introduction

Transdisciplinary engineering education has emerged as a new approach in Higher Education, aiming to equip students with the skills necessary to tackle complex, real-world problems that transcend disciplinary boundaries [1,2]. In an era marked by climate change, the need for sustainable development and technological innovation, the ability to integrate knowledge from multiple disciplines is essential. Transdisciplinary engineering education can enable this integration by encouraging collaboration among

diverse fields, leading to holistic and innovative solutions, that place people at the heart of decision making.

To enable this transformation, it is necessary to equip future professionals, in this case engineers, with transdisciplinary skills and knowledge. Studies have shown that collaborative learning in STEM disciplines enhances academic achievement, promotes favourable attitudes toward learning, and increases persistence in STEM courses [3,4]. Such collaborative approaches are important in engineering education, where teamwork mirrors professional engineering practices and prepares students for industry demands [5]. By engaging with multiple perspectives and methodologies, students learn how to navigate and appraise diverse viewpoints, an ability that is invaluable in addressing current engineering challenges [6-10].

Despite its benefits, transdisciplinary collaboration presents several challenges, particularly in teamwork and communication. One significant issue is the potential for conflict arising from different disciplinary perspectives and methodologies. Studies have shown that students from various fields often struggle to align their problem-solving approaches due to their distinct ways of thinking. These disagreements can lead to slow progress in collaborative projects [10]. Communication barriers are another frequently encountered challenge and, sometimes, misalignment can come from mismatched communication styles rather than disagreement over outcomes. Establishing a common language and shared understanding is essential for effective collaboration [11].

In addition to disciplinary differences, cultural differences further complicate teamwork and communication in transdisciplinary projects, especially in international teams. Students from diverse cultural backgrounds may have different expectations regarding leadership, communication styles, and decision-making processes. Research has shown that Western students tend to favour direct communication and active participation, while students from Confucian heritage cultures, such as China, may adopt a more hierarchical approach [12,13]. Language barriers, differing educational backgrounds, and the lack of familiarity with Western academic norms can make it difficult for them to express ideas confidently in group settings. Chinese students may hesitate to challenge the ideas of others or engage in debates, which can sometimes be misinterpreted as a lack of engagement rather than a cultural difference in communication style.

Furthermore, international students could encounter challenges associated with living abroad, feeling a lack of social integration, which can affect academic performance [14]. These challenges can be difficult to overcome, especially in the first year of study, which for many students is the first time they may be required to carry out transdisciplinary work. Proactively addressing these barriers through structured team-building activities and facilitating the building of cross-cultural communication skills can improve inclusivity and foster more effective teamwork.

Staff play an important role in addressing communication and teamwork challenges within student teams. Whilst they strive to teach students about the importance of teamwork and communication, particularly when addressing complex challenges, they often encounter difficulties due to the varying academic levels, communication styles, or cultural backgrounds [15,16].

Despite some previous studies being available, many focus on student experience and perceptions towards communication and teamwork in a disciplinary or interdisciplinary setting, rather than in-depth staff perspectives on managing transdisciplinary teams, particularly in relation to specific teaching strategies, cultural barriers, and the nuances of real-time collaboration. This is the focus of the current

qualitative study. Over the next sections, the authors provide insights into the research methodology, followed by the analysis of interviews with staff teaching teamwork and communications skills at UCL and HKU, and conclusions.

1. Methodology, author positionality and educational context

This study employs a qualitative methodology, using interviews as its data collection tool. This is key in enabling in-depth discussion on complex topics and complements prior studies and institutional knowledge, given the authors' goal to explore academic practice and further avenues to enhance student support, and improve student engagement and satisfaction.

During the study, 7 academics were interviewed, 5 at UCL and 2 at HKU, all with experience in designing, delivering and assessing modules that require students to work on transdisciplinary projects or engage students from different disciplinary backgrounds. All participants answered a set of questions addressing transdisciplinarity, teamwork and communication skills, during 1-hour long interviews conducted online and recorded via MS Teams. All interviews were subjected to thematic analysis [17], leading to the results presented in the next section.

The authors themselves hold academic posts within their institutions and teach or conduct research on inter and transdisciplinarity, some previously presented to the transdisciplinary engineering community [1, 18]. The present study complements previous work on transdisciplinary engineering programmes [1] and student perceptions toward transdisciplinary education [18].

