AC 2012-5541: BEST PRACTICES FOR USING GLOBAL VIRTUAL TEAMS

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Best Practices for Using Global Virtual Teams

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Abstract

Many internationally based business and engineering enterprises are using global virtual (GV) teams to connect and collaborate with international partners. To better prepare students to be successful leaders in this type of international interaction, universities are beginning to add GV teams to their repertoire of learning experiences to develop international outcomes. However, using a GV experience for international collaboration and interaction presents a number of issues and concerns that need to be resolved prior to implementing GV student teams. Using experience gained through GV team projects in an advanced engineering design course, this paper discusses key lessons learned to efficiently achieve successful results. The paper will focus on actions a university engineering program can take to facilitate GV team collaborations with partner universities.

Introduction

Globalization of engineering and business has necessitated collaboration among culturally and globally diverse groups of people [1]. Traditionally this required key company personnel to journey to international locations using expensive and time-consuming travel [2]. To counter the time and monetary costs associated with this travel many companies have turned to using virtual communication tools to contact international counterparts to share information and collaborate [3]. This collaboration requires individuals to have the hard skills needed to perform the required engineering tasks blended with the soft skills that facilitate cross-cultural interactions and the technical skills needed to choose and use appropriate virtual technologies to facilitate these interactions.

Traditionally universities prepare engineering students for the cross-cultural soft skills through the use of study abroad programs [4, 5]. While highly effective at providing engineering students with significant international, cross-cultural experiences, many of these programs are limited by the financial cost and time commitment required of students. As a result few students take the opportunity to interact cross-culturally with international counterparts on one of these meaningful study abroad experiences. In addition, few of these programs require students to learn how to use virtual technologies to facilitate team interactions prior to or during the study abroad experience [6, 7].

GV Teams

Students need to be engaged in a meaningful course of instruction that enables the acquisition and development of the engineering, cross-cultural and virtual communication skills (See Figure 1). Global virtual (GV) teams have the potential to provide students with such an opportunity in both a time and cost effective manner. While it does not carry the cultural impact of an international study abroad program, it does require cultural interactions and facilitates learning virtual communication skills requisite to be globally competent as described by Ball et al. [8]. When completed correctly a GV team experience enhances the educational experience of students and prepares them for participation on GV teams in the work place. Understanding the nature of GV teams is critical prior to integrating them into engineering course work.

GV teams are defined as teams whose members consist of experts from different cultural backgrounds and who use a variety of technologies to work across locational, temporal, cultural, and relational boundaries to accomplish a complex, specific task. Chen, Zhang, Vogel and Zhao [9] indicate that, at a minimum, each GV team has the characteristics of usually working on short-term projects, with team members from geographically dispersed countries, who are interdependent on one another and must establish and maintain a set of team member traits to enable the team to work, via communication technologies, to accomplish a collaborative goal. While GV teams must have many of the traits similar to co-located teams, filtering team relationships through culture and technology lenses requires students to adapt cross-cultural and technology skills to facilitate the team member interaction through virtual communication media. As a result team members must find new ways to build and maintain trust, share documents, organize workflow and tasks, mediate disagreements and reach consensus in a timely manner with other cultures through virtual communication tools. [10, 11, 12, 13]

