DEVELOPING TEAMWORK SKILLS BEYOND CROSS-CULTURAL BARRIERS: A CASE STUDY FOR ENGINEERING STUDENTS IN HIGHER EDUCATION

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ABSTRACT

In 2013, our university has implemented a new educational model that puts team projects at the core of all BSc programmes, requiring that students develop teamwork skills. On top of this, in 2018, our Chemical Science & Engineering BSc has become an English-taught, international programme. In consideration of this challenging transition, we have developed additional training to facilitate students' acquisition of knowledge, skills, tools, and attitudes to aid conscientious intercultural teamwork. For this, it is paramount that students become aware of, and learn to appreciate, differences in the educational and cultural backgrounds of themselves and their peers. Concurrently, students should practice what they have learned and adjust their behaviour when appropriate.

In this paper, we share our experiences, best practices, and lessons learned. More specifically, our study: i) explores which factors are key to a successful intercultural team, ii) investigates how diversity in teams can be cherished and used for the benefit of the team, its members, and its goals, and iii) how these teamwork skills can effectively be taught in engineering programmes. Building on this, the paper

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describes how the new curricular education has been designed, what is taught, and how an inclusive, regardful, and pleasant atmosphere has been created for the intercultural project teams.

1 INTRODUCTION

1.1 Essential skills in engineering education

In this ever-changing society, higher education (HE) institutes should take on the responsibility of preparing students with the necessary skills in addition to their respective disciplines to face the world's greatest challenges. Among these skills, teamwork [1] has been identified as a key characteristic that employers seek in university graduates because workplaces demand interpersonal cooperation and high levels of interpersonal skills. In response to this, since 2013 all bachelor programmes at our university are designed based on a new educational model that enables students to create their development and learning experiences through a variety of projects that weave their way through the programme like a thread.

Furthermore, our Chemical Science & Engineering BSc has become an English-taught, international programme, and in today's globalised environment, intercultural skills are becoming increasingly important and desired [2]. Teamwork involves challenges that might be exacerbated when members come from diverse backgrounds but lack intercultural competence; students must be aware of their roles and of how to cooperate with different peers. Growing industrial interests also require the diverse population of engineering students to develop beyond traditional technical abilities. These challenges call for in-depth research to gain a better understanding of how to foster effective teamwork and intercultural skills in engineering education.

This study recognises the importance of intercultural skills and intends to provide means to train students to effectively work in teams with people from diverse backgrounds. More specifically, this study aims to (i) explore factors that are key in establishing success in intercultural teams, (ii) investigate how diversity in teams can be cherished and used for the benefit of the team, its members, and its goals, and (iii) develop an effective teaching method for these teamwork skills in engineering programmes.

1.2 Underpinning Theory

A team is here considered “a collection of individuals who classify, define and evaluate themselves in terms of a common social category membership” [3]. The core of a team is a shared responsibility for achieving common goals [4], which requires the commitment of each individual team member to work on assigned tasks.

In academic settings, simply getting individuals together is insufficient for effective teamwork. Students need guidance and mentorship to learn how to interact and work together and understand the team roles and responsibility of each member [5]. Teamwork competencies encompass a set of behaviours, knowledge, skills and attitudes from students that contribute to the team’s efforts [6]. Four dimensions of teamwork skills development [7] are identified: (i) identity (goals, sense of belonging, roles, adaptability, teamwork climate, commitment); (ii) communication (information, personal interaction); (iii) performance (planning, decision making, carrying out the

tasks, monitoring performance); and (iv) regulation (collaborative problem solving, negotiation, making improvements). From this, one can conclude that the key components of teamwork skills development are:

- why the team exists (objectives),
- what a team does (activity), and
- who is on the team (roles) [8].

Furthermore, being able to work with diverse people is a prerequisite for successful teamwork, necessitating a comprehensive approach to incorporating intercultural skills into teamwork-skill training. Intercultural skills are “the ability to communicate effectively and appropriately in intercultural situations, to shift frames of reference appropriately and adapt behaviour to cultural context” [9]. Respect, openness and curiosity are the pillars [10] around which the competence is based.

From a pedagogical perspective, the development of teamwork skills is a process of learning involving strategies of (i) providing opportunities for the application of knowledge; (ii) structuring opportunities for collaboration and interaction with diverse peers; and (iii) providing opportunities for perspective-taking and reflection [11]. Based on this three-stage process, this study develops the teamwork skills training utilising the framework described in Figure 1.