UCL Engineering introduced the Integrated Engineering Programme (IEP) in 2014. This programme acts as a pedagogical framework that embeds problem-based learning (PBL) and transdiciplinarity from year 1, term 1 of undergraduate (UG) studies across 8 engineering disciplines (see figure 1). This paper primarily focuses on the upskilling of 1st year UG students. In their 1st year of studies, students on the IEP work in transdisciplinary teams to solve a global challenge. Over 60% of the year 1 intake are international students, of which approximately 70% are from China and Hong Kong,

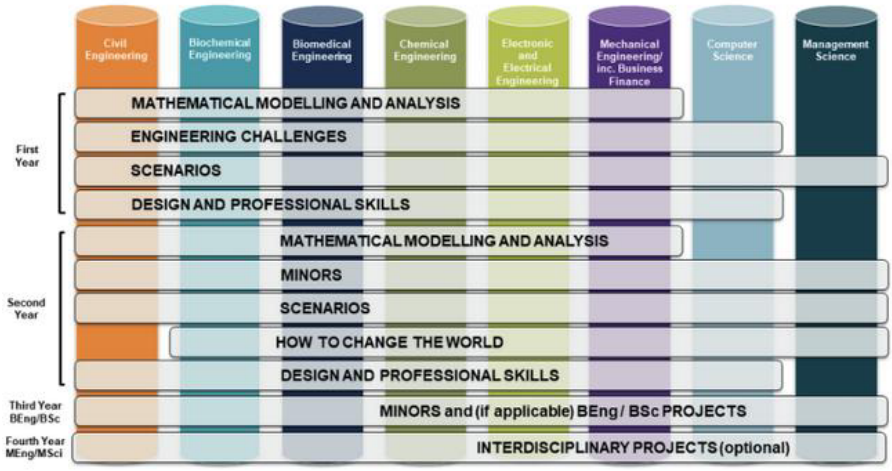

Figure 1. Simplified IEP structure showing transdisciplinary elements taken across the disciplines (disciplines are shown the coloured columns).

emphasising the need for intercultural, communication and teamwork upskilling from the onset and therefore the need for this research collaboration.

2. Results and discussion

The analysis of engineering educators' experiences at HKU and UCL regarding teamwork and communication challenges in transdisciplinary contexts revealed three main themes. The themes included: 1) the impact of cultural differences on teamwork and communication skills, 2) pedagogical gaps in teamwork training, and 3) systemic barriers to current support mechanisms.

2.1. The Impact of Cultural Differences on Teamwork and Communication Skills

Five participants observed that students from Western cultural backgrounds demonstrate greater adaptability to teamwork and exhibit comparatively stronger teamwork capabilities than their Chinese counterparts. This phenomenon reveals profound cultural differences that shape team dynamics in interdisciplinary projects, particularly manifesting through their approach to communication and role expectations between Confucian-influenced educational systems and Western pedagogical models.

Differences in students' teamwork experiences often stem from communication styles shaped by cultural backgrounds. Chinese students are accustomed to hierarchical educational structures where teachers are perceived to hold the highest authority. As a result, they may hesitate to share ideas proactively and tend to express themselves less directly than their Western peers. This dynamic can impact team collaboration. A HKU tutor observed:

" Mainland students shaped by an exam-oriented education system often wait for explicit permission before speaking. Hong Kong students, on the other hand, tend to be more outspoken but are considered less assertive than their Middle Eastern or Indian counterparts. In contrast, Middle Eastern and Indian students typically express their views openly and directly."

Role expectation differences further complicate cross-cultural collaboration. The conventional Chinese educational model, emphasising hierarchical structures, conflicts with Western norms of egalitarian debate. An HKU lab supervisor observed:

"Mainland students accustomed to teacher-assigned roles hesitate to initiate tasks. Meanwhile, international students—particularly Indian students—actively negotiate roles and maintain open communication channels with supervisors."

A study conducted by [19] explored how the cultural differences between Chinese and students of other backgrounds manifested in teamwork and collaborative settings. In line with this study, they found that majority of Chinese students tended to be social-oriented, which reflected in the teamwork roles they selected whereas their Western counterparts tended to take on initiative-based action-oriented roles. The cultural norm of hierarchical educational structures in Chinese classrooms has been found to have links with passivity within teams and the misperceptions of effort vs. achievement. A study reported in [20] found that the impact of the Chinese education structure meant that students were

reluctant to see peers as facilitators of learning, often leading to passivity in group settings. The study also found there to be a mismatch in the amount of effort vs. actual achievement, where it is implied by Chinese students that disciplined effort to acquire knowledge was expected to suffice for good grades, rather than a focus on the process of working as a team as the achievement itself, especially where teamwork was a measured learning outcome. However, it was also argued that the influence of being educated in a foreign language cannot be overlooked. Language barriers add challenge to communication in teamwork, often leading to misinterpretations in team settings. The linguistic disadvantage frequently results in Chinese students' behavioral patterns being misconstrued as disengagement：

"They retreat to their native language because they're out of their comfort zone... Others think they're not contributing, but really, they just can't express it in English."

