The International Journal of Management Education 19 (2021) 100512

Contents lists available at ScienceDirect

The International Journal of Management Education

journal homepage: www.elsevier.com/locate/ijme

Cross-university virtual teamwork as a means of internationalization at home

Johannes Nikolaus Rauer [a,*], Michael Kroiss [a], Natalia Kryvinska [a,b], Corinna Engelhardt-Nowitzki [a], Mohamed Aburaia [a]

[a] Faculty of Industrial Engineering, University of Applied Sciences Technikum Wien, Höchstädtplatz 6, 1200, Wien, Austria
[b] Department of Information Systems, Faculty of Management, Comenius University in Bratislava, 82005, Bratislava 25, Slovakia

ARTICLE INFO

Keywords:
Global virtual teams
Intercultural competencies
International communication
Experiential learning
Interdisciplinary teamwork
Telecollaboration

ABSTRACT

In today's globalized world, international competencies and the ability to communicate effectively in global virtual teams are key workplace requirements. To offer university students an opportunity for internationalization at home and simultaneously provide them with the experience of working in virtual project teams, we present a universally applicable international telecooperative project. In this teaching approach, students from different universities and fields of study worldwide collectively solve problems in a simulated business environment and present their findings to a remote professor for grading. The analysis of the pilot testing with 150 students from 26 nations indicates that the participants have recognized the difficulties that can occur when working in international, interdisciplinary, and geographically distributed teams. Rated as a valuable experience by 80% of the participants, the presented online educational concept constitutes an important contribution in the tertiary education sector, especially in situations such as the COVID-19 pandemic.

1. Introduction

International competencies are a key workplace requirement in today's globalized world, regardless of branch, profession, or geographic location. Many companies operate across national or international borders, and therefore, demand personnel that are capable of performing well in a multicultural organization (Taras et al., 2013; Alvarez, 2019; Schworm et al., 2017). For many employees, communication with customers, colleagues, and business partners across international borders is an everyday affair. Research indicates that employing people who possess the ability to communicate effectively with people from different cultures provides real business value and should be considered in human resources development strategies (British Council, 2013; Caligiuri & Tarique, 2012; Rehg et al., 2012).

Another trend in multinational companies is virtual teams (VTs) (Paul et al., 2018; Cathro, 2020; Jimenez et al., 2017). These consist of geographically, organizationally, and temporally dispersed members that collaborate through information and telecommunication technologies to jointly perform tasks (Powell et al., 2004). Global virtual teams (GVTs) are VTs whose members are separated by national borders and have never met each other before (Zwerg-Villegas & Martínez-Dí). Virtual teamwork is increasingly

* Corresponding author.
E-mail addresses: rauer@technikum-wien.at (J.N. Rauer), kroissm@technikum-wien.at (M. Kroiss), natalia.kryvinska@technikum-wien.at (N. Kryvinska), corinna.engelhardt@technikum-wien.at (C. Engelhardt-Nowitzki), mohamed.aburaia@technikum-wien.at (M. Aburaia).

https://doi.org/10.1016/j.ijme.2021.100512
Received 21 September 2020; Received in revised form 4 May 2021; Accepted 5 May 2021
Available online 4 June 2021

important and impacts such as the COVID-19 pandemic have greatly expanded the number of people working in virtual teams. However, insufficient training in virtual collaboration often leads to cooperation-related problems (Lewkowicz & Wijnhoven, 2008; Zemliansky, 2012). Studies indicate that consistent training of all team members positively influences the overall team performance, cohesion and trust, teamwork, and dedication to team goals (Opdenakker & Cuypers, 2019; Kaiser et al., 2000; Powell et al., 2004; Tan et al., 2000; Van Ryssen & Godar, 2000; Warkentin & Beranek, 1999).

Universities are responding to these developments and are seeking to increase the degree of internationalization in their curricula (Schworm et al., 2017; Jurse & Mulej, 2011; Çiftçi, 2016; Engelhardt-Nowitzki et al., 2019) through measures such as using English as language of instruction in courses or including subject matters that explore global, intercultural, and indigenous perspectives (Griffith University, 2011; European Parliament, 2015; Vriens et al., 2010). Events such as the COVID-19 pandemic demonstrate the importance of digitalizing the education system. Having affected almost 1.6 billion learners, the current crisis is the greatest disruption to the education system in history. However, digital learning methods facilitate the continuation of high quality education even in such difficult times (Reimers et al., 2020; United Nations, 2020). University education is not only about teaching content, but also about conveying process skills. The ability to adapt to changing conditions and to constantly expand one's knowledge are increasingly being focused on, in addition to critical thinking, creativity, intercultural communication, and teamwork abilities (European Commission, 2020; Trautrims et al., 2016; Rudman & Kruger, 2014). Internationalization of curricula (IoC) at the course level is one of the most effective methods to foster the global awareness and intercultural competence of students (Griffith University, 2011). However, researchers have also emphasized that intercultural education needs to be accompanied by cultural immersion. Cultural intelligence—the ability to gather, interpret, and act effectively in situations characterized by cultural diversity (Earley & Ang, 2003)—is enhanced by first-hand cross-cultural experiences (Earley & Peterson, 2004; Taras et al., 2013; Belton et al., 2006).

International student exchange programs are often presented as the leading strategy for cultural immersion (Griffith University, 2011). However, the 2017 analysis of credit mobility by the Organization for Economic Co-operation and Development (OECD) shows that, on average, only 12% of all students spend time abroad at another university as part of their academics (OECD, 2019). Therefore, different strategies are needed to help local students develop global, international, and intercultural knowledge, awareness, and skills, without having to leave their home country (Griffith University, 2011; Beelen & Jones, 2015). In this context, the term "Internationalization at Home" (IaH) is used, which covers all internationally oriented activities except outbound mobility (Crowther et al., 2000). The very broad definition of IaH also includes global interconnectedness through the Internet (Beelen, 2007). This is called "virtual mobility"—using information and communication technologies to achieve goals of physical mobility without the need for travel (Bijnens et al., 2006; Vriens et al., 2010). Virtual mobility is considered one of the most important innovative aspects of the internationalization of higher education (European Parliament, 2015). The integration of virtual mobility into the curricula of universities is particularly important for the long-term anchoring of virtual mobility activities (Beelen, 2007; Ferreira-Lopes et al., 2018; Griffith University, 2011; Schworm et al., 2017).

In order to offer students the opportunity of internationalization at home and simultaneously provide them with the experience of working in virtual project teams, we propose a universally applicable international telecooperative project. In this teaching approach, students from different universities and fields of study worldwide collectively solve problems in a simulated business environment. Over a span of two weeks, the student teams discuss real-life business problems, develop solutions, and present them online to a professor for grading. Challenges arise due to the geographical distribution across national borders and time zones, the different cultural and professional backgrounds of the team members, and language barriers. Students learn to establish contact with strangers in a foreign language via digital communication channels, define and use tools for collaboration, and set up a simple project management strategy for working in a virtual team. They have to explain complex topics belonging to their field of study to their colleagues in English, combine technical and strategic aspects of the given tasks, make joint decisions on business problems, and present their findings in a video conference. They learn to work together in geographically distributed and disciplinary and culturally diversified teams in a solution-oriented manner and to confidently deal with international and intercultural dissonances (Zwerg-Villegas & Martínez-Dí; Easton, 1992; Engelhardt-Nowitzki & Blahota, 2014; Heath, 2006; Taras et al., 2013; Trautrims et al., 2016).

