

Students' tensions in challenge-driven collaboration across cultures

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Abstract—This full research paper reports on a study regarding students' views and experiences of teamwork in a challenge-driven course (also known as challenge-based learning). The students were situated in either the European university offering the course, or, in an African university where challenge-based learning was introduced for the first time. This study was performed as a case based study using thematic analysis to gain better understanding of students' views and experiences of challenge-driven, multicultural blended/online teamwork. The students were found to have different approaches during their teamwork: task-driven or relationship-driven approaches and, in addition, patience and solution-driven in regards to the digital technology. These findings can provide a deeper understanding for teachers that wish to organize collaboration between universities to support engineering students' collaborative learning in challenge-based/driven education.

Keywords— *collaborative learning, challenge-based instruction, teamwork, multicultural, blended, remote learning.*

I. INTRODUCTION

Engineering education continuously strives to find new ways to strengthen students' abilities to address broader societal challenges and develop sustainable solutions relevant at global scale. To that end, universities have taken initiatives to collaborate and educate students across institutions and country borders. Previously, it has been recognized that the development of sustainable solutions to multifaceted problems need different disciplinary approaches and inclusion of a variety of perspectives during the design process [1]. In order for such work to be successful, engineers have to be trained and skilled in team collaboration.

The need to include students' collaboration skills in the curriculum has been identified and practiced within engineering education for several decades [2]. In industry and business, the ability to work in cross-functional teams is recognized as both a necessary and challenging part of modern organizational life [3]. In response, engineering faculties have introduced, for example, problem- or project-based courses which are widely used to train students' abilities to work in teams [4, 5]. In more recent years, challenge-based education/learning is introduced to not only train collaboration skills but also to engage students in design-based learning and attend to multifaceted and critical societal issues [1, 5, 6]. One of the purposes with challenge-based/driven pedagogy is to create opportunities where students learn to collaborate with peers and stakeholders outside university that have different backgrounds and bring different perspectives. Therefore, students with various educational backgrounds are often put together in teams [5, 6].

In a challenge-driven course, the students address authentic and often complex sustainability issues [5, 6]. Due

to the nature of these challenges, it is preferable that students collaborate in multidisciplinary teams to innovate and leverage on the team members' different perspectives to create solutions that are environmentally, socially and economically sustainable [6]. From the teacher perspective, the goal is to create learning experiences where students collaboratively identify, analyze and design solutions to sociotechnical problems [6]. Typically, the students' work is performed in multicultural teams. The introduction of challenge-driven education in international settings have previously been evaluated [1, 5]. For example, findings suggest that students felt socially pressured to depend on each other, working as a team, rather than emphasizing an individualistic and more independent approach [5].

The instructional design in a challenge-driven course aims to be inclusive, creating novel learning experiences regardless if the students' prior knowledge is engineering, health sciences, social disciplines, or other. According to Hockings [7] students' differences can enrich learning, and to make the most of intercultural course settings teachers should strive to make diversity transparent. Such awareness among students can be achieved through reflections and discussions regarding inequalities, and that teachers address sensitive issues [8]. Challenge-driven pedagogy often include that teachers promote and facilitate reflective processes regarding diversity and different norms throughout the course. Unspoken expectations and differences in taken-for-granted norms may cause tension during collaboration. One intention with challenge-driven pedagogy is that students learn from the different viewpoints and experiences of others', and therefore the outcome of challenge-based pedagogy depends partly on how well students and teachers manage to include various perspectives.

Previous studies have identified factors that influence successful teamwork as well as factors that may cause tension [9-11]. Research have also shown how teachers can support the development of students' collaboration skills. Furthermore, investigations regarding online teams, interaction and collaboration are increasingly common [12, 13]. Still, there are few studies that provide deeper understanding of students' experiences of collaborative learning and how they make sense of tensions that may arise during project work performed in multicultural settings where students have unequal conditions regarding on-site, blended and classroom settings. Universities are increasingly using digital media to offer students across countries joint courses, and a better understanding of students' experiences related to such conditions can enhance the learning conditions.

