

# Building Intercultural Competencies through Virtual Teams in Engineering Education

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**Abstract:** In an increasingly complex, interconnected, and globalized economy, engineers require intercultural competencies. This paper describes a unique international experience program composed of students and faculty from multiple universities and engineering firms, in which student teams collaborate on technical projects. We investigate students' understanding of intercultural competencies to ascertain the impact of our program on their perceptions of intercultural values and virtual teamwork. We discovered that integrating intercultural content with virtual international projects was a successful approach for helping these students build intercultural competencies and expand their engineering project knowledge and experiences.

**Keywords:** Collaborative Learning, Intercultural Competence, Global Virtual Teams, Engineering Education

## Introduction: The growing need for intercultural competencies in engineering

Beyond technical skills and domain knowledge, future engineers require intercultural competencies and collaboration skills to succeed in an increasingly diverse and interconnected global economy (Downey et al, 2006). Globalization trends, technological advancements and the recent COVID-19 pandemic have accelerated the rise in global engineering projects with multicultural virtual teams. However, diverse global teams often encounter cultural differences, which can lead to poor social integration, mistrust, and conflict (Han and Beyerlein, 2016). Thus, we must prepare future engineers with intercultural competencies that can help them communicate in culturally respectful ways and make inclusive decisions. Our research takes advantage of a new global engineering program and investigates the development of intercultural competencies by participating engineering students from various nations who collaborate on engineering projects while working in virtual teams. We report early-stage findings from a study of the development of intercultural competencies within this program.

## A Virtual International Experience Pilot Program

This study was situated at a large university in Canada, within a new program where virtual teams of engineering students are engaged in international cross-institutional partnerships to conduct technical projects. The study included 7 virtual project teams involving 20 engineering students from 8 universities and 1 industry partner. Each virtual team comprised 3 - 5 students and their supervisors. The students from over 10 countries were self-selected and represented diverse engineering fields.

## Design framework

The design of our intercultural curriculum was guided by the Knowledge Community and Inquiry model (KCI) which provides a set of principles for learning community curriculum (Slotta, Quintana & Moher, 2018). Working in a KCI curriculum, students engaged in collaborative knowledge construction related to virtual team working and intercultural communication. Their knowledge artefacts (e.g., presentations, discussion notes or survey responses) are aggregated to form a community knowledge base that the students regularly referenced and, which reflects the community's growing "voice" and resources about intercultural understanding, and perspectives.

## Learning activities and materials

The 4-week curriculum was delivered through a blend of social and collaborative project-based learning using Microsoft Teams, and Zoom. Students engaged in asynchronous and synchronous learning, which featured interactive lectures and guided collaborative small group discussions. The goal was to help students reflect on their prior knowledge and experiences, work in groups to co-construct new intercultural understandings and apply their learnings to improve intercultural communication and team effectiveness in their virtual teams.

## Data collection and analytic approach

The study employed a mixed method approach. Data included pre- and post-survey responses, asynchronous discussions, responses to inquiry items, and observation notes. The pre-survey collected information on students' background and cultural orientation. At the end of the learning program, students were surveyed about their overall impressions of the course and addressed specific open-ended questions about their experience in virtual teams. Content analysis examined patterns in students' experiences and their perceptions of intercultural learning and virtual team collaboration.

## Findings and discussion

### Pre-survey of students' experiences and cultural orientations

Students' responses showed that *no student recognized the importance of intercultural communication, and only one student identified intercultural awareness as a potential challenge for virtual teams*. Hence, before the program, students did not recognize the importance of intercultural competencies to virtual teams.

### Post-survey and discussion of students' experience (Likert and open-ended items)

Students were highly satisfied with the learning sessions, with 90% rating the intercultural communication and virtual team sessions as "excellent" or "very good" and saying they would recommend the sessions to others. Student feedback revealed four distinct themes, described in the following sections: (1) intercultural awareness and appreciation, (2) diversity, (3) intercultural communication, and (4) trust and commitment.

**Intercultural Awareness and Appreciation.** Students identified cultural differences (e.g., *"weekends aren't the same across the world"*) and their potential impact on virtual teams (e.g., *"different dedicated religious days and workdays that result in compromise"*). Several approaches for improving intercultural awareness were articulated, such as *"Being aware that there are cultural differences and being accepting and understanding of these differences"*, and *"Compromising, so that work is still completed while being respectful to your teammates"*.

**Diversity.** Students indicated an appreciation of the similarities (e.g., *"shared university culture, peer-aged"*), the diversity of team members, (e.g., *"There're some team members that are quiet and some that are the complete opposite which makes the team balanced"*) and the benefits of working in multicultural engineering virtual teams: *"We studied the same concepts, which makes us think in the same way. However, every member provides a different idea based on the many different backgrounds we have"*.

**Intercultural Communication.** Students recognized and appreciated that communication across cultures and geography was essential for virtual teams. Students used technology to promote agency (e.g., *"Ensuring that everyone has a chance to voice their opinion"*), seek clarifications (e.g., *"Asking a lot of questions to understand the tasks better and seek clarification to reduce the number of miscommunications."*), resolve issues (e.g., *"The team has produced very efficient meetings as everyone are willing to help and discuss the problem together"*).

**Trust and Commitment.** To create a sense of community, teams made efforts to build a sense of belonging (e.g., *"We are a diverse team, spanning different continents. We are proud of our chemistry as a team."*). This served to build trust and encourage deeper social interactions. (e.g., *"Each of us is active on the group chats, answering any questions our teammates may have as soon as possible"*), and commitment (e.g., *"When someone has a busier schedule, the team helps by taking on a larger role for that time period, which is usually worked out later"*).

## Conclusions

This program has demonstrated a successful strategy to help students develop intercultural competencies. The international teams provided a basis for our interventions around intercultural sensitivities and virtual teamwork. This was a relatively small-scale study, conducted against the backdrop of the COVID-19 pandemic, but nonetheless demonstrates proof of concept and revealed four themes that were salient to student participants.

## References

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