The described teaching project is an experiential learning activity. This means that the participants learn through the experience that they acquire through their collaboration and reflection on their collaborative endeavors (Kolb, 1984; Kolb & Kolb, 2005). The cooperation resembles a real-life work environment. Instead of the creation of a valuable result or the acquisition of specific content knowledge, the experience gained through the process is considered paramount (Herrington, 2010). Students are confronted with a complex real-life problem and have to employ their content knowledge for problem-solving, which is highly practical and extremely relevant for job training (Saatci, 2008). The virtual approach makes the project particularly cost- and time-effective (Zwerg-Villegas & Martínez-Dí; Clark & Gibb, 2006; Gavidia et al., 2005). Research indicates that both teachers and students displayed very positive sentiments towards this teaching concept (Popescu & Warmenhoven, 2019; Alvarez, 2019; Helm, 2015; Taras et al., 2013; Zwerg--Villegas & Martínez-Díaz, 2016).

The telecooperative GVT project presented in this article is designed to provide the basic framework for executing the project and can be equipped with assignments and tasks tailored to the participating study programs. It has been piloted with 150 students from across 26 nations and five universities. Their fields of study ranged from engineering to management and economics. Twenty different native languages and five continents were represented through the participants. The feedback and the performance of the participants were analyzed quantitatively and qualitatively.

In addition to a review of numerous prior works in this area that clearly demonstrate the effectiveness and usefulness of teaching approaches that utilize telecooperation to teach intercultural competences to globally distributed participants, this article contains these two main contributions: This is the first work that applies such a project in an interdisciplinary context across different fields of study (e.g. engineering, marketing, business). We are not aware of any similar research, although such collaboration is common in

companies. The paper shows on the one hand how training of students of different disciplines can be combined in such a project, and on the other hand the evaluation demonstrates that there is an added value in doing it. Secondly, this article describes a structured approach for the realization of such educational projects, and additionally the design of an information processing system which allows such a project to be carried out with relatively little effort is illustrated.

This article is structured as follows. In section 2, similar international teaching projects and their strengths and weaknesses are discussed. A detailed project description follows in section 3, which includes a presentation of the structure of the data processing system developed for this project. In section 4, the results of the pilot project are analyzed and discussed. Finally, the most important findings are outlined in the conclusion.

2. Related work

In higher education, GVTs have been already used as an experiential learning method for teaching intercultural skills. They have been deployed in intercultural training courses (Chuang & Suthers, 2016; Eslami et al., 2019, pp. 263–282), logistics (Trautrims et al., 2016), marketing (Van Ryssen & Godar, 2000), and business education (Ferreira-Lopes & Van Rompay-Bartels, 2020; Walker et al., 2018; GeeBiz, 2020; X-culture, 2020).

The works analyzed have presented no consensus regarding the duration of such GVT projects, the types of assignments, the size of the teams, or the platforms for the execution. Based on an extensive literature review, Ferreira-Lopes et al. (2018) presented a procedure for the structured planning and realization of telecollaborative programs for the development of intercultural competence. The universality of the approach was preserved in order to facilitate the execution of such projects in an interdisciplinary and customizable manner across various higher education disciplines. They applied their method in a four-month-long telecollaboration project, where 85 students from two universities analyzed how a selected international company adapts its business to different cultures. The survey indicated that the project facilitated an increase in the students' intercultural skills and that they appreciated the experience (Ferreira-Lopes & Van Rompay-Bartels, 2020).

A very early work, in which students from two countries telecooperatively analyzed the marketing of a product, demonstrated a similarly positive result; although, e-mails were primarily used for communication due to limited functionality of the internet at the time (Van Ryssen & Godar, 2000). Through his five-week project with American and Ukrainian participants, Zemliansky (2012) addressed students' lack of experience in technical and scientific communication with peers from other countries, cultures, and professions. In another project, American and Thai students worked together with a partner from the other country via a Facebook group and discussed culturally determined influences on topics such as food and the meaning of words (Chuang & Suthers, 2016). Eslami et al. (2019, pp. 263–282) carried out a similar project in which American and Qatari pre-service teachers jointly prepared lessons and reflected on their experiences. All these studies demonstrated overwhelmingly positive experiences.

The award-winning (University of North Texas, 2014) international teaching project, "Globally displaced workgroups: Creating a real world experience in the classroom," was designed to prepare students from the logistics sector for their professional careers. The project has already been carried out several times, most recently with more than 900 students from 15 international universities (Engelhardt-Nowitzki et al., 2019). Students in teams of five are given nine days to work out a solution for a uniquely parameterized logistics problem and present it to a faculty member in an online presentation. The project was carried out using a website that was specifically created for this purpose (Trautrims et al., 2016). Another related study investigated whether this concept can be transferred to an engineering context. It investigated the possibility of constructing prototypes through the international exchange of construction data and the use of 3D printing. Despite the high degree of complexity involved, they concluded that this should be possible (Engelhardt-Nowitzki & Blahota, 2014; Engelhardt-Nowitzki et al., 2019).

International telecooperation projects are particularly prevalent in the field of business education. For example, Walker et al. (2018) successfully carried out a six-week project twice with a total of approximately 600 students of business disciplines from eleven institutions in six countries. The participants had to analyze the web presence and reputation of a self-chosen company and suggest improvements.

Another particularly successful example of the use of telecooperative online courses in business education is the "Global Enterprise Experience" (GEE). The GEE is an international competition that aims to develop skills in managing across cultures, time zones, world views, and levels of wealth. It has been conducted annually since 2004. To date, an impressive 13,000 students from 700 universities in 120 countries have participated. The students are made to work in teams of eight over three weeks to develop a six-page business concept proposal for a given real-life business problem. This project has not been integrated into any course, but can be voluntarily undertaken by interested students, who are incentivized to participate through the offer of prize money (GeeBiz, 2020). All participants are expected to submit a one-page journal describing their experiences over the project period. The evaluation of this data indicated a measurable increase in competence among the students and that 86% considered the experience to be a positive influence in the development of their cross-cultural skills (Gonzalez-Perez et al., 2014). A study that compared the results of the 2007–2017 sessions of the GEE indicated that different technologies have been dominant over the years, displayed a trend towards the simultaneous use of several tools, and showed that students appear to be able to determine which technologies are best suited for which purposes (Cathro, 2020).

Probably the best known international telecooperation project is the X-Culture competition, which has been running since 2010. Every semester, thousands of students and professionals from over 40 countries participate in it. This project is often integrated into the International Business Management courses of universities worldwide. Participation is usually voluntary, but in the event of non-participation, a compensatory assignment is expected to be submitted. Teams of six to eight students from different countries work together over a period of two months to develop a report on a real-life business project solution for a real company, which is

followingly evaluated by multiple independent experts. The students are granted a high degree of autonomy, as is the case in real-life GVTs (X-culture, 2020; Poór et al., 2018). The feedback given in mandatory surveys conducted before, during, and after the project, as well as the performance data of the teams are made available to researchers free of charge. Evaluations of these data indicated that students perceive virtual teamwork as added value to their theoretical education and demonstrated an improvement in various competences owing to their participation (Popescu & Warmenhoven, 2019; Alvarez, 2019; Zwerg-Villegas & Martínez-Díaz, 2016; Taras et al., 2013). Analyses illustrated that students have significantly less cultural difficulties when interacting with others after the project has been completed, which indicates a clear learning effect. Furthermore, students became aware that although they are trained in technologically enhanced communication, the coordination and administration of GVTs are much more complex than expected (Zwerg-Villegas & Martínez-Dí). Participants whose native language is English appear to have an advantage in such projects (Popescu & Warmenhoven, 2019).