The aim of this study is to gain a better understanding of students' conditions to learn and perform when they collaborate in multicultural teams, and when digital resources

are needed and set the condition for communication during such collaboration. This paper also aims to contribute in the conversation regarding planning, delivery and evaluation of challenge-based/driven courses where students are expected to develop solutions regarding authentic sustainability issues. With this in mind, two specific research questions guided this investigation. In the context of blended and multi-cultural challenge-driven education:

- 1) *How do students with experiences from different educational cultures view teamwork in a formal learning situation?*
- 2) *What are students' experiences of teamwork when digital tools are mediating the learning process?*

The first research question refers to the students' views of how collaboration in teamwork should be performed, ideally. The second question attends to the conditions that digital tools creates for communication during the students' collaboration.

II. COLLABORATIVE LEARNING AND TEAMWORK

In engineering, as well as in other STEM education fields collaborative learning has been extensively researched. Learning through collaboration as well as teamwork have also been theorized from various perspectives including research in education, psychology and philosophy [14]. For example, studies have focused on group dynamics, interpersonal behavior, and team development [9, 15]. One underlying assumption for employing collaborative learning in higher education is that learning is a social process embedded in a cultural and historical context [12]. When students interact, discuss, provide peer-feedback and solve problems jointly their way of thinking is challenged and they develop new perspectives and deepen their knowledge [16, 17].

Commonly, in the literature, there is a difference between learning activities where students cooperate or collaborate [18]. Cooperative learning refers to '*as a structured form of group work where students pursue common goals while being assessed individually*' [p. 223, 4]. Using cooperative learning as instructional method include communication of group goals, assigning roles and engage in team building activities, whilst each member is accountable for his/her own learning [14]. Collaborative learning, is described as less structured processes where the group members jointly define problems, and negotiate goals as well as how to collaborate whilst creating knowledge together [14]. Prince [4] argues that collaborative learning include cooperation and refers to '*any instructional method in which students work together in small groups toward a common goal*' [p. 223, 4]. In challenge-based education, students need to identify the specific issues and how to address those together in the group. The students also communicate with stakeholders as one team, and are required to present one joint solution. Hence, the assessment are based on collaborative learning rather than mere cooperation. Although, individual exams are sometimes included in the course in addition to the students' project work assignments.

In the literature, there is also a difference between group and teamwork where the latter sometimes are referred to as high functioning and well performing. Thus, teamwork holds a normative and positive attribution whilst group work may refer to any kind of work where two or several people collaborate via face-to-face interaction (not necessarily in a physical space) towards a common goal [9, 19]. In a commonly referred book, Katzenbach and Smith [10] defines

teamwork as: '*A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable*' [p. 41, 10]. Teams often develop a unique way of interacting and approaching tasks, and researchers have proposed different phases that team members go through in order to establish an effective collaboration and increase team cohesion [15, 19]. Stage theories emphasize the interpersonal relationship between members. This include matters such as norms, roles (formal and informal), power to influence the group's choices, as well as how to engage in task performing processes [15, 19, 20]. In his theory, Tuckman [15] included the three phases: norming, storming and performing, which explains well the essence of how interactions between team members are commonly played out. Common to stage theories is that group members need to agree on, and come to terms with the different roles and responsibilities, as well as the joint goals and how to approach each other whilst communicating and interacting. One well-known strategy to move from role-seeking to performance is to make unspoken norms and taken-for-granted views explicit [9-11, 15].