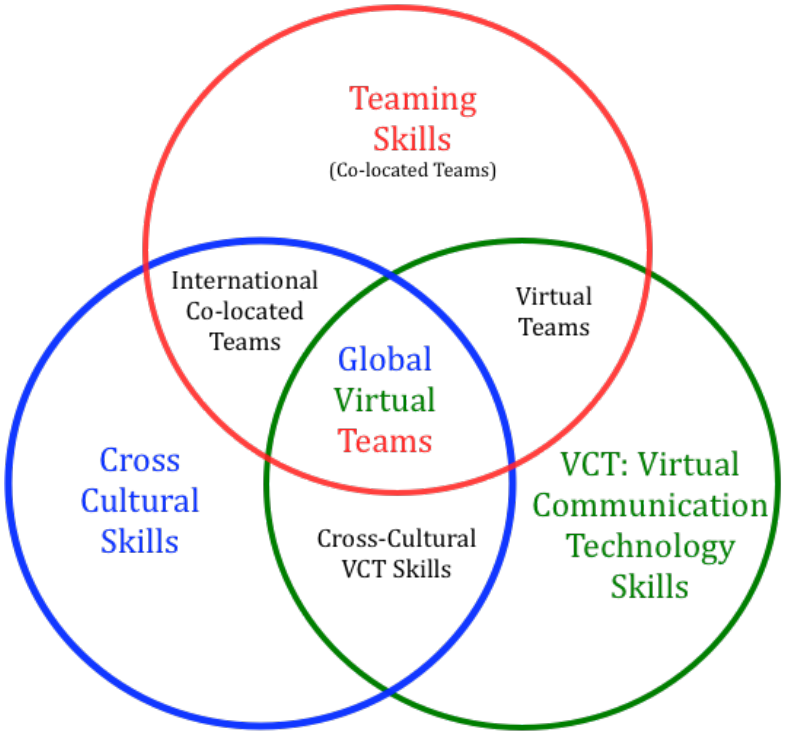

Figure 1. Interaction of team, cross-cultural and virtual communication technology skills to create global virtual teams.

Using GV teams in real world settings is a complex process with no straightforward rules to guide interactions and collaborations [14]. To better understand this complex process and prepare students for GV interactions, many universities are beginning to provide a GV team experience as part of students' engineering education. Merging GV teams into the framework and constraints of higher educational institutions in several countries only increases this complexity. GV team collaborations need to build on inter-institutional relations that professors

have established and maintained. The undertaking needs to be viewed as something that is worthwhile and helps set institutions, faculty, and students apart from and above other programs.

For faculty, GV teams offer the opportunity for a truly unique educational experience with students. It creates an excitement about the college's educational and research undertakings that challenges and draws students to the program and faculty. A GV team experience creates the opportunity for the faculty to establish an appropriate educational and social infrastructure to facilitate the new technologies and collaboration systems [15].

However, the true benefit of a GV team experience embedded within current engineering programs is what it offers the student. Collaboration and learning on a GV team provides students with the awareness, knowledge, and skills to successfully navigate future GV team interactions [6]. It allows students to participate in a GV team exercise working on a real world problem. The experience provides students with the opportunity to come away with a better understanding of what it takes to collaborate successfully with other cultures through virtual communication technology on a GV team [16].

Prior to using a GV team experience as part of course instruction considerable preplanning and agreement needs to take place. This begins with identifying the goal of using GV teams and the specific competencies or outcomes to be taught [8]. Not all global competencies can or should be taught in a single course or program. However, drawing from a broad set of global competencies, the faculty member decides what competencies are best suited and possible for integration into his or her current course. Once the competencies are chosen a learning experience is designed where students have the opportunity to learn and develop the identified competencies. This often builds on existing courses and programs that have the potential to expand into using GV teams. To maximize the success of the GV team experience three stakeholders – the institutions, the faculty and the students – need to identify and understand their roles and responsibilities. Doing so will create a strong atmosphere for GV teams to thrive and succeed. The rest of the paper describes these stakeholder roles and the course structure as determined from research and experience of using GV teams in an advanced mechanical engineering design course offered at Brigham Young Universtiy (BYU) with partner universities in Brazil, Mexico, China, Taiwan, Korea and Canada.

Institutional Support

The support of the institution, including college administration, is critical to the introduction and maintenance of GV teams in course instruction [17]. This support enables institutions to integrate the GV team experience into existing courses. At BYU, GV teams were fully integrated into a pre-existing, locally taught course. Using academic connections from a previous international collaboration (P.A.C.E.), the BYU professor began using GV teams in his mechanical engineering design course. This took an already strong course and added the GV team experience to improve and strengthen it. Administration support acknowledged the additional workload of the faculty member and supplied additional TA resources or other institutional support for the course.