Over 90% of participants reported that the X-Culture project was useful for them. The comparison of the student evaluations to the control groups that attended the same course without the X-Culture project indicated that the course with X-Culture was assessed significantly more positively in all dimensions, regardless of the participants' country of origin. The groups who participated in X-Culture also showed a statistically significant increase in their cultural intelligence, understanding of the challenges of working together in GVTs, and course grades. Furthermore, the data displayed a statistically significant decrease in perceived cultural differences—not only towards the cultures represented in the team, but among cultures in general. The effectiveness of telecooperative projects as a teaching method is also evident in the evaluation of data from students who participated several times, who behaved substantially differently during additional attempts. They acted in a more structured way and tended to take the lead, used collaboration tools more efficiently, were more productive in general, performed better, and received higher peer evaluations (Taras et al., 2013).

These aforementioned studies clearly demonstrate the effectiveness and usefulness of teaching approaches that utilize telecooperation to teach intercultural competences to globally distributed participants. However, our research has not found any studies where such projects are used in an interdisciplinary way, as our project does. Numerous projects were implemented without or with very limited use of modern information technologies. On one hand, this generates increased organizational effort. On the other, the systematic use of a website for such projects enables new tasks with distributed information, which makes cooperation and coordination indispensable.

3. Cross-university GVT teaching project

In this section, the concept and the process of the presented GVT teaching project is presented. Subsequently, didactic considerations regarding the assignments, the evaluation concept, and the technical structure of the system developed for the project are discussed.

3.1. Concept of the project

During the implementation of the project, we strongly followed the concepts provided by Ferreira-Lopes et al. (2018); Trautrims et al. (2016); Taras et al. (2013), but arranged the tasks and teams such that students from technical and economic fields can work together. Fig. 1 illustrates the basic concept of the GVT teaching project.

Students from universities worldwide are assembled into internationally mixed teams. Each team receives automatically

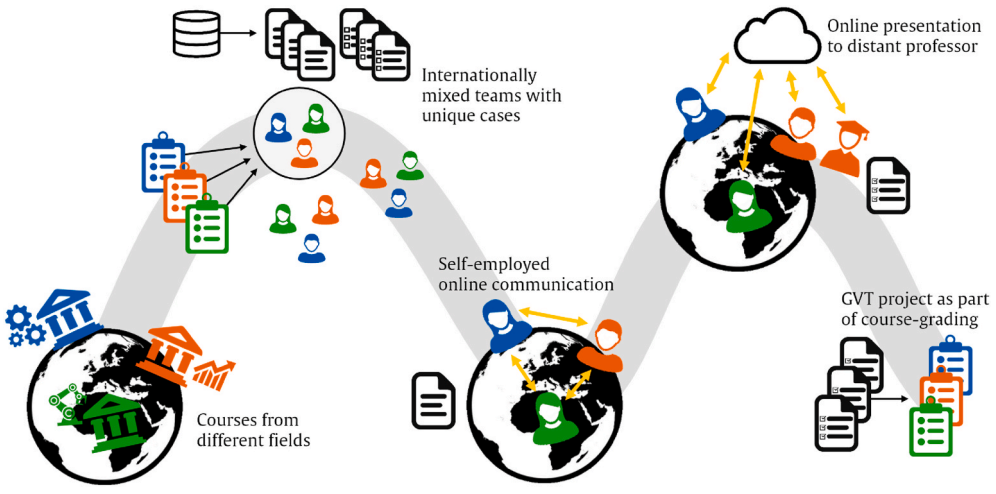

Fig. 1. Concept of the GVT project: Students from universities all over the world are assembled into internationally mixed teams that solve a uniquely parameterized case study within a two-week period and present their solution to a remote evaluator.

parameterized tasks with randomly selected questions from a pool of predefined tasks to create a unique real-world case study for each team. The teams solve their tasks within a two-week period and present their solution to a remote evaluator. The professor assesses the group's performance using a sample solution generated by the system and sends the completed evaluation sheets to the organizers. These are merged with the peer evaluations of the participants and a grade book is resultantly created for each course. The weights of the individual tasks can be changed in this grade book to enable an evaluation that is based on the course content. In addition, each professor can autonomously determine the degree to which the GVT project is included in the students' course grade. The only requirement is that participation must be either mandatory or voluntary in order to avoid a high bounce rate during teamwork.

