INTERCULTURAL COMMUNICATION IN A GLOBAL SOFTWARE ENGINEERING COURSE DURING THE PANDEMIC

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Abstract

The importance of intercultural communication skills required for global software engineering has become increasingly more important due to the current pandemic. Cooperative, digital classes conducted simultaneously in two different countries can help students learn the intercultural communication skills necessary to work effectively with team members from different cultures.

Introduction

The advent of the Covid-19 pandemic has interrupted lives world-wide. Students, educators and universities are no exception. Students, who had made plans to spend a semester abroad to gain international experience, have had to cancel their plans due to travel restrictions. Educators, who have been teaching classes in-person for years, have had to adapt to teaching online almost overnight. Universities, as meeting places for discussion and sharing of knowledge, were suddenly emptied due to contact restrictions. Teaching and learning as inherently social processes needed to be adapted to the remote communication dictated by pandemic mitigation measures.

IT professionals may have an initial advantage in adapting to remote communication, namely technical affinity. Use of computers in everyday work can make the changeover to remote communication easier than for those who work in non-technical subject areas. Previous experience in exchanging software modules over online collaboration platforms and discussing ideas via chat forums can be leveraged to keep the channels of communication open, even during lockdown measures.

However, technical capabilities alone are not sufficient for effective communication. Nuances of context, pauses, and facial cues are sometimes more important than the actual words spoken. Written text can often be misunderstood when these cues are missing. Such misunderstandings can be further amplified when communication partners speak different native languages and come from

different cultural backgrounds. Students of information technology need to master both the technical as well as the intercultural skills necessary to communicate effectively with stakeholders in different countries. The acquisition of these skills has been made much more difficult by the travel and contact restrictions to minimize the spread of infection.

IT students from traditionally underrepresented groups may have suffered from above average disadvantages during the pandemic. Women, student parents, students from non-academic families and those from a migration background were already underrepresented in Science, Technology, Engineering and Mathematics (STEM) subjects before the pandemic (Wang, 2017). A lack of financial resources or the need to care for family members made spending a semester abroad more difficult than for traditional students.

One possibility to help students get international exposure without leaving their home countries is to participate in distributed, collaborative courses which take place simultaneously in two countries. The goal of this experiment was to see whether it is possible to conduct a cooperative course in two countries over video conferencing systems during a global pandemic. A special focus was placed on trying to determine whether students from underrepresented groups faced additional difficulties, which traditional students did not. They may need specially focused support to cope with the effects of the pandemic.

This work describes a hybrid, master's level course in global software engineering which was conducted entirely in English by the Ritsumeikan University in Japan and the Nuremberg Institute of Technology in Germany, during the winter semester of 2021 – 2022. First, related work done by other researchers is surveyed. Next, the organization and pedagogic methods employed in the course are described. Then, experiences reported by students and instructors are evaluated. Finally, conclusions and plans for future research are presented.

Related Work

This section provides an overview of current literature relevant to this work. The first subsection covers literature on the effect that the pandemic has had on students and instructors at universities. The second section discusses cultural aspects of international communication.

The Effect of the Pandemic on Universities

A number of authors have discussed the effects of the pandemic on educators and students in STEM subjects during the pandemic. The lightning speed of transition from traditional (in-person instruction) to online learning in engineering education

was investigated by Park et al. (2020). They found out that emotional experiences of students can have an effect on the efficacy and efficiency of remote learning. As a result, the entire educational community should recognize that they have a responsibility to address the intellectual and emotional needs of students, especially when designing remote instruction.

Experiences in converting a software engineering course to an online format during the pandemic were described by Barr et al. (2020). The authors first began by streaming their in-person lectures as online ones by using video conferencing software. Due to the length of the traditional lectures, many students complained of difficulty concentrating for such a long period of time, so-called Zoom fatigue. Instructors achieved better results by breaking longer lectures into smaller "chunks", which mixed live lectures with recorded videos. Another aspect highlighted by the authors was the increased prevalence of uncertainty and anxiety reported by students during the pandemic due to social isolation. Thus, Barr et al. (2020) also emphasized the importance of supporting students' psychological well-being.

Manea et al. (2021) conducted an analysis of the experiences reported by students in Romania. Positive advantages associated with online instruction were reported in both educational and personal areas. The highest rated educational benefit rated by students was the possibility to record, stop, and rewind lectures at any time and from any place. The highest rated personal benefits were savings in time, money and an increase in comfort due to not having to travel to and from the university daily.