To enable students to gain credit for work in this course, international partner institutions need to integrate the GV team engineering design experience into parallel courses at their

respective universities. The University of Sao Paulo (USP) enrolls students in their "special topics in mechanical engineering" course. Students at the University of British Columbia (UBC) are provided the option to use the GV team design experience in place of the required project in a similar mechanical engineering course [[18]]. This institutional flexibility allows students to receive credit and have the course work show up on their transcript. It also encourages students to put the required effort into course work as the GV experience becomes part of a for credit course. By adding the GV experience on to a currently strong course, the course is improved and evolves into an exercise that represents current efforts in the global community.

If possible it is beneficial for the institution to co-ordinate course schedules with the lead university's lecture and lab times. For example, if BYU is the lead lecturing university and holds class at 10 AM local time, a partner university in the West coast time zone should schedule class time for 9 AM. Similarly, if an institution aligns with the Eastern time zone, their class time should be scheduled for 12 noon. This allows the partner universities to connect live with the instructing university without conflicting with other courses. It also provides the opportunity for cultural interactions during the lecture and lab times. However, this alignment is not always possible because of individual university engineering program schedules and conflict arising with changes associated with going on to and off of daylight savings time (DST). For example, USP initially has a time difference of three hours during North American DST. After BYU switches off of DST (and USP begins DST) the time difference is increased to five hours. This does not always allow for the institutions to align semesters and schedules, but where possible doing so is helpful.

When partner universities have a large time zone difference, the course needs to be recorded so those students can view the materials asynchronously. This limits the in-class cultural interaction, and requires students at these universities to seek help answering questions from team members or e-mails to the professor. However, the asynchronous course material continues to provide the foundations for the GV project to be worked on and completed. This greater time zone difference may also provide students the example of a global, 24-hour factory where someone is always working on the project.

As mentioned earlier, the college administration also needs to devote the required resources and personnel for participation. For example, each institution needs to commit the funds so all have the same engineering software versions and access to virtual communication applications to allow the sharing of documents among students. Students need adequate computer lab space and time allotments to complete assigned tasks. Where student numbers support, the institution may devote institution classroom space designed specifically for GV team interactions. For example, since BYU hosts the course and generally has half of the students involved in the course, four teaching assistants (TAs) split the equivalent of one full time position to teach and assist students in labs and home work questions. Partner universities need to provide commensurate support for their students. This support becomes critical as students learn to use new engineering and virtual communication tools. Technical support also becomes critical as problems with computer systems and applications occur. This support allow students in the GV experience to focus on learning without expending a great deal of valuable time trouble-shooting.

Finally, as GV teams experiences expand into other courses and opportunities for collaboration increase, institutions need to be willing to modify and adapt policies that allow for

greater interaction with other institutions. Instruction involving a GV experience can no longer be viewed as something that is happening within the four walls of the classroom or during the start and finish times of the semester. There needs to be provisions for students to start or end the semester at different times to help align with other institution's semester start and finish times. Agreements and alignments with other institutions also facilitate the sharing of expertise and knowledge of each institution's participating faculty. This sharing of expertise only serves to strengthen current programs of study.

Faculty

Co-ordination between partner schools becomes a primary focus for faculty. Faculty involved in a GV experience need to be aware of the start and finish dates of participating universities as there may be a 2-3 week difference depending on the partner universities. Provisions need to be prepared for some universities to begin course work ahead of others and to help those starting later to catch up with work that has been completed. Holidays, assignments and exams from other courses and of changes in daylight savings time need to be considered. Decisions need to be made to determine how assignments and exams in the GV experience course will be distributed, proctored, graded and returned.

The faculty from each of the participating institutions also forms a GV team. However, their focus becomes the course content, presentation and student completion of course assignments and tasks. Meeting on a regular basis, the lead faculty member will seek input from his or her counterparts on what is working well for the course and troubleshoot for things that are not working as well as desired. This co-ordination also extends to the TAs. In this way minor issues and concerns may be addressed in a prompt and efficient manner. The faculty GV team draws on the experience and expertise of each faculty member to improve how the course is run and what tasks the students need to complete. While this may take the form of a regular meeting, contact may also occur between meetings to deal with emerging issues.