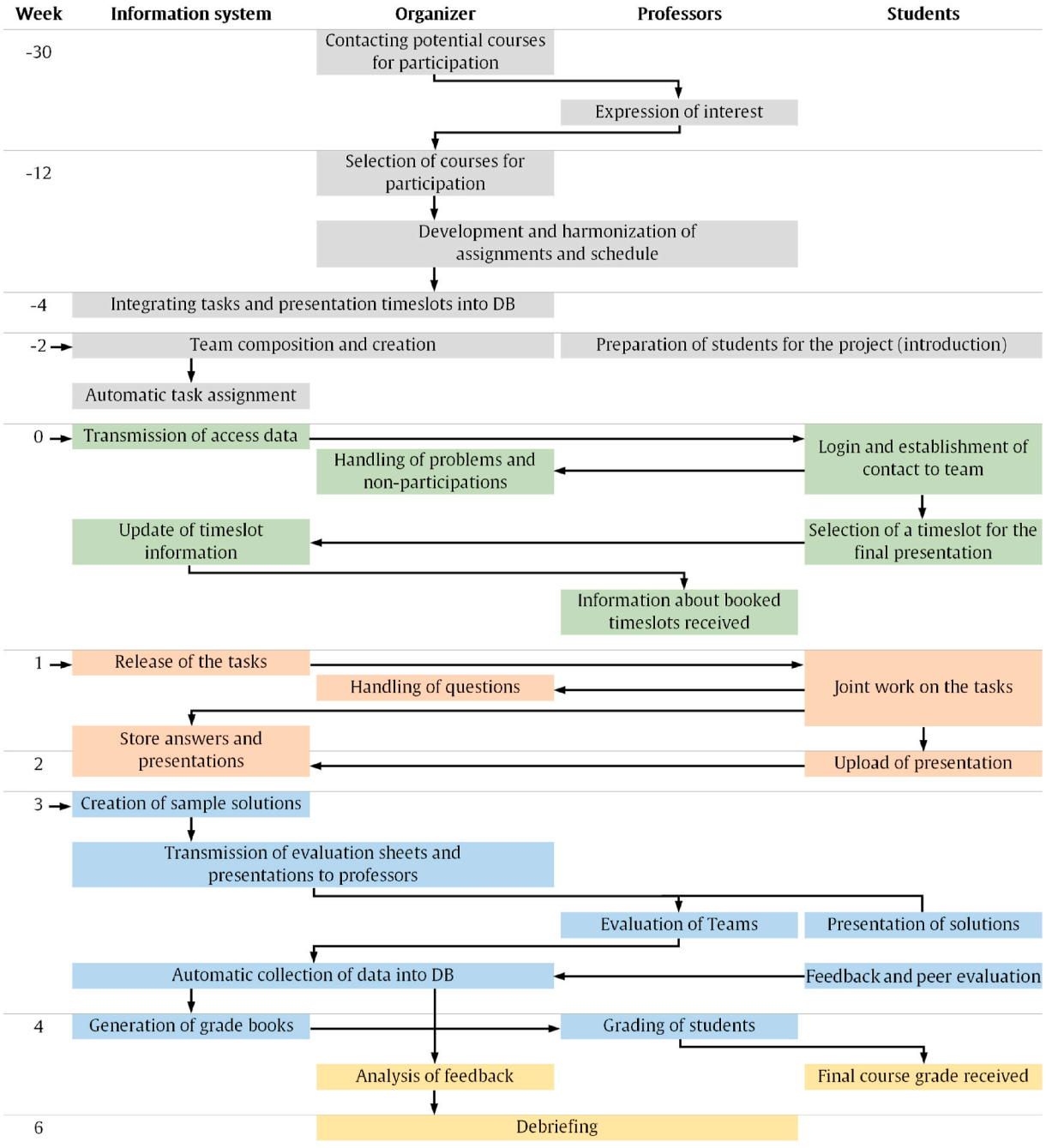

Fig. 2. Course of the project: Involved parties (horizontal), time (vertical). The arrows symbolize dependencies and information flows. The process is divided into preparation of the project (grey), getting to know the team members (green), working on the tasks (red), presentation and evaluation of the results (blue), and post-project work (yellow).

3.2. Course and organization of the project

The course of the project and the activities for the parties involved are shown in Fig. 2. Horizontally, the graphic is divided into the different parties involved (Organizer, Professors, Students) and tasks of the information processing system that are managed by the organizer. Vertically, the time is plotted in weeks, with zero marking the beginning of the students' teamwork. The information processing system is an essential feature of the presented project. A central database (DB) stores all information relevant to the project, such as participants, tasks, submitted solutions, or feedback. The students thus have a single, personalized website, protected by login data, through which they can carry out the whole project and receive necessary information (see 3.6).

In the preparation phase (grey), universities and courses are contacted to solicit their participation. One of the main difficulties is to find courses with professors who are interested in participating and who are simultaneously instructing the course. Due to varying academic calendars in different countries, it is difficult to find a suitable period for everyone (Trautrims et al., 2016). For the selection of courses, interested professors provide the syllabi of their courses, an approximate number of participants, and the possible time frames for running the project. Based on these data, courses are selected and topic-specific tasks are developed in cooperation with the professors. It is important that the tasks for the students are not just a series of arbitrary questions, but follow a common narrative and are related to each other to create a real-life situation (see 3.3). At this point, the professors must also announce possible dates when they are available for final presentations, which can be booked by the teams. All this information is integrated into the information processing system in order to enable central administration and is displayed via the website. The professors send a list with the names and e-mail addresses of all their participants. The students are arranged into interdisciplinary and intercultural teams of four people each, which are created by the information processing system, and automatically receive a randomly composed task description. Before the actual group work for the students begins, all participants receive an introductory presentation from their university professor.

At the beginning of the work for the students (green), they receive an e-mail that contains their access credentials for the website. After logging in, the participants can view the names and e-mail addresses of all their team members and are asked to establish contact and agree on a basic project management strategy and communication channels. They do not receive any further instructions, as this is often the most difficult task. In this first stage, the team members must also agree on a common presentation timeslot during which all participants are available and book it in the online system.

After a week, the teams are provided access to the tasks online and are given two weeks to work on them, discuss opinions, and come to a consensus (red). Their solutions are stored in the database and they have to upload a presentation that outlines their findings.

In the evaluation phase (blue), a sample solution is automatically generated from each team's unique task definition and is combined in an evaluation sheet with the team's stored solutions. The video-chat service Jitsi is used, which means no registration is required for participating in the video conference. The team members meet the professor in the chatroom at the specified time, present their findings, and answer questions. The evaluator enters the assessments in the evaluation sheet and sends it to the organizer, who integrates the scores into the database. After their presentation, the students have to give mandatory feedback and perform a peer evaluation. The result of the peer evaluation and the points awarded by the evaluator are copied into a grade book for each professor. In this spreadsheet, the professor can set the weights of the different tasks and the peer evaluation, which automatically results in a grade for each student.

The feedback is evaluated by the organizer and discussed with all participating professors during a final online debriefing (yellow).

3.3. Assignments and case description

The nature of the tasks has a significant influence on the motivation of students and on the learning outcomes that can be achieved. The assignments must not be too simple, but should also not require the acquisition of new subject knowledge, so that the focus remains on the development of intercultural skills and teamwork. In order to make free-riding difficult, it should be ensured that a joint effort is necessary to solve the tasks (Trautrims et al., 2016; O'Dowd & Waire, 2009). Since students from different disciplines are involved and communication among team members is the main focus of the project, the tasks are intended to be relatively easy to solve for students that possess expertise in that area. The GVT teaching project aims to make students share their field-specific knowledge with other team members who lack it. This improves their language skills and develops their ability to work together in interdisciplinary and intercultural teams. The combination of technical tasks with economic considerations reflects everyday life in real companies, allows students to look beyond their own professional horizon, and encourages interdisciplinary thinking. During decision-making processes, the participants negotiate in English and are required to jointly find economically and technically reasonable compromises. Situations and processes of this kind are usually not developed during academic life. As a result, most students are unprepared when confronted with them for the first time during their career.

In order to create a realistic and company-like situation, an industry-oriented case study is chosen as the basis for the tasks. This can be divided into three parts: A company description, tasks with access restrictions, and open problems for discussion.

3.3.1. Company description

A company description gives an overview of the environment in which the tasks are integrated: The company involved in the case study is a manufacturing company that produces colored pencils—a simple product that is well known. It is a global company with branches in the team members' countries of origin. The team is jointly responsible for solving all technical and economic problems related to this manufacturing process. All tasks are either related to production or to the final product.

3.3.2. Tasks with access restrictions

A differentiation can be made between tasks with and tasks without access restrictions. The tasks with access restrictions ensure that all team members *must* participate. The online system is configured in a manner where only specific team members have access to certain tasks, thus forcing the peers to interact. For these tasks, technical problems have been chosen which can be evaluated quantitatively, which enables automated evaluation by the system. These are easy to solve for students of technical subjects. The complexity arises from the fact that the solution must be explained to (and understood by) non-technicians in English. The tasks can only be solved correctly if information is exchanged between the team members.

3.3.3. Open problems for discussion

The other group of tasks are open problems for discussion. These are several questions and tasks that are categorized into a general topic, which are specifically designed for the participating courses but remain related to the presented production line. The information processing system is structured in a manner that enables new task categories and questions to be easily integrated into the database. As a team is created, random questions from each category of tasks are automatically assigned to it. In addition, the parameters in questions can be automatically varied within certain limits or assigned from a table of possible parameter sets. This ensures that each team receives a different case study.