A. Students' teamwork online

In online collaborative learning students have ample opportunities to become co-creators of content and share resources. Ku and colleagues [13] researched students' attitudes and satisfaction in relation to specific factors identified as important in online collaborative learning. Their findings suggest that students' satisfaction in teamwork correlates with team acquaintance and dynamics, as well as instructor support. Students reported that in addition to the instructors' encouragement, critical elements were: team commitment, clear objectives and goals, clear and frequent communication, timely resources, use of interactive software, synchronous meetings, opportunities to access and view examples, and, well-defined and well-organized instruction [13]. In sum, many factors that are known to influence teamwork in general, are applicable to online collaborative learning. In addition, digital technology such as platform affordances affects how collaboration can be performed. Furthermore, collaboration via online platforms are increasingly multicultural by nature. This may require intercultural communicative competence that include students having an open mind, curiosity, and commitment in recognizing others as persons [21].

III. METHOD

This research project was performed with an interpretative approach grounded in socio-cultural views of learning and human interaction [16, 17, 22]. Whilst digital technology mediated students' interaction and learning, it is the students' lived-experiences that are in focus, here framed as students' views and experiences. The research approach taken in this study can neither inform about students' various conceptual understandings, nor provide clarity regarding the essence of the phenomenon, or measure the correct or most successful way to perform multicultural teamwork. Instead, a single-case study was chosen to gain rich data concerning students' views and experiences in an authentic and novel course setting. Yin [23] argues that a case study is needed when:

- an empirical inquiry must examine a contemporary phenomenon in its real-life context, especially when

- the boundaries between phenomenon and context are not clearly evident [p. 98. 23].

A. Context of study and course setting

The students collaborated in teams during twenty weeks (part-time studies) to identify and design sociotechnical solutions to authentic sustainability issues provided by external stakeholders from two countries. The challenge owners included one municipality (in the European country), and one organization working with sustainability initiatives (in the African country). The same sustainability issue was provided from both stakeholders, and no prior solution to the issue existed in either country. As part of the challenge-driven pedagogy, the students' work included identification of the specific goals and conditions relevant in each setting. To achieve this, the students were expected to communicate regularly with the challenge owners about their emerging solution and they visited the rural sites where their respective solution were expected to be implemented.

The course was offered from an engineering faculty in northern Europe as part of a two year masters' program in product development. The course was also offered to students enrolled in a three year bachelor program in health informatics at an African University. In total, twenty students started the course, of which half of the student group participated from the African university site. The other half pursued their studies from Europe including two students from the African university. Two students came from the same country as the hosting university and the rest were exchange students. The course was given in English although, neither students, nor teachers were native English speakers. Lectures were provided from the host University and live-streamed, hence half of the student group experienced the sessions live in the classroom, and the other half via link but with one tutor present. In between sessions, the students used various digital tools to communicate and collaborate within their respective projects, however no joint LMS could be utilized since the two different Universities used different systems. In the beginning of the course, the students performed team exercises together with an expert teacher. Initially each team agreed upon joint rules regarding how to communicate and how to meet course requirements including deadlines.

B. Generation of data

Data was generated through multiple sources but relevant for the analysis in this paper are seven semi-structured individual and group interviews held with students, as well as, individual student reflections from all enrolled students gathered throughout the course at fourteen different occasions. In the beginning and the end of the course, each student wrote a more open and elaborate reflection regarding collaboration and the use of digital technology. Interviews were held through physical meetings at each student's 'home' University. The interviews were audio-recorded and later transcribed. In addition, one in-class observation was made when the students' gave their final project presentations and engaged in an open discussion regarding their learning in the course. Notes were taken during this observation [24].

Data concerning the students' performances in assessments informed the case study. Furthermore, teachers, and course management, as well as one administration manager responsible for the university collaboration initiative were consulted to gain information regarding the course setting. Course materials such as syllabus, schedule and

information regarding assignments and activities, as well as the students' course evaluations were also used to inform about the case and the formal learning setting. The nature of multifaceted data was considered during the research process. For example, that the analysis and hence results regard students' experiences at group level, and that individual experiences cannot be the focus when data from diverse interview situations is analyzed as one set.