Course instruction may also change as the lecturing faculty member addresses the local and remote classes of students. In some cases he or she may send questions out to international students in advance. This provides the international students with English as a second language the time needed to prepare a response. As the lecturing professor engages local and remote students during the lecture, students gain the confidence to ask and answer questions during the lecture via virtual technology. Engaging international students into the lecture conversation provides some of the rich cultural interaction possible in a GV experience course.

Exams and assignments also become an issue as international students must complete and submit assignments on-line. When an exam needs to be proctored, co-ordination among all institutions becomes an issue as well as time zone differences where some students may take the test hours ahead of others. For the first few weeks of the course, deadlines may be more soft than hard to allow students entering the GV experience time to complete assignments. Co-ordination between the GV team faculty allows for the appropriate handing out, proctoring, marking and return of assignments and exams. This co-ordination also helps encourage international students to complete assignments in an appropriate and timely manner.

For the BYU engineering design course described earlier, all students (local and international) submit all assignments electronically to BYU for grading. In the case of exams, BYU e-mails the exams to the international professors who print off and administer each exam. Once completed, the exams are scanned and e-mailed back to the BYU Professor. The exams are graded, re-scanned (in color) and returned to the international professor to distribute to his or her students. Since the BYU course is often integrated into courses at the international universities, the international professors decide how the exam grades are to be used and weighted for each individual institution.

Faculty needs to be constantly searching for new virtual communication technologies and ways to implement those technologies with those currently in use locally and with partner universities. Student evaluation at the end of the course helps identify which virtual tools were easy to use and practical for solving the assigned engineering problems. This student evaluation serves to improve the GV experience and provides the faculty with insights on how the GV experience may be improved.

Finally, faculty needs to have an eye to the future and consider practices and tools that allow the course to be more fully integrated at each international institution. This eye to the future seeks to develop links with study abroad programs, language instruction and other cultural and learning opportunities that strengthen the GV team experience and, in turn, strengthens the other programs. Students who have had the opportunity to live and work in different cultures, prior to the GV team experience, are better able to adjust and assist team members. In one GV team, Mexican counterparts explained how helpful it was when their BYU counterparts spoke Spanish in the initial meetings. Similarly, the BYU team members were aware of interpersonal actions in Mexican culture and were able to use this knowledge to facilitate team interactions. Both of these factors helped establish a relationship of trust that allowed all team members to fully express themselves during team meetings. This developed into a strong, successful collaboration.

Students

Participation in a GV team-enhanced-course requires a higher commitment than other courses for students. With team members separated by culture, time and distance, it becomes more difficult to establish contact, build relationships of trust between team members. Knowing that all team members are committed to working on the project and course work as a for credit course helps to build trust as students commit the required amount of time to complete assignments. Taking time to understand each other's engineering skills and personal backgrounds, creates the atmosphere needed for trust and collaboration. It is important that students schedule the time to get to know their international counterparts so this trust and collaboration is established early and maintained throughout the project.

It is essential for international students to have strong English language skills and a willingness to expand those skills to include technical engineering terms. It is helpful for English-speaking students to assist the English as-a-second-language (ESL) students with new engineering vocabulary acquisition. Similarly English students with second language skills need to develop those second language skills as they interact with international team members. When students have weak second language skills, it hampers how well the team can communicate with

each other and how fast the team can progress engineering problems. Since many students at BYU speak a second language, it is common practice to match students with students in a partner university with the same common language. This pairing has proven important in the establishment of team relationships and trust.

Course work in a GV team becomes more difficult. Co-ordination of times for students to meet and work together on a common project are difficult. One student, who had Asian counterparts on his team, commented that after adjusting for time zones, class and work schedules, there was only 1 hour each week where the entire team could meet to discuss the project. While this is more of an extreme example, GV team members do not have the luxury of taking several classes together or meeting team members in the hallway between classes as students on co-located teams do. GV team students need to be flexible in establishing weekly contact and modifying workloads and assignments. Students need to co-ordinate local holidays that do not correspond with the holidays of other GV team members and changes that occur in the semester, such as going off of or on to DST. As this GV experience occurs in a school situation and semesters do not perfectly align, GV team members need to discuss, in advance, times during the semester with heavy assignments or exams so project workloads and assignments can be adjusted.