Four different task categories have been created for the GVT project. In the category **production optimization**, the team is given production parameters and ask to calculate different characteristics and discuss possibilities for increasing the productivity and profitability. Therefore, the students have to explain the terms and combine economic considerations with technical feasibility. During the **risk assessment**, possible technical and economic problems are to be identified and evaluated with an FMEA (Failure Mode and Effects Analysis). Thus, one's abilities to participate in interdisciplinary discussion and provide simple descriptions of complex topics from one's own field of expertise are trained. For the **visualization and analysis of data**, a spreadsheet with production and sales figures is provided. The team must visualize and analyze these data and make recommendations. Country-specific units and different currencies were specifically chosen. For instance, the students could encounter cultural conflicts and be pushed to explore how to deal with sales prices in euros and production costs in dollars. In the **eServices and international marketing** topic area, which eServices would be interesting for the company (economic view) and how they could be technically implemented in the factory are to be discussed. In addition, aspects of the international distribution of goods are to be discussed (e.g. customs, taxes, data protection) and a marketing concept for a given country and target group is to be created. This promotes the discussion of international and intercultural diversity.

Theoretically, the tasks can be completed in any order. However, the presented sequence allows students to first solve the tasks that have access restrictions together and get to know each other. The assignments that follow relate primarily to interdisciplinary and secondarily to international aspects. Only at the end, when the team already knows each other better, intercultural topics such as marketing for women in a certain region, are addressed. This enables a gradual approach to potentially more conflictual topics.

3.4. Evaluation concept

The accreditation of students' achievements is particularly problematic in the case of internationalization measures (Vriens et al., 2010; Bijnens et al., 2006; European Commission, 2020). This is not the case with the GVT teaching project, as the international experience is gained in a course offered in the regular curriculum of the home university. The project represents only a part of the final course grade, whose size can be freely chosen by each professor.

3.4.1. Evaluation sheets & sample solutions

Most of the tasks are not quantitatively answerable, which is why their evaluation takes place at an online meeting with one of the professors who has a total of 30 min per team to listen to the presentation and ask in-depth questions. The teams' sample solutions are automatically inserted into a spreadsheet where the professor can select an evaluation for each question from a drop-down menu and comment on it if necessary.

3.4.2. Peer evaluation

The second component of the grade is the peer evaluation, which is an individual assessment. All students must rank their own performance and that of their teammates, deciding who they think has contributed most to the teamwork. The purpose of this assessment is to reward particularly committed team members and to sanction free-riders. Through this form of assessment, students are an integral part of the grading process and share the responsibility (Trautrims et al., 2016). For the evaluation of the peer evaluations, the average of the grades received by each team member is calculated. Then the highest average of each team is taken as 100% and the other averages of the team members are expressed as a percentage of this score. If everyone in a team has performed similarly, the averages of all team members are approximately identical, resulting in good percentage ratings for all members. If a student has only participated to a small extent and therefore only receives poor assessments from their colleagues, but ranks themselves as the best, the averaging process gives the assessments of the team members greater influence and leads to a lower overall assessment.

3.4.3. Grade books

In the grade book, which is the spreadsheet for the professor, all evaluations of their students are summarized. Each task as well as the peer evaluation are provided with an adjustable weighting factor. This allows each professor to choose how much influence the different tasks and the peer evaluation should have on the final grade. A percentage score for each student is calculated in the

spreadsheet, which can be used to calculate the course grade.

3.5. Feedback & reflection

The mandatory student feedback is collected via the online system and stored in an anonymized form in a database. The students' feedback serves to further develop the concept and the system of the GVT teaching project. On the other hand, the many free text questions are intended to encourage reflection on various aspects, which is an elementary pedagogical component of experiential learning activities (Ferreira-Lopes et al., 2018; Trautrims et al., 2016; Van Ryssen & Godar, 2000). The most important results from the feedback are summarized in section 4.

3.6. Technical concept

Research indicates that a well-developed online system is important for the realization of telecooperation projects, which should be adapted to the IT skills of the participants and faculty members in order to ensure a fluent process (O'Dowd, 2013; O'Dowd & Waire, 2009; Bijnens et al., 2006). A sophisticated online system also helps to reduce the coordination effort for the organizers (Engelhardt-Nowitzki & Blahota, 2014).

Therefore, a special information processing system has been developed to facilitate the realization of the GVT teaching project. This system consists of three interrelated components (see Fig. 3).

3.6.1. Database

The central element of the system is the database, which manages all information—user data, tasks with access rights and sample solutions, student submissions, presentation timeslots, and the answers to frequently asked questions. A central location for storing all data is advantageous because information can be easily created, changed, or expanded without the need for any programming modifications to the online system or the administration tool.

3.6.2. Administration tool

The administration tool serves as an interface to the database for the project organizer. It is a Python application with a simple graphical interface based on Qt, which depicts the processes necessary for the execution of the project. The participating professors are not given direct access to the administration tool, but are provided with information by the organizer.

3.6.3. Online system

The online system is responsible for user interactions. It is a PHP-based web server that displays the information from the database as a website in a way that users can easily comprehend. It consists of the following core components:

- Login: The users must log in with their access data that they receive by mail
- Guide: The schedule of the project is presented and hints are given regarding which activities should be carried out when and how
- Administration: Users can view information about their team colleagues, select a presentation time slot, and upload their final presentation
- Tasks: All tasks are listed and supported with images
- Help: The frequently asked questions are displayed and the organizer can be contacted
- Feedback: Displays the feedback and peer evaluation survey

The page with the assignments is activated for all students simultaneously after one week of the project is completed. Similarly, the feedback page is only accessible after the final presentation has been conducted.

3.7. Data protection & privacy

The GVT teaching project involves students from different universities and countries. Data processing systems are used and personal data and evaluations are stored. Therefore, the data protection of all participants must be focused on.

In order to ensure a high level of legal compliance, a declaration of consent is obtained from all students and professors via the

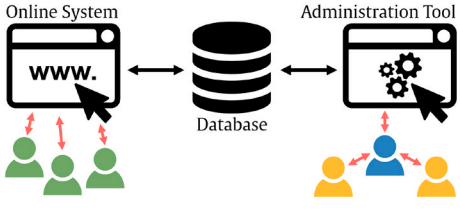

Fig. 3. Technical system design: The participants (green) interact with the information from the database in an online system. The database is administrated by the organizer (blue) and information is exchanged with the professors (orange).

online system, which provides information on the collection and use of data. Furthermore, technical precautions are taken for data protection. Student feedback is stored in the database without user identification, which renders it anonymous. The video conferencing service Jitsi is used for the final presentations. This service complies with data protection regulations and does not require user registration. The evaluations of all students are only visible to the organizer. The professors receive a list of the performance of the students in their course only. In addition, all personal data is anonymized after the end of the semester. The names are replaced by random numbers and e-mail addresses are deleted.

4. Results & discussion

This section describes the pilot testing of the project and the feedback that was obtained.