C. Analysis - coding and interpretation

The interviews were analyzed thematically following the procedure suggested by Clarke and Braun [25]. Inductive coding were made based on the search for patterns and similar responses. In thematic analysis, researchers may use different approaches, such as manifest (semantic) coding and latent interpretation of what the participants' expressions regard [24-26]. In this study, the initial coding was conducted based on students' recurrent and manifest expressions throughout the data set. The result of such coding is a descriptive report of what the students report during interviews and in written reflections. Accounts of students' common views and experiences is included in the findings section of this paper. However, the main result of the coding is three overarching themes based on the latent interpretation illuminating the meaning of students' views and experiences regarding teamwork in a challenge-based, multicultural blended course setting.

The researcher is well experienced in qualitative methods and was not a teacher or course management, and have no other relation to the students' than this study. During the research process ethical guidelines regarding research on humans were followed [27]. For example, all participants signed informed consent after receiving both oral and written information regarding the study and their rights as research participants, and they were promised anonymity.

IV. FINDINGS

Based on the thematic analysis performed in this study the author identified three themes that depict students' views and experiences of teamwork in a multicultural, online/blended challenge-based course. The first theme is labelled, *A) patience and a solution-driven approach* and refers to the students' experiences of online collaboration and the use of digital technology. The second and third theme regard the students' approaches to teamwork and include their views of how collaboration should be performed and their experiences during the course, these themes are labelled: *B) task-driven approach*, and *C) relationship-driven approach*.

The different approaches regarding teamwork created tensions between the students and sometimes made it hard for them to collaborate. The students reported that they understood the course setting to be based on western models and ideals of how collaboration should be performed. The students' different approaches to teamwork were reflected in how important they believed interaction regarding personal and private matters was for teamwork to be successful. Views of how the joint decision-making process should be enacted, also differed, e.g. whether ideas should be brought to all team members first. Or, whether anchoring new suggestions with a few peers before joint meetings was acceptable, or not. The students' views also differed in how they perceived the importance of making compromises, or, if the majority opinion should guide decisions. Despite these tensions, most students showed an open attitude and expressed curiosity and

found it exciting to collaborate in a multicultural course setting.

Actually study online with different people, it's quite a learning curve. And I'm enjoying it, there are challenges, I wouldn't lie, because we have to adapt to each other's culture. The way we conduct things here is different from how overseas you do it. So we there is a bit of compromising between the two universities and we have to meet each other half-way. And I feel it also boost ones teamwork spirit. (Int 1)

Several students made broad generalizations regarding culture and emphasized the differences between African students and 'other' students. These generalizations regarded norms of how to interact and approach life and studies in general. The majority of students at the host university in Europe however were exchange students and came from several different continents and countries. Regarding her positive experience of working in teams during the course one student said:

Plus, getting a different perspective, we are African so one can say we have a similar way of thinking, we socialize in a similar way. The [refers to university] guys over there they bring a fresh different perspective from ours, so that's a good thing. (Int. 4)

Next, the three themes are presented in the following order: A) patience and a solution driven approach, B) task-driven approach, C) relationship-driven approach.

A. Patience and a solution-driven approach

The students were generally positive towards collaboration via online digital tools. They reported several obstacles with being restricted to communicate through digital tools due to limited or, unstable internet connection and expensive data usage for half the student group. The fact that live-streamed lectures sometimes were interrupted because of the shifting internet access, occasionally caused frustration for students and teachers. One consequence was that the students at the host university sometimes got to hear parts of some lectures twice, whilst the students participating from remote, at times, missed out on parts of the sessions. During several seminars there were activities and discussions which meant that all students had to wait until the remote connection came back. Despite that internet access was limited and sometimes unstable, the students' recurrent reflections shows that they were in general happy with the digital solutions and found them very useful. Overall, they expressed patience when the digital technology failed. The students also reported being determined to make communication work, as one female student said:

Those doing it distance as I did, I would say, don't give up. Learn to adapt, though it is not easy. It never comes easy but strive for the best. (Int 3)

The students situated at the European and the African university had different conditions for using online communication. The students at the host university had stable and affordable internet connection and were used to working on computers whilst studying, regardless if they were at school or at home. According to some students at the African site, their university were still in the process of introducing digital literacy for all students, and increase the requirements on students to use computers in written assignments.