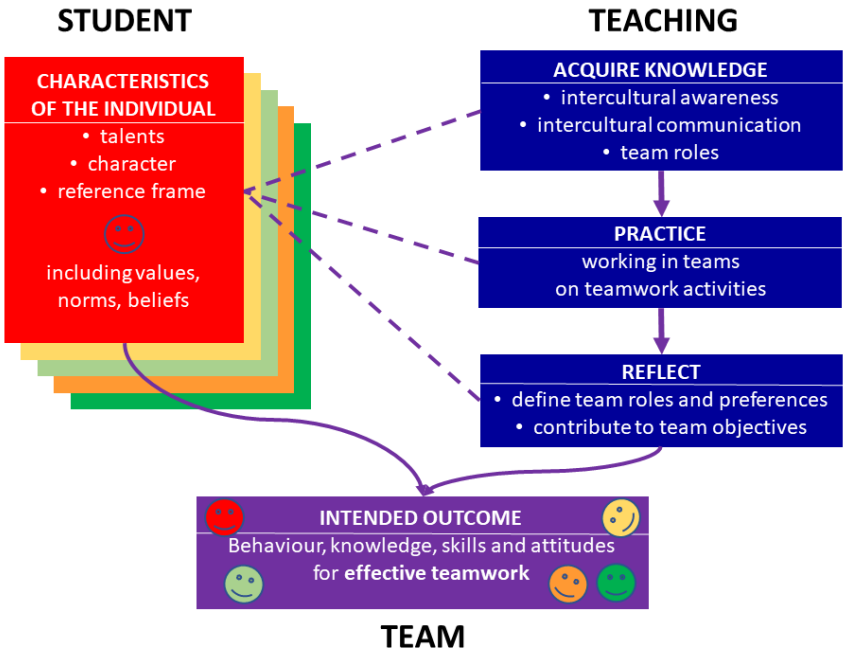

Fig. 1: Intercultural teamwork, from theory to practice in our programmes

2 METHODOLOGY

2.1 Programme context

Originally, our Chemical Science & Engineering programme was only offered to national (Dutch) students. The programme was converted into an international English-taught programme in 2018, with approximately 60% of the current students being international. This development is highly valued, yet a smooth transition from a national to an international classroom can be challenging. Therefore, the teamwork

skills training was developed to prepare students to work effectively in project teams with their international peers.

2.2 Design of teamwork training

The training is designed as a four-stage process. Students acquire necessary knowledge and apply it through teamwork activities, while also reflecting on their experiences for future improvement (see Figure 1). The following section details the training setup for each stage.

Freshmen: When students enter our bachelor's programme, we teach them organisation skills, focusing on how to carry out effective meetings in a team of peers they hardly know. Some students have experience with group work, while others were used to working individually in their high school. In their first project, they experience what intercultural group work can be like in their studies. They take their successes and failures in this group work, as well as their individual questions, with them to the second project, where they receive the teamwork training with a new group of students (typically four-six students per team in the first and the second project).

Workshop on cultural diversity: We commence with a workshop on cultural and educational diversity, with the following learning goals: to (a) be more aware of each other's expectations; (b) be able to identify differences in (prior) education of their group mates; (c) devise ways to get the most out of their education at our institution; (d) empower effective teamwork in a (project) group of diverse people.

In a classroom setting, students sit with their new project team and work on assignments. First, they introduce themselves to their peers (with a focus on their name, its meaning, who named them; their upbringing; their high-school experiences; their affiliation with the project). Then, students collectively discuss given cases – situations where individuals have misunderstood each other – and try to identify what was the cause of the confusion. Students continue with collecting keywords that link to 'culture', and try to use these to constitute a definition of 'culture'. Additionally, students practise with an exercise about universal, cultural and personal characteristics, that they discuss with their team. At the end of the session, we teach students about conceptual knowledge on intercultural communication (emphasis on high vs. low context; perception of time as synchronic or sequential; affective or neutral emotions; relationship vs. deal orientation; and hierarchical vs. egalitarian cultures), with an exercise to highlight where on these axes students would position themselves and what the effects might be on the group or group process. After the workshop, the project groups work on an assignment about how they wish to work together, and how they will take into account each other's needs, norms, values, and beliefs, resulting in a project group agreement.

Workshop on team roles: We realise that, when they work in groups, students often define group roles by themselves, while they lack a theoretical background about roles in group processes. Hence, we introduced the Belbin model [12] to improve their understanding of team roles. The students fill out a self-perception inventory and ponder on its possible meanings. Then, they discuss the outcomes within their team, draw conclusions about missing or underrepresented roles in the team, and

how to use these insights to the benefit of the team. Also, they are asked to decide who to work with in their next project (small groups of three students), taking into account the outcomes of the Belbin model.