4.1. Pilot testing

Five courses were selected for the pilot testing of the project in spring 2020. However, the number of participants was not limited in general. A total of 150 students from the following courses took part in the pilot project:

- UAS Technikum Vienna (Austria) – Mechatronics/Robotics
- Comenius University Bratislava (Slovakia) – Management Information Systems
- National Formosa University (Taiwan) – Students from various courses who applied voluntarily
- University of Vienna (Austria) – eBusiness and Service Science
- University of Lodz (Poland) – Systems for Enterprises

As the courses were offered especially for incoming students at two of the universities, a total of 26 different nations were involved in the GVT project. Of the participants, 79% originated from Europe, 18% from Asia, 2% from Africa, and 1% of the participants were from South and North America respectively. A total of 20 different native languages were represented by the participants. The most frequently mentioned mother tongues were German (42%), followed by Chinese and Spanish (13% each), Polish and French (7% each), and Arabic (3%). An attempt was made to create teams as diverse as possible. Nevertheless, it cannot be ruled out that several people with knowledge of the same language (other than English) were in one team, but the data show that in no team all people had the same native language. The main goal – to achieve an internationalization experience by working in a virtual project with people from other countries – is moreover also preserved in the case of several students speaking the same language. 138 students participated in the project till its completion and 132 participants filled out the feedback form. Three quarters of the participants were male. The age of the majority of the students (70%) was between 20 and 24 years.

4.2. Value of the GVT project

Only about 40% of the respondents already had international experience prior to the project, and only 8% of them had gained this experience through their jobs. A majority (80%) said that their international experience was enhanced by the GVT project. About three quarters reported they liked or loved working on the project. Only about 4% did not like or hated the work. Other studies report similarly high levels of approval for such projects (Ferreira-Lopes & Van Rompay-Bartels, 2020; Taras et al., 2013).

Of the participants, 84% stated that the GVT project has been valuable for them (Very valuable 32%, Somewhat valuable 52%, Neutral 9%, Not very valuable 5%, Not valuable at all 2%). Three quarters felt better prepared to enter the workforce after participation. Very similar results were achieved in comparable projects: Taras et al. (2013) 91%, Zwerg-Villegas and Martínez-Díaz (2016) 68%, Gonzalez-Perez et al. (2014) 86%. This substantiates the notion that the GVT teaching project is an added value for the students and successfully prepares them for their professional life.

Table 1
Biggest perceived challenge given by students as free text answer. Percentages based on total number of respondents.

Biggest perceived challenge	%
Communication	21
Missing knowledge	14
Coordination	12
Language problems	13
Doing the technical tasks	9
Nothing	6
Doing the business tasks	5
Motivation of team member(s)	4
Finishing in time	4
Making the presentation	4
Unresponsive team member(s)	3
Understanding the requirements	3
Time zone difference	1

4.3. Perceived challenges and learnings

The students were asked to describe what the biggest challenge for them during the GVT project was. Table 1 depicts a categorization of these answers. One out of five participants indicated that communication with team colleagues was the biggest challenge. 14% were concerned that they did not have expertise in all areas, and some also reported coordination difficulties and problems that arose due to communicating in English. Interestingly, cultural differences were not mentioned at all and difficulties due to different time zones were barely reported.

This coincides with the investigations conducted in similar studies. Taras et al. (2013) evaluate the expected and observed challenges before and after their GVT project over several years. The students assumed that cultural differences would be the greatest difficulty and coordination problems the least (28% culture and 16% coordination). However, the real perceived problems were distributed the other way around (3% culture and 35% coordination). Also in other work the problems due to cultural differences were assumed to be more severe than they actually turned out to be (Walker et al., 2018) and it was pointed out that coordination and communication in a GVT are much more complex than people who have never worked in such a team would expect (Zwerg-Villegas & Martínez-Dí; Trautrims et al., 2016).

Some students named a lack of knowledge regarding solving technical or business problems as their main problem. This results from the interdisciplinary character of the project and the fact that the students are not accustomed to working alongside people from other fields. Many of them were working together in an interdisciplinary environment for the first time through this project.

The evaluation of the most important learnings from the project that is displayed in Table 2 reflects the biggest challenges that the students had to face.

Most students reported that they are now more aware of the importance of communication (18%). Many respondents indicated that the project had helped them to improve their English skills and that they had learned a lot about teamwork (in an international group). This is consistent with the results published by Trautrims et al. (2016).

4.4. Technology usage

Collaboration tools are an elementary component of working in virtual teams. The evaluation depicted in Fig. 4 indicates that students often use a variety of different programs and services simultaneously. Only 10% reported that they only used a single program. Every second student used three or four tools, and one in five said they used five or more collaboration tools for the project. Nearly 80% reported that it was easy for the team to decide which tools to use.

The data show that textual and video-based communication was preferred over voice-based channels. It can be observed that programs that the students were already familiar with and had installed or created an account for were used more often. For example, WhatsApp is the world's most frequently used messenger. Every person with an Android smartphone can use all Google services free of charge and everyone with a Windows operating system can use Microsoft Teams. Other research also confirms that students are capable with technology and are more likely to use programs they are familiar with (Cathro, 2020; Trautrims et al., 2016; Zwerg-Villegas & Martínez-Díaz, 2016). In the GeeBiz project, students can enter their mobile phone number and usernames for common services in the enrolment form so that they can be contacted by their team directly on these channels (GeeBiz, 2020). However, in the GVT teaching project, the establishment of communication channels was also designed to be trained in the same way as in real teams, which is why only an e-mail address was provided for establishing initial contact.

4.5. Participants' performance

On average, each student spent about 10 h working on the project. The median was 8 h. The times given ranged from 1 to 85 h. On average, the teams performed better in the technical tasks than in the economic problems that had more international hurdles. However, the students' performance was predominantly good. With equal weighting of all tasks, almost every second participant achieved a score of over 90%. The worst performing team still scored 65%. The evaluation indicates that the size of the team (three or four persons) has no statistically significant influence on the group's performance.

Table 2
Most important learnings highlighted by the students in their free text answers. Percentages based on total number of respondents.

Most important thing learned	%
Importance of communication	18
English	16
Working in an international team	16
Teamwork	15
Importance of English	11
People are different	7
Working in a distributed team	6
International communication is easy	5
Communication with new people	4
Importance of a good team	4

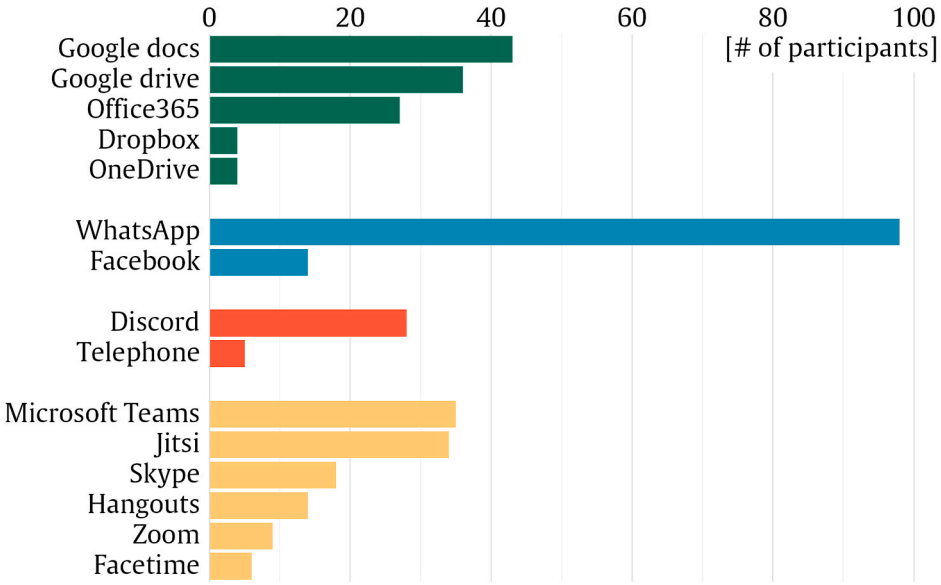

Fig. 4. Collaboration tools used by the participants. Categorization based on primary function of services: File sharing (green), chat (blue), voice-chat (red), and video-chat (orange). E-mail not included due to it being mandatory. Number of mentions by respondents (multiple choice).