We are getting there, we are not yet technological advanced. I think in maybe in 5 years, 10 years or so, that's when we'll adapt, google-docs. Yea, because we are quite slow, we believe much more in paper-based writing, than having to write through the phone or the computer. We believe so much in paper-based. (Int 1)

Although the students situated at the African university perceived that they were not as technological advanced as their peers at the host University, they were well experienced in using apps via mobile phones and social media to communicate. During the first course sessions the students that participated remote frequently used their phones during lectures. Live-streaming via camera was used at both sites so that all students and the teacher could see everyone joining the class. The frequent mobile views by the remote students during class made the teacher react, and were brought up in several student reflections. During one interview a female student explained:

We believe so much on our smart phones, always on our phones. Even though we are listening, but for us, I don't know if it's the culture but we are always on our phones. [...] I think that the long period of the lesson, I think the phone is like a distracter. Then you come back, feeling refreshed. [...] I don't think that is what they are used to there. [...] You're using your phone, it's a personal thing. So I think [the teacher] couldn't understand. But we were in fact listening to her, it's just trying to refresh, 5 minutes, and then you come back to the whole study, and then you come back to. So I think that was a bit of problem, so we had to agree, so no phones in class. (Int 1)

The two universities used different LMS and because they couldn't share access to procured online applications, the course management introduced open educational resources to support the teamwork, for example google-docs. However, since several students lived in rural areas distant from the African university campus, where internet access was limited, communication had to be managed through apps accessible via mobile phone and that required low data usage. The need to find a solution that did not require computer access was brought up by most students in the course.

Yes, one of the reasons to why we changed, is because I'm having a problem with my phone, so I couldn't get google docs. It was one of the reasons. (Int 3)

We use WhatsApp most of the time. Because we realized that due to adaption of culture, technological culture, us we are very different, we only communicate with emails, and sometimes WhatsApp. The google doc was bit of a challenge so we shifted to WhatsApp. So WhatsApp was very easy and accessible to everyone. Because here wifi is not for everyone. It's only a few of us who have wifi in our own homes. [...] So we communicated through WhatsApp to build a solid project and actually have a real thing. (Int 1)

The student's experienced different learning environments based on if they participated in lectures from the same site as the teachers, or not. Facing these different conditions, the students used WhatsApp to communicate and compile materials during their projects. Most students reported being content with the opportunities that WhatsApp/ digital technologies had created. Due to long and, according to some unsafe commute, the distance students wanted to leave the school campus before dark which in their view gave them few chances to use computers at the university after the class sessions ended for the day. The possibility to communicate

with the rest of their team via their phone using WhatsApp was perceived as 'a fantastic opportunity' (written reflection).

Each team worked on designing a product that addressed their respective sustainability-challenge. One complicating issue was that half of each team was situated at another continent and had never experienced the context where the product should be used (Africa or Europe). The team members that could communicate face-to-face with the stakeholder that provided the challenge did their best to include their peers by filming.

Because, for us we took videos when we went to the site, we took videos just to include them. We also took a bit of a live recording so that they could see that we are really there. So we send them videos so that they can relate, and also know what was going on in the interview. And also we scripted everything down, and we sent to them, and they read, and we actually discussed over WhatsApp. (Int 1)

B. Task-driven approach

In the written reflections and in the interviews, some students expressed that during teamwork, it was more important to complete the assignments on time and focusing on the team performance than to include all team members at all times. According to the interviews, most students at the European host University had adopted this task-driven approach, as illustrated in the following quote:

We are committed to do our work, but the level of the commitment that the [European] cohort has. Like when they have a task, it's that task and nothing else. (Int 2)