Reflection: Lastly, we have reflection activities. Already early in the project, students give each other feedback on their perception of the leadership qualities, team-player behaviour, fitness for specific tasks and roles, and potential for interpersonal conflicts; students score themselves as well as all their peers from the project group. They discuss, in particular, discrepancies in the perceptions of themselves and the others; e.g., someone may consider her/himself a well-liked natural-born leader, whereas the other group members anticipate this person to induce problematic coacting and conflicts.

At the end of the project, we offer a reflection workshop. We look back at the original group agreement, what worked and what did not, why things did or did not work, and how a group might improve teamwork for the next project.

In the master's programme, we offer similar teaching activities, adapted to the fact that these students often have more experience in teamwork.

2.3 Evaluation

The evaluation input was gathered from multiple stakeholders:

- We asked the participating students after each workshop for feedback to improve the workshops and used that in the next year;
- The training is assessed as part of the regular course evaluation of the Chemical Science & Engineering programme to assure its quality;
- Additional input from teachers and programme management is requested to determine how the training is integrated into the programme's overall curriculum.

3 RESULTS

3.1 Acquire knowledge, practice, and reflect

The teamwork skills training is embedded in the existing programme. This implies that students have opportunities to apply their knowledge to concrete tasks through an engineering project: students have goals to achieve, technical issues to solve, and deadlines to meet while participating in a group process. Students focus on interpersonal qualities and relations in the team, which is separated from, yet in the context of the specific content and aims of the project. Additionally, students are encouraged to engage in meaningful and practical reflections.

The peer-review process revealed interesting insights, as students often have a different perception of their behaviour, strengths, and weaknesses than their peers do. They also needed time to reflect on their own performance for the group reflections to be successful. The introduction of the individual (peer and self) reflections has made the group reflections more meaningful and more thorough.

Students' perspective: Students' feedback provides input on how the training was perceived and what effects were obtained (see Figure 2). Below is a summary:

- The workshops validated that intercultural differences could be a cause of problems in a project group. For many students, working in an international project team at first was overwhelming. The workshops assist students in understanding how norms and values can differ and that there is no ‘wrong’ or ‘right’; just a different basis.
- Due to the workshops, differences among cultures were discussed, which would otherwise not happen automatically. Students claim that confusion and irritations were mitigated because of this approach. Often, groups immediately focus on the tasks they need to work on; now, they would start with the fundamentals of intercultural teamwork instead, and the workshops made it easier to address any teamwork issues.
- The workshops increase self-awareness in intercultural collaboration, especially when students need to decide on a project approach and agree on how they will work as a team (project group agreement).
- Students say that the workshops have massively impacted the way national and international students interact, and group bonding was increased – not just in this project but across the student cohort.
- The workshops were taught playfully, helping students to get to know each other better, on a personal level, increasing the groups’ ability to discuss possible issues.
- Groups were more aware of how they could improve the group atmosphere through better understanding and communication about expectations (from the project as well as from their peers). This also increased the likelihood of success. Success for a project group also was valued more by the students, because it was a true team effort.

Fig. 2: Word cloud of feedback from students after teamwork training: what did they learn?

Course teachers’ perspective: The course teachers of the project indicate that, due to the intercultural workshops, the teams perform and contribute better in their

intercultural "Process Plant Design" project. The teams consist of 4-5 students and they sit together in a project room for 2-3 days a week. They need to collaborate intensively for five months to make their project successful. They are now much more aware of differences due to cultural backgrounds which makes it easier for them to discuss issues beyond their personal perspective, especially since this was addressed during the workshop. Potential conflicts are now discussed and solved within the team.

Programme director's perspective: Although about 60% of our students has an international background, our national culture and norms tend to remain dominant in the classrooms. This workshop is of particular importance to broaden the perspective of international and national students and contribute to a truly international classroom culture. The workshop seems to have a lasting positive effect on mutual understanding and on formal and informal collaborations between students of different cultural backgrounds.

3.2 Future development

We shared our experiences with other programmes at our university. As a result, other engineering programmes also introduced workshops on cultural diversity in teams. On top, this implementation has become a stepping stone for the development of teaching methods for other essential skills in our programme (like academic writing, oral communication, critical thinking, conceptual modelling, and civic engagement including sustainability awareness). We couple these activities with existing courses or projects in the programme, and ensure that we assess students' development in these essential skills.

The workshops also accomplish that students value and contribute more to global citizenship, as they learn to appreciate different perspectives.

We conclude that with this study, we found factors that are key in establishing success in intercultural teams. The main factor is awareness of the different backgrounds of students' peers. Diversity in teams can be cherished and used for the benefit of the team, its members, and its goals, which became apparent to the students, who started their projects with more focus on what intercultural teamwork entails and requires, and with more awareness of the needs and backgrounds of their peers. Also, we have developed effective trainings to teach these teamwork skills in engineering programmes.

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