This underscores the need for teamwork training that fosters empathy, encouraging students to recognize diverse communication preferences. For example, while Chinese learners may hesitate to express themselves verbally in English, they might excel in written English communication. Thus, intercultural teams need to be guided to accommodate diverse communication abilities by offering flexible modes of interaction (e.g. choice of written communication) to ensure equitable participation and mutual understanding.

The study presented in [21] investigated the adaptability of Chinese students in the UK from a cross-cultural perspective, with focus on the impact of English language proficiency on performance. With reason it was found that students with lower English proficiency seem to have more difficulties in academic performance and it is exacerbated by the teaching of English in Chinese settings being focused on rote-written exam-type assessments rather than oral and auditory focused assessment. There seems to be very little motivation to change this from a UK perspective. In a report published in 2024 by the Higher Education Policy Institute (HEPI) [22] on ways in which UK universities can improve their strategies for tackling integration challenges among Chinese students, it was reported that UK universities are heavily reliant on Chinese students for financial stability, with Chinese international students accounting for £2.3 billion annually in fees and this has influenced the leniency in the need to demonstrate adequate English language proficiency in Engineering. It is reasonable to conclude that unless more stringent requirements on English language proficiency are implemented by the UK HEIs, the academic status quo will remain as is for the foreseeable.

2.2. Pedagogical Gaps in Teamwork Training

When teaching teamwork, UCL adopts a structured pedagogical approach emphasizing systematic scaffolding. Three UCL educators highlighted their use of formalized teamwork protocols while acknowledging limitations in practical implementation. One instructor detailed her phased methodology:

"*We enforce meeting minutes in Year 1 and gradually release autonomy in Year 2... First-years learn 'how to deal with conflict,' second years explore 'why conflict happens.'*"

The institution supplements these protocols with peer assessment systems and technical argumentation frameworks to cultivate critical thinking. However, participants noted a disconnect between language assessments and real-world communication demands. As one educator observed: *"Peer marking teaches rubric internalisation, but students still can't articulate ideas verbally. Their polished reports (thanks to ChatGPT) mask oral communication deficits."*

There are some reported drawbacks in this approach including possibly undermining student's ability to think independently and demonstrate authenticity [23] however it seems that literature reflects more benefits than disadvantages. The benefits of the deliberate and scaffolded approach to teamwork training in PBL settings include creating a sense of ownership and responsibility for the teams work and performance, accountability measures such that everyone is held to the same standards, and it encourages collectivism as opposed to individualism [24].

In contrast, HKU prioritizes hands-on project-based learning to stimulate creativity but lacks teamwork scaffolding. Two engineering instructors described typical collaborative projects: *"Students use some tools to create virtual environments like dinosaur ecosystems—through self-organized teams requiring diverse skillsets, from coding to visual design."* However, this experiential approach lacks intentional teamwork instruction. A faculty member admitted: *"No dedicated courses address teamwork fundamentals. Our packed curriculum leaves no room for systematic soft skills training."* The lack of teamwork training in HKU has tangible consequences. For example, one of teachers interviewed in HKU expressed frustration with emerging professional norms: "*They drop courses without emailing professors... Workplace norms like accountability are alien to them.".* Such issues could be mitigated if students were explicitly taught how to collaborate and communicate effectively in professional settings.

To aid in bridging this gap, a number of collaborative efforts have been initiated via partnerships with Eastern and Western HEIs. Whilst global HEI partnerships are common in research, there are vastly fewer reported partnerships that are solely pedagogy-based and even fewer that report on successful influence on students as a result of said partnership. One study of note was reported by [25], presenting findings from an international capacity building project led by European educators where mentoring was used as tool for the pedagogical upskilling of Eastern tutors. Whilst the study positively highlighted the development of Eastern educators through this project, very little was reported on the upskilling of Western educators and an equal transmission of upskilling for the benefit of embedding cultural competence in the Western, more globalised classroom. This is one of many ways in which better understanding of the needs of international students in Western HEIs can be addressed, in hopes of improving the learning support mechanisms readily available that enable enhanced teamwork and collaboration in transdisciplinary engineering settings.