The students perceived that this task-driven approach was the result of previous project-based studies and training in project management skills. These skills included self-directed strategies of how to plan a project so that deadlines and milestones were defined and reports were handed in on time. One student described how the peers at the European university were more familiar with 'how to get the project moving forward' (Int 6). Most students used the expression 'goal-directed' and associated this with the ways of living in western societies. Several students from both sites reflected upon how the multicultural collaboration made them aware of that goals and tasks seemed to have different meanings in different education contexts. The students experienced that the course was designed in accordance with a task-driven approach. Consequently, students that were less familiar with project management tasks therefore experiences that it was hard to meet the expectations and to understand some of the unspoken norms during teamwork. During the course, this however changed and several students reported that they had learned a novel way of conducting teamwork during the challenge-based course. These students experienced what it meant to adopt a task-driven approach, different from their previous experiences.

C. Relationship-driven approach

Several students talked about how the establishment of a good relation is the foundation for teamwork and conducting tasks collaboratively. Some students emphasized that getting to know each other and establish a friendly and trustful relationship needs to come before any collaboration is possible. After getting to know each other, then, they can engage in conducting tasks and joint assignments.

The collaboration between the teams have been kind of a challenge, and how we relate to one another, getting to know

one another. [...] So getting to know them in a so short period of time have been kind of a struggle. (Int 2)

Students with a relationship-driven approach viewed the relation between all group members as important. They reported that everyone needed to be heard, and that all members' ideas should be acknowledged as equally important. Making sure to include suggestions from all group members were considered essential in teamwork. In situations where group members felt that their ideas were not taken seriously or had little impact on the teams' choices, they talked about inequalities and even discrimination.

He feels they also suppressing him, because if he comes up with additions, they take decisions as a whole, and then he is forced to agree, because majority over minority. [...] Because for us it's a multicultural course, so we have put aside the self-mentality, and actually adopted a group mentality. Because group mentality entails teamwork, entails having to accept each other's views and opinions whether they differ. But in the end it's a group, we have to agree. (Int 1)

If the group had decided to go forward with one solution in a course assignment, students expressing a relationship-driven approach, considered it more important to stick with a jointly agreed idea than having a few team members work extra to develop a solution that potentially could provide a better result. Doing the work together and distributing tasks fairly was seen by the students as good teamwork.

Because I haven't seen us fighting over, you did not submit. Because it helps sharing the duties equally. It works for us, sharing things equally, just equally, it works well for us in our group (Int 3)

During a group interview one student talked about how he pictured teamwork: *You have to brainstorm all the time, in every stage (Int 6)*. The same student also shared that his experiences of the group collaboration during the course were different from how he had imagined it to be:

We're also doing things independently. It's different for me, because when I thought about project, I got an understanding, that every matter has to be discussed together. (Int 6)

During another group interview one student gave her explanation to why she experienced the teamwork in the course to be different from her previous experiences:

Yes, the teamwork, comparing it with [our university's] lectures, usually the teamwork with other students, it is usually school based. If we have a task we do it at school and that's it. But with this course we do it at home. We still have to communicate with your group. You still have to do something that communication throughout the whole school, you still have to communicate with your group. Which is positive because you always have, you always improve anyway. Yea, up to date with assignments and stuff. (Int 5)

During a third group interview another student shared a similar experience, but from the perspective of being used to having a task-driven approach:

We are more used to knowing that we have to do certain things individually between meetings. [...] They don't understand why we do things on our own. And then, when we do things on our own, they feel that we are not collaborating. (Int 6, group)

One aspect that was brought up by several students as a tension between the relationship-driven and task-driven approach was how they understood anchoring of ideas before coming to team meetings. The task-driven approach included an understanding that teamwork required individual work between meetings, and that new discoveries during such preparations could be discussed with a few peers in the team, before bringing a new suggestion to the whole team.