We assumed that most students would rank themselves best in the peer evaluation to improve their grade. However, the results show that only 28 participants rated their performance as the top of the team. In 19 cases this reflected the group's opinion as well. Only three students rated themselves as the best despite the remaining members selecting them as the poorest-performing peer. A similar level of self-perception is also evident among the students who ranked themselves lowest. It is also interesting to note that on average, female participants were rated better than their male colleagues, with a median of 85% and 69%, respectively (Average 75% and 66%).

5. Conclusion

The telecooperative GVT project presented in this article is designed to provide the basic framework for the execution of a universally applicable international telecooperative project and can be equipped with assignments and tasks tailored to the participating study programs. It is the first project of its kind that provides international experience in *interdisciplinary* teams and also involves students of technical professions. By participating in the GVT teaching project, students learn to establish contact with strangers in a foreign language via digital communication channels, define and use tools for collaboration, and set up a simple project management strategy for working in a virtual team. They learn to explain complex topics from their field of study to their team colleagues in English, combine technical and strategic aspects, make joint decisions on business problems, and present their findings online.

The analysis of the pilot testing with 150 students from 26 nations across five continents indicates that the participants have recognized the difficulties that can occur when working in international, interdisciplinary, and geographically distributed teams. 80% of the students stated that the case study was a valuable experience for them that increased their international experience. The students realized that the biggest challenges are rarely caused by cultural differences and that good communication and coordination skills and English proficiency are the most important factors in (intercultural) teamwork. To organize and support their work, most teams used multiple tools, preferring video- and text-based communication channels over voice-based tools. On average, the students needed about 10 h to work on the project and more than 50% achieved an overall score of over 90%. The evaluation of the feedback shows that only a negligible percentage of students (8%) had already gained international experience in a professional environment. As this work and other similar studies confirm, the GVT teaching project prepares students better for their future careers. This unique teaching project offers the opportunity to gain experience in working with both international and interdisciplinary teams during university education, which is common in the corporate world but cannot be easily replicated in a single local classroom. Events such as the COVID-19 pandemic have greatly increased the number of people working in virtual teams, making it extremely important to equip students with the necessary skills.

Since the presented project is neither limited to certain subject areas, nor to a maximum number of participants, a group of persons, a type of university or a country of origin, it can be integrated into existing curricula with reasonable effort. The only constraint to be considered in the cooperation with other universities is that all participants should speak a common (foreign) language, so that purposeful teamwork is possible. In future projects based on the system presented, it would be interesting to ascertain how different team compositions in terms of gender, previous education and language skills affect teamwork and the results achieved. It would also be interesting to investigate how these different formations affect the experience for the students, although a larger number of teams would be necessary to be able to make valid statements.

Author statement

Johannes Nikolaus Rauer: Methodology, Software, Formal analysis, Data curation, Writing – Original Draft, Visualization, Supervision, Project administration.

Michael Kroiss: Methodology, Software, Data curation.

Natalia Kryvinska: Conceptualization, Validation, Writing – Review & Editing, Supervision, Project administration.

Corinna Engelhardt-Nowitzki: Conceptualization, Methodology, Funding acquisition.

Mohamed Aburaia: Validation, Writing – Review & Editing.

Acknowledgement

Funding: This work was supported by the city of Vienna (MA23 – Economic Affairs, Labour and Statistics) through the research project ENGINE (MA23 project 22-04).

References

Alvarez, X. P. (2019). The virtual collaborative work and the development of intercultural competences in university student's: The case of virtual global teams. *ACM International Conference Proceeding Series*, 738–744.

Beelen, J. (2007). *Implementing Internationalisation at home*. European Association for International Education (EAIE).

Beelen, J., & Jones, E. (2015). Redefining internationalization at home. *The European Higher Education Area*, 59–72.

Belton, V., Gould, H. T., & Scott, J. L. (2006). Developing the reflective practitioner—designing an undergraduate class. *INFORMS Journal on Applied Analytics, 36*, 150–164.

Bijnens, H., Boussemaere, M., Rajagopal, K., Beeck, I. O. D., & Petegem, W. V. (2006). *Virtual mobility - a best-practice manual*.

British Council. (2013). *Culture at Work - the value of intercultural skills in the workplace*.

Caligiuri, P., & Tarique, I. (2012). Dynamic cross-cultural competencies and global leadership effectiveness. *Journal of World Business, 47*, 612–622.

Cathro, V. (2020). An odyssey of virtual global team activity in the experiential learning environment of the global enterprise experience (gee). *Computers in Human Behavior, 107*, 105760.

Chuang, L. M. L., & Suthers, D. D. (2016). Behavioral manifestations of intercultural competence in computer-mediated intercultural learning. In *2016 49th Hawaii international conference on system sciences (HICSS)* (pp. 2085–2094).

Çiftçi, E. Y. (2016). A review of research on intercultural learning through computer-based digital technologies. *Educational Technology & Society, 19*, 313–327.

Clark, D., & Gibb, J. (2006). Virtual team learning: An introductory study team exercise. *Journal of Management Education, 30*.

Crowther, P., Joris, M., Otten, M., Nilsson, B., Teekens, H., & Wächter, B. (2000). *Internationalisation at home - a position paper*.

Earley, C. P., & Ang, S. (2003). *Cultural intelligence: Individual interactions across cultures*. Stanford University Press.

Earley, P. C., & Peterson, R. S. (2004). The elusive cultural chameleon: Cultural intelligence as a new approach to intercultural training for the global manager. *The Academy of Management Learning and Education, 3*, 100–115.

Easton, G. (1992). *Learning from case studies* (2 ed.). Prentice Hall.

Engelhardt-Nowitzki, C., & Blahota, J. (2014). *Forschungsinitiative AGTIL 2014 - Beiträge zur Stärkung der Veränderungsfähigkeit von Unternehmen*.

Engelhardt-Nowitzki, C., Pospisil, D., Otrebski, R., & Zangl, S. (2019). Virtual teaching in an engineering context as enabler for internationalization opportunities. *Advances in Intelligent Systems and Computing, 1035*, 502–512.

Eslami, Z., Hill-Jackson, V., Kurteš, S., & Asadi, L. (2019). *Telecollaboration among Qatari and US undergraduates in a multicultural course: Opportunities and obstacles*. Springer International Publishing.

European Commission. (2020). *Curriculum guidelines 4.0 - future-proof education and training for manufacturing in Europe*.