Some educators reported difficulties in adapting to remote instruction. Without adequate time or resources to adapt to remote teaching, many educators reported feeling overwhelmed (Johnson et al., 2021). Changes in productivity levels, as defined by the number of scientific articles authored, among university faculty in STEM subjects was investigated by Krukowski et al. (2021). This study found that women and faculty members with young children reported a significant decrease in the number of scientific articles they authored during the pandemic.

Finally, the pandemic has also forced IT professionals in industry to adjust to remote work. Ralph et al. (2020) investigated the effects of the Covid-19 pandemic on the sense of well-being and general productivity of software engineers in 53 countries. They found out that the pandemic has definitely had a negative effect on the sense of well-being and on the productivity rates of software engineers, mainly women, parents with small children and people with disabilities. Especially for these disadvantaged groups, employers need to find ways to provide additional support to compensate for their specific disadvantages.

The Effect of Culture on Intercultural Communication

The role of differing cultural perspectives in intercultural communication has been well-documented by Hofstede, et al. (2010). The authors identified six cultural dimensions, which can considerably differ among people from different countries:

1. Power distance: Attitude to inequalities among individuals in a society
2. Collectivism vs. individualism: Importance of group vs. the individual
3. Assertiveness and achievement vs. cooperation for group harmony[1]
4. Uncertainty avoidance: Fear of the unknown or ambivalence
5. Long-term vs. short-term orientation
6. Indulgence vs. restraint: Enjoyment of life vs. self-discipline

Hall (1990) observed differences between high context and low context cultures. In high context cultures, personal relationships and differing levels of status between conversational partners often play an important role in non-verbal communication. Facial expressions, gestures and pauses can often convey more meaning than the actual words spoken. In contrast, in low-context cultures, written and spoken words directly convey meaning. Because all of the necessary information is explicitly exchanged, communication tends to be verbose and often blunt. Collectivist societies such as Asian countries tend to show characteristics of high context cultures, while western countries, such as Germany, tend to be more individualistic and lower context cultures.

Pedagogic Methods

The course in "Global Software Engineering" described in this paper was taught according to the principles of project-based learning. Krajcik and Blumenfeld (2006) define project-based learning as a situated learning method which allows students to learn by doing. By working on real-world projects, they gain a deeper understanding of concepts by actively investigating questions, posing their own hypotheses and then constructing their own solutions. Kokotsaki (2016) points out that this context-specific, inquiry-based method helps students to achieve their learning goals through social interaction and knowledge sharing. Sharma et al. (2020) found that students who took part in a project-based learning courses during the first and second years of their engineering degrees did better in the third year of their degrees than those who only took part in traditional, instructor-centered lectures. Fioravanti et al. (2018) applied project-based learning to the field of software engineering and experienced that it helped students practice the interpersonal skills necessary to communicate with project managers and real-world stakeholders. Han et al. (2014) found that project-based learning was especially effective in improving performance among students who had previously been identified as low-achieving, which also correlated with student's ethnicity and socio-economic status. Chen et al. (2015) also found that collaborative project-

based learning led to a greater increase in self-efficacy, especially among students from minority groups, who had initially scored lowest on self-efficacy before the course.

Clark et al. (2012) have expressed criticism of minimal guidance pedagogical methods, which include project-based learning. They warn of the dangers of cognitive overload among inexperienced students who lack the basic knowledge necessary to identify and analyze problems on their own. Ertmer and Glazewski (2019) recommend a scaffolding approach to avoid this problem. Scaffolding refers to providing students with additional guidance at the beginning of a project to help them learn to deal with the complexity of structuring a project and to focus on the most relevant aspects of the project. Macleod et al. (2020) showed the importance of scaffolding to minimize potential cognitive overload.

Course Organization During the Pandemic

Two universities which have a long history of cooperation, the Ritsumeikan University in Japan and the Nuremberg Institute of Technology in Germany, took part in the *Global Software Engineering* course which was taught entirely in English. During the winter semester of 2020 – 2021, this cooperation also fell victim to the pandemic[2]. As the pandemic situation improved during the summer of 2021, a new attempt was made to revive the cooperation. During the winter semester of 2021 – 2022, a hybrid version of the course was offered. Eleven students (all male) from the Ritsumeikan University and 16 students from the Nuremberg Institute of Technology (3 female, 13 male) took part. Four students who were physically present in Japan participated in person, while those who were still in their home countries waiting on their visas participated online.

The Nuremberg Institute of Technology returned to face-to-face classes in October of 2021. As the semester progressed however, infection rates worsened. In November, classes in Germany returned to a hybrid format. Students who felt comfortable took part in the face-to-face classes, while others who had health concerns took part online. By December, the infection rates had further increased, so that classes were held exclusively in the online format.