In one particular instance, group members at one site came up with a 'contingency plan' of how to address one issue where they thought that the agreed team solution were not applicable according to stakeholders. In an effort to improve their joint assignment that should be handed in the next day, they continued the conversation after team members at the other campus had left their joint discussion. The experience that some group members had 'gone behind their backs' of other members and what was jointly agreed by the whole team lead to that one group split into two. Regarding the importance of sticking to the agreed plan, one student said:

I just felt like, we are not doing, we are losing the hope, the whole point of the group, of the collaboration of the project. (Int 2)

Time management was perceived as 'following the teachers' instructions' and keep the given deadlines for submitting assignments [and not viewed as a self-directed process]. Time management was also thought of in relation to the other group members.

We talked about time management. Like if we agreed to meet we should be there on time. But it's a challenge, even though we are full time students, some of us work part time. So everyone is not home at 7 pm. Maybe I'm working until 10 so then is when I find messages and can comment. For us, if I'm not at school, I'm at home or voluntary work. (Int 1)

The students' ways of addressing potential conflicts included showing an understanding for each team members' life situation. The students with the relationship-driven approach regarded consideration of peers' personal and private life important in teamwork.

Because all along we have our WhatsApp group. We have to notify each other before we go to the lecturer. We cannot just go to the lecturer and say, Mam, for example, Lucy is not doing the work. I have to talk to Lucy first. Lucy why you don't doing your work. Get to her first, get to her reasons, maybe she is facing a lot. Maybe she's having problem at home. I don't know, maybe she has lost her life, these things happen. So it's better to hear someone out. Specially working as a team. Working as a team, we're having a relation. We have sort of relationship, that is what I say. That's why we have to communicate. (Int 3)

The above quote also shows that the students wanted to keep their issues within the group and not involve the course management.

V. DISCUSSION

When students engage in multicultural teamwork they experience not only unfamiliar norms and approaches but they also become aware of their own taken for granted perspectives. In this study it became clear that the students' views of how teamwork should play out differed and that they approached the collaboration focusing on tasks or how to maintain good relationships in mind. Several students made

broad generalizations regarding cultural norms and emphasized the differences between African students and 'other' students. Some students perceived that the different team approaches were associated to 'being African', or 'way of living in western societies'. However, Africa is a big continent and, furthermore, the majority of students came from countries outside 'northern Europe', such as Asia and southern Europe, which are parts of the world where students are known to be relationship-driven during collaborations. It is therefore likely that the students' experiences of differences in culture rather relates to expectations that prior studies in their local education context form, and, how well they were familiar with the conditions set by the hosting University, such as requirements in this kind of project work. In this study, the students' experiences can be explained by a typical case of in- and out-group thinking [9]. This, 'us-and-them' were initially defined by the two different sites, rather than culture or ethnicity. Throughout the course, the students were asked to reflect upon differences due to culture. This was made in relation to this study, but also as one way for the teachers to acknowledge potential tensions due to different norms and unspoken rules that could arise during the teamwork. It is likely that these recurrent questions regarding multicultural collaborations evoked the students' thoughts about differences rather than similarities and jointly agreed norms. Most students reported that they felt like one team when they could communicate frequently and more flexible with the use of WhatsApp.

Theories regarding group development suggest that working groups put together to perform a task need initial time to get to know each other [15, 28]. This initial phase can be short, or take longer time. In addition, group size matters as it affects the likelihood of establishing interpersonal connection between all team members and communicate effectively. In recognition of previous findings, teams in similar challenge-based courses should not include more than eight members [11]. Furthermore, research regarding collaborative learning online suggests that students' attitudes and satisfaction are statistically connected to how well they succeed in communicating and creating group cohesion, and that knowing your peers, such as their personal beliefs and learning styles matter [13]. The students in this study participated in one day team development exercises in the beginning of the course. However, the students did not seem to link these team exercises to their teamwork during the course, but rather to group work in general. This implies that team development exercises could be performed not only in the beginning of the course but also during the project work. In addition, such exercises should be connected to the tasks that the students perform and give opportunities for students' meta-reflections regarding collaboration skills and what they have learned about teamwork. With extensive work regarding team development in various organizational settings, Wheelan too, argues that activities aimed at enhancing teams' performances should be linked to the team purpose and task at hand [11, 19]. Kuipers [29] studied teams' performances in industry and argues that there is a need for balancing the soft and the hard aspects of teamwork. Too much emphasis on team development and harmony – the softer approach – he argues, risks leaving the outcome with too little result. The hard approach, on the other hand, includes an emphasis on measuring and steering towards the objectives. When planning and control becomes a goal in itself, it leaves little room for teamwork creativity [29]. Engineering teachers are