2.3. Systemic Limitations to Current Support Mechanisms

The analysis revealed differences in the support mechanisms for teamwork and communication and their corresponding systemic limitations.

At UCL, existing resources prove inadequate in addressing students' linguistic challenges. While initiatives like language cafes aim to facilitate informal English practice, participation remains low due to misaligned incentives. As one participant noted: *"Do you know that they are not coming to it? Because students will not get marks attached to it, or they do not really see the benefit of it."* Furthermore, discipline-specific

support appears fragmented. One UCL tutor revealed: "*Beyond the 'Professional Skills Development' course, we offer no formal training for teamwork adaptation. Current support relies too heavily on isolated modules, leaving critical gaps uncovered."* The findings suggest significant mismatches between institutional support systems and student needs across educational contexts. However, due to the teamwork-heavy nature of Engineering degree programmes at UCL, tutors have generally reported substantial upskilling in teamwork from first year compared to final years of study [26].

In efforts to embed language and communication training in the engineering curriculum at UCL, academic speaking and writing sessions have been integrated into the Design & Professional Skills module in order to address reported issues of incentives being isolated from learning. Despite this, similar to incentives to support teamwork upskilling, there are issues with uptake and attendance. Student annual surveys suggest a few reasons for this, some of which are linked to these sessions not being compulsory, poor advertising of these opportunities, poor timing of sessions and no perceived academic benefit (in relation to grade attribution). Systemic limitations in the timetable and limited staffing in English language upskilling have made it difficult to make substantial improvements to the initiative.

HKU's approach to teamwork development presents contrasting yet equally problematic systemic limitations. As previously noted, the institution assumes teamwork skills will be naturally acquired through project-based learning, without explicit instruction. Support to students during teamwork is mainly provided by their tutor or lab supervisors who mainly focus on providing advice and guidance to teams which encounter difficulties in working together. However, reliance on personalised feedback and encouragement may have a negative impact on students' ability to deal with difficulties on their own in the future. For example, one of the interviewed teachers pointed out excessive student protectionism as a flaw in the current supporting system: *"Students require constant reassurance—even high achievers lack confidence and struggle to accept criticism, so I have no other ways but to keep on encouraging them in a teaching and learning context. This is in contrast with what happens in the industry."* Another teacher pointed out the inability of the current project-based assignments in mimicking pressure in real-life engineering projects: *"We can't completely replicate workplace stressors like tight deadlines or client feedback. Without modeling industry norms, our teamwork project is somehow naïve."*

Literature presents many advantages to incorporating industry ways of working into the engineering curriculum and ways in which it improves teamworking and communication skills, particularly when working in transdisciplinary teams. However, despite best efforts, there are a number of limitations that do not allow for true replication of the workplace in classroom settings, most of which are related to university timetable restrictions, physical environment and financial resources. However, a number of viable solutions have been reported with successful impact, such as the inclusion of placements in degree programmes, integrating industrialists as guest lecturers and hiring educators with industry experience, among other solutions [27, 28]. Whilst the curriculum limitations will likely remain, simultaneous incorporation of multiple of the presented solutions should substantially help in building the teamwork and communication competencies needed for the transdisciplinary workplace.

3. Conclusions

This paper has identified a number of contributing factors affecting the upskilling of students in teamwork and communication competencies that facilitate working in a transdisciplinary engineering environment via interviews at HKU and UCL. Participants of this study from HKU reported on the impact of the traditional hierarchical Chinese education system and how this reflects in teamwork compared to Western counterparts, possibly leading to hesitation in sharing of ideas and passivity in teams. Another identified factor relates to the economic reliance on Chinese students in UK engineering higher education and the resulting leniency in English proficiency requirements negatively impacting both the teamworking and communication skills needed in transdisciplinary settings. A further factor of note relates to the lack of reported pedagogy-based Eastern-Western partnerships that focus on equal knowledge exchange that directly benefits classroom cultural competency, which can then be used to introduce adequate support systems for students. Finally, the limitations in the engineering curriculum timetable present challenges in reflecting the transdisciplinary working environment in the classroom, however several solutions, particularly the incorporation of placements in degree programmes have proven to have the biggest impact in helping students improve their teamwork and communication skills in transdisciplinary settings.

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