Because this course was taught at the master's degree level, participating students already had basic knowledge of software engineering from their bachelor's degree programs. To support students who lacked experience in intercultural communication, a scaffolding approach was implemented. At the beginning of the semester, each group of students met separately with their instructors in Japan or in Germany. This initial scaffolding session was designed to prepare the students for the coming international cooperation. First, students were first given a short introductory lecture about methods of distributed software engineering, cultural

dimensions, and international communication. Next, students were divided into sub-groups to work on independent case studies. Each group had to conduct independent research into the cultural dimensions of one country, for example Germany, Japan, or Vietnam. At the end of this scaffolding session, each group presented their findings and discussed the implications of cultural dimensions for international projects.

During the second week of class, students from both universities met online for one real-time 90-minute video conference. First, students and instructors briefly introduced themselves. Next, the course organization was presented. Three cross-site groups with students from the two universities were formed, each composed of roughly half the students from the Japanese university and the other half from the German university.

The project assignment for each mixed, cross-site team was to generate a creative idea for a software solution to a common problem: use machine learning to detect anti-social behavior. In this context, anti-social behavior was defined as actions unsuitable to a particular cultural context. Some of the ideas generated by the students were to develop a system to detect hate speech online, to identify litter in public parks, and to advise which type of clothing would be appropriate for certain occasions in specific countries. Each team had to conduct the requirements engineering and system design and develop a functioning software prototype demonstrating their idea. Teams met online for 90 minutes of real-time contact every week. All other communication had to be conducted via online cloud-collaboration software. Students applied the theoretical knowledge on intercultural communication they had learned during the scaffolding session while working on real-world software projects with team members in different countries. They experienced cultural misunderstandings firsthand and had to try out different methods to overcome conflicts and build trust within their teams.

Grading regulations differed between the two cooperating universities. At the middle of the semester, the students from the Ritsumeikan University were required to hold a mid-term presentation to demonstrate the current state of their projects, which counted for one-third of their final grade. The study regulations for Nuremberg Institute of Technology do not allow for mid-term grades. Students from both universities were required to hold a final team presentation at the end of the semester. The final presentation counted for two-thirds of the grade for the students at the Ritsumeikan University but only for one-third of the final grade at the Nuremberg Institute of Technology. German students were required to submit a written project report, which counted as two-thirds of their final grade.

Data Collection Methods

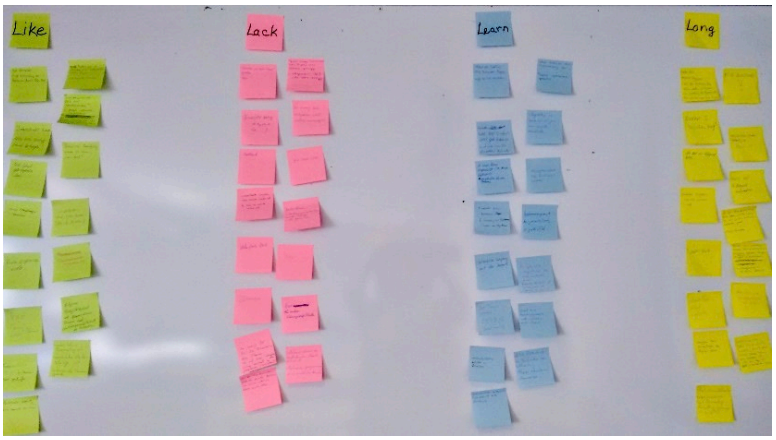
Two qualitative data collection methods were implemented: observation and a project retrospective. During the semester, a student research assistant was responsible for observing and taking notes about the interactions between students and instructors during the common 90-minute-classes.

At the end of the semester, a project retrospective was held. The 4L's method developed by Gottesdiener (2010) is a retrospective method designed for use in agile software engineering projects. The method was originally meant to be used by a small team, with everyone sitting together in the same room. First, each team member is given four sticky notes, one in each color:

- **Like** (green): What did you like about this project?
- **Lack** (red): What did you miss / What went wrong?
- **Learn** (blue): What did you learn during this project?
- **Long for** (yellow): What would you do differently next time?

Figure 1

Project retrospective conducted with 4Ls method



Team members are given a few minutes to fill out their notes in private, so that they are not influenced by peers. Afterwards, each member places their notes on a large board and explains their experiences in each category. This structure should inspire honest, open discussion of both positive and negative aspects of the project, helping each team member learn from the perspectives of the other members and thus improving efficacy and team cohesion for future projects.

By the end of the project in January, contact restrictions made it impossible to conduct project retrospectives in person in both countries. A collaborative, digital

method was required to allow for online participation in the project retrospective. The software program EasyRetro was selected, because it enables the group to conduct a close approximation of the 4Ls retrospective process which can be done online.