not expected to be 'team developers'. Finding the right balance between supporting interpersonal relations and emphasizing that students' perform in accordance with tasks and goals, is one challenge where teachers could benefit from having a colleague as a critical friend to exchange ideas with when students seem to need additional support to progress in their teamwork.

Understanding the findings in this study through the lens of socio-culture theory of learning, means that the students' views of teamwork and the tensions they experienced reflects not only multicultural collaboration as in 'coming from different countries'. Rather, it shows to what extent the students understand the specific course setting framed by the project work, including requirements and expectations. Each student joins the course with previous experiences and thus expectations of what collaboration means and how teams should work and perform together. The students that joined the two-year masters in the European University had previous training in how to work in projects according to the procedures at the host University. To them, developing shared norms with the remote students was a new experience, as was this particular form of challenge-driven pedagogy where they addressed real-life challenges provided by external stakeholders. However, they were familiar with the course requirements of how to plan and manage a project performed in teams. Whilst, for the distance students enrolled at the African university, performing the project work according to the norms of the 'host university' was new and came with several unexpected requirements. Team skills training and students' engagement in problem-solving are recognized as important in ongoing reform of engineering education in several countries [30]. In light of the findings in this study, and as others suggest, additional models of how to collaborate in multicultural settings may be needed.

In the current study, several factors associated with the digital infrastructure may from an outside perspective be seen as unfair between students situated at the different Universities, and are likely to have caused frustration. The limited and unstable internet connection, expensive data usage versus stable and often free or affordable internet and data usage, are examples mentioned in this study. However, from the students' perspective this was perceived as a fact of life that can be managed by finding alternative solutions. Most students seemed satisfied with the solution to communicate via WhatsApp, although they believed that conflicts could have been avoided if they could communicate more frequently using methods other than shorter texts. Communication skills are often part of engineering training and include how to perform written academic texts and presentation skills, as well as, how to listen to others and awareness of non-verbal expressions during verbal talks. However, with a new generation, and increased flexibility enabled by digital technology, such training could acknowledge how to communicate effectively via mobile/ short text messaging in a multicultural environment. Short communication often rely on symbols and 'smileys'. In this study, the students perceived that short text messaging was one factor that slowed their project progress and created misunderstandings.

The findings in this in-depth case study can shed light on some of the issues that teachers and students may encounter in similar course settings. In the current study, challenge-based pedagogy was addressed but the findings are likely to be transferable to other multicultural contexts where students

perform teamwork online/blended. The result of a qualitative single-case study is not meant to be generalizable, rather new insights and characteristics of students lived-experiences are brought forward. Future research is needed to investigate if the different approaches to teamwork found in this study is valid at large scale. Furthermore, being aware that alternative digital solutions initiated by students may be beneficial and needed, and that teamwork may be regarded in more or less cooperative-collaborative ways can help foresee and prevent issues when organizing similar education initiatives between universities. It is immanent that engineering education continue to include learning that address global sustainability issues, and that teachers and students continue to be engaged despite unfavorable circumstances or tensions that arise. Some of the challenges experienced by students in this study can be prevented in similar course settings. However, more studies are needed regarding the conditions and factors that can facilitate collaborative learning in multicultural and blended environments when students aim to develop solutions for a better world.

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