European Parliament. (2015). *Internationalisation of higher education*.

Ferreira-Lopes, L., Bezanilla, M. J., & Elexpuru, I. (2018). Integrating intercultural competence development into the curriculum through telecollaboration. a task sequence proposal for higher education. *RED. Revista de Educación a Distancia. Núm, 58*, 31–41.

Ferreira-Lopes, L., & Van Rompay-Bartels, I. (2020). Preparing future business professionals for a globalized workplace through intercultural virtual collaboration. *Development and Learning in Organizations, 34*, 21–24.

Gavidia, J. V., Mogollón, R. H., & Baena, C. (2005). Using international virtual teams in the business classroom. *Journal of Teaching in International Business, 16*, 51–74.

GeeBiz. (2020). *Gee - global Enterprise experience: Global contest in leadership, cross cultural communication, social entrepreneurship and international business*. https://www.geebiz.org/. (Accessed 1 August 2020).

Gonzalez-Perez, M. A., Velez-Calle, A., Cathro, V., Caprar, D. V., & Taras, V. (2014). Virtual teams and international business teaching and learning: The case of the global enterprise experience (gee). *Journal of Teaching in International Business, 25*, 200–213.

Griffith University. (2011). *The GIHE good practice Guide to Internationalising the curriculum*.

Heath, J. (2006). *Teaching and writing case studies: A practical Guide*. European Case Clearing House.

Helm, F. (2015). The practices and challenges of telecollaboration in higher education in Europe. *Language, Learning and Technology, 19*, 197–217.

Herrington, T. (2010). Crossing global boundaries: Beyond intercultural communication. *Journal of Business and Technical Communication - J Bus Tech Commun, 24*, 516–539.

Jimenez, A., Boehe, D. M., Taras, V., & Caprar, D. V. (2017). Working across boundaries: Current and future perspectives on global virtual teams. *Journal of International Management, 23*, 341–349.

Jurse, M., & Mulej, M. (2011). The complexities of business school alignment with the emerging globalisation of business education. *Kybernetes, 40*, 1440–1458.

Kaiser, P. R., Tullar, W. L., & McKowen, D. (2000). Student team projects by internet. *Business Communication Quarterly, 63*, 75–82.

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *The Academy of Management Learning and Education, 4*, 193–212.

Lewkowicz, M., & Wijnhoven, F. (2008). Misunderstandings in global virtual engineering teams: Definitions, causes, and guidelines for knowledge sharing and interaction. *Methods and Tools for Effective Knowledge Life-Cycle-Management*, 145–157.

O'Dowd, R. (2013). Telecollaborative networks in university higher education: Overcoming barriers to integration. *The Internet and Higher Education, 18*, 47–53.

O'Dowd, R., & Waire, P. (2009). Critical issues in telecollaborative task design. *Computer Assisted Language Learning, 22*, 173–188.

OECD. (2019). *Education at a glance 2019*.

Opdenakker, R., & Cuypers, C. (2019). *Virtual project teams and their effectiveness – a design science approach to building a strategic momentum*.

Paul, S., He, F., & Dennis, A. R. (2018). Group atmosphere, shared understanding, and team conflict in short duration virtual teams. In *Proceedings of the 51st Hawaii international conference on system sciences*.

Poór, J., Kollár, C., Szira, Z., Taras, V., & Varga, E. (2018). Central and eastern European experience of the X-Culture project in teaching international management and cross-cultural communication. *Journal of Intercultural Management, 10*, 5–41.

Popescu, F., & Warmenhoven, R. (2019). Use of technology and virtual communication via global virtual teams at Arnhem business school. *Advances in Intelligent Systems and Computing, 783*, 239–248.
Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *Database, 35*, 6–36.
Rehg, M. T., Gundlach, M. J., & Grigorian, R. A. (2012). Examining the influence of cross-cultural training on cultural intelligence and specific self-efficacy. *Cross Cultural Management, 19*, 215–232.
Reimers, F., Schleicher, A., Saavedra, J., & Tuominen, S. (2020). *Supporting the continuation of teaching and learning during the COVID-19 Pandemic*. OECD – Organisation for Economic Co-operation and Development.
Rudman, R., & Kruger, W. (2014). Using a group work project as an educational tool in management accounting education. *International Business & Economics Research Journal (IBER), 13*, 611–627.
Saatci, E. (2008). Problem-based learning in an intercultural business communication course communication challenges in intercultural relationships in internationalizing small or medium-sized enterprises. *Journal of Business and Technical Communication - J Bus Tech Commun, 22*, 237–260.
Schworm, S. K., Cadin, L., Carbone, V., Festing, M., Leon, E., & Muratbekova-Touron, M. (2017). The impact of international business education on career success — evidence from Europe. *European Management Journal, 35*, 493–504.
Tan, B. C. Y., Wei, Kwok-Kee, Huang, W. W., & Ng, Guet-Ngoh (2000). A dialogue technique to enhance electronic communication in virtual teams. *IEEE Transactions on Professional Communications, 43*, 153–165.
Taras, V., Caprar, D. V., Rottig, D., Sarala, R. M., Zakaria, N., Zhao, F., Jiménez, A., Wankel, C., Lei, W. S., Minor, M. S., Bryla, P., Ordeñana, X., Bode, A., Schuster, A., Vaiginiene, E., Froese, F. J., Bathula, H., Yajnik, N., Baldegger, R., & Huang, V. Z. (2013). A global classroom evaluating the effectiveness of global virtual collaboration as a teaching tool in management education. *The Academy of Management Learning and Education, 12*, 414–435.
Trautrims, A., Defee, C., & Farris, T. (2016). Preparing business students for workplace reality - using global virtual teams in logistics and scm education. *International Journal of Logistics Management, 27*, 886–907.
United Nations. (2020). *Policy brief: Education during COVID-19 and beyond*.
University of North Texas. (2014). *UNT professor Ted Farris earns logistics innovation award.* https://northtexan.unt.edu/issues/unt-professor-ted-farris-earns-logistics-innovation-award Accessed: 2020-08-01.
Van Ryssen, S., & Godar, S. H. (2000). Going international without going international: Multinational virtual teams. *Journal of International Management, 6*, 49–60.
Vriens, M., Petegem, W. V., & Achten, M. (2010). Virtual mobility as an alternative or complement to physical mobility?. In *Edulearn 10 proceedings. 2nd international conference on education and new learning technologies* (pp. 6695–6702).
Walker, R. C., Cardon, P. W., & Aritz, J. (2018). Enhancing global virtual small group communication skills. *Journal of Intercultural Communication Research, 47*, 421–433.
Warkentin, M., & Beranek, P. M. (1999). Training to improve virtual team communication. *Information Systems Journal, 9*, 271–289.
X-culture. (2020). *X-culture: An international collaborative project where students work in global virtual teams for two months to produce a business plan.* https://x-culture.org/. (Accessed 1 August 2020).
Zemliansky, P. (2012). Achieving experiential cross-cultural training through a virtual teams project. *IEEE Transactions on Professional Communications, 55*, 275–286.
Zwerg-Villegas, A. M., & Martínez-Díaz, J. H. (2016). Experiential learning with global virtual teams: Developing intercultural and virtual competencies. *Magis, 9*, 129–146.