Results

In this section, qualitative results of the project observations are presented. First the experiences observed at the Ritsumeikan University and then those observed at the Nuremberg Institute of Technology are described. Finally, results of the online project retrospective are presented.

Experiences at the Ritsumeikan University

Students participating from the Ritsumeikan University faced a major disadvantage during this course. Only four of the students were in Japan and thus, could take part in face-to-face classes. The majority of the students were still in their home countries (China, Korea, or Vietnam), waiting to obtain their student visas to enter Japan. This meant that they could only take part in online classes via Zoom.

Students who were physically present in Japan for the face-to-face classes had the advantage of using a special classroom set up with high quality technology for video conferences. Multiple video cameras, microphones, and split screen technology greatly increased the quality of hybrid instruction in Japan.

The Chinese, Korean, or Vietnamese students were observed to appear quite hesitant in participating in class discussions. This may have been partly due to a lack of self-confidence in their English skills. Furthermore, their undergraduate courses featured traditional lectures, where the instructor conveys knowledge while students take notes to receive this knowledge. Asking questions during class would be considered disrespectful. None of the students from East Asian countries had prior experience with project-based learning. This corresponds to the high power distance between those in authority (instructors) and those with less authority (students) observed by Hofstede (Hofstede, 2010).

Experiences at the Nuremberg Institute of Technology

Students from the Nuremberg Institute of Technology had the advantage that their semester began with face-to-face classes. They had the opportunity to meet the other students and their instructor in real life. Informal communication during class and outside of class, such as in the cafeteria over lunch, greatly increased the sense of camaraderie and helped to build trust between team members. German students suffered a major technological disadvantage in comparison to their counterparts in Japan. As a traditional face-to-face university, the Nuremberg Institute of

Technology did not have the adequate technical infrastructure in place before the pandemic. Pedagogic methods specifically suited to online learning had not yet been developed. As a result, sub-optimal solutions had to be improvised with whatever hardware and software could be acquired.

From the beginning, German students participated vigorously in class discussions, often interrupting their instructors to ask questions. They sent Ritsumeikan University students long, text-filled e-mail inquiries and requests for additional video conferences. The German students became confused when the answers they received were very brief and vague. They reported frustration and doubts about whether their colleagues at the other institution were actually doing any work. They tried to increase the number and length of their e-mails and requested more frequent video calls, hoping that more information would solve the problem. This corresponds to Hall's (1990) observations that people from a low-context culture like Germany tend to miss important, non-verbal cues sent by team members from high-context cultures in East Asia. Facial expressions of the Ritsumeikan students and long pauses during video conferences were often ignored by the German students. The lack of personal contact exacerbated these misunderstandings.

After about half of the semester, some German students noticed that they received the best responses through short chat messages. Chats removed the pressure of having to respond immediately, as in video conferences. Students on the Japanese side could take the time they needed to formulate brief answers.

Retrospective with the 4Ls Method

At the end of the semester, a project retrospective with the 4Ls method (Gottesdiener, 2010) was conducted to reflect on positive and negative aspects of student experiences. Because face-to-face meetings were no longer allowed in January, the online retrospective tool EasyRetro was used. Some of the most common observations are summarized in Table 1.

Table 1

Most common observations from the project retrospective

Like	Lack	Learn	Long for
Working in an international team	Off-site members very shy/quiet	Hard to work with time difference	Asynchronous work across time zones
Creativity of own project ideas	Communication with off-site team	Address team members by name	Inform myself about culture of members
Develop our own project solution	Concrete specifications	Prepare an agenda before meetings	Support informal communication
Freedom to self-organize	Fast internet, better audio quality	Assign tasks to team members	Team-building to generate trust

Conclusions and Further Work

This experiment has demonstrated that it is possible to conduct a hybrid, distributed, collaborative course in global software engineering even during a pandemic. Adequate technical infrastructure to conduct video conferences with high quality audio is a must. Use of cloud-based collaboration software and e-learning platforms need to be adapted to pedagogic methods.

In spite of the increased difficulties caused by travel and contact restrictions, this type of cooperation between universities in different countries can help students gain intercultural experience without leaving their home countries. Further work will explore whether geographically distributed, hybrid courses can benefit students from underrepresented groups, such as from non-academic families, women in STEM subjects, student parents and students who come from a migration background.

Notes

1. Hofstede et al. (2010) defined this dimension as “masculine vs. feminine”, which might be considered offensive by some today.
2. The Ritsumeikan University is an international university, with students from many East Asian countries, such as China, Korea, Thailand, and Vietnam. Due to travel restrictions, none of the foreign students were able to obtain visas to travel to Japan. As a result, many courses were canceled.

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