It also becomes critical that students take time to focus on building trust and relationships. For example, as part of the first two labs at BYU, team members must choose a team lead, establish procedures for contact, determine roles of team members and interview one another to get to know each other. This assignment helps to jump start the GV team experience as students are compelled to plan and to get to know one another. Learning new technology also becomes important for team members to communicate and share documents with one another. While the tendency is to focus on the task, team members must take the time to develop on-line relationships with team members they likely will never meet outside of this project. This relationship building becomes critical as the project proceeds and team members require assistance and support from one another during stressful and critical times. It also increases student commitment to the GV team project.

Upon completion of the course students should reflect on what they have gained during the course and what did and did not work for them. Often the course is so busy, students do not realize the skills and new understandings they have gained. Taking a moment to reflect and describe what they can now do or what they now know about building trust and relationships with GV team members helps to solidify their new skills and knowledge. Students can highlight these new skills and experiences in their resumés. Students may also wish to maintain and expand their contacts with international team members through social media such as LinkedIn to build an international network of future engineers.

Finally evaluating the course and sharing the evaluations with the faculty in a constructive way provides the opportunity for the faculty to improve the course presentation and content. As the front line workers and the focus of the course instruction, student insights become helpful for faculty and future iterations of the course. However, these reflections also become important for the students to understand what they now know and what they can do as they move into the work world.

Course Structure

Key to the success of the course is the structure of the course components. Critical questions focusing on the size and make up of GV teams, the choice of technology, how GV instruction is integrated into the engineering course and type of project need to be addressed. Each circumstance is unique it is important to consider whether a structure decision facilitates or hinders the GV interaction and the engineering learning. While the findings below are unique to the advanced engineering class at BYU, they offer insights for faculty to consider.

To facilitate interdependence, smaller teams (between 5-7 members) have proven to be most effective for GV team interactions although larger teams may work with increased faculty guidance. The complexity of the GV project also plays a factor in team size. Instruction on how to help set up team procedures, roles and interactions with other team members helps students begin the GV team experience on a strong foundation.

Instruction on cross-cultural and virtual communication technology issues also becomes important. Several formats are possible. It may be embedded within course lectures in a synchronous manner, but this will force the professor to combine or eliminate original engineering course content to facilitate the new soft skills instruction. It may occur as asynchronous, on-line lessons and assessments, or it may also be a blended experience where lectures are initially presented synchronously but recorded and posted on-line for all in the course to use and review as needed. In each case the faculty member needs to consider the content of the course, how it will be affected by the addition of these GV lesson materials and how both of these may be blended to create GV instruction and experiences.

Currently at BYU 10 principles of global virtual team lessons are presented asynchronously as part of lab assignments. These lessons focus on how team interactions change by using virtual communication tools and cover topics such as establishing GV team protocols, conflict resolution, virtual and cross-cultural communication, GV team leadership, global product design, cultural dispositions and building and maintaining trust. Each lesson, including a brief assessment, takes about 1 hour to complete depending on each student's English language skills and experience. This format allows students to complete the lessons at a time convenient to them. The format also allows (and in some lessons requires) collaboration between GV team members. The pace of completing lessons is determined by the course content, but since several lessons deal with GV team set up, organization and relationship building, more lessons may be completed near the beginning of the course. The current version of these lessons may be found at http://BYUipt.net/PGVT.

It is also important to have a simplified common project for students to work on. Initially, the projects for students were set in real life settings with a broad topic that required considerable research by the student teams. While this served a purpose in the course, it detracted from the actual modeling and analysis that was the focus of the course. To simplify the project, but still make it meaningful and set in a real world setting, BYU now uses radio-controlled cars for students to model. This allows the BYU half of the team and the international partner half to each have the same physical model of a vehicle to reference. It also constrains the project to a workable task given the time, culture and other restrictions of the semester.

Steps to Success

While each GV team experience will vary depending on the institution, the faculty and the students, the roles and responsibilities serve as a checklist to determine if elements are in place for the start up and maintenance of a GV team experience. The steps discussed in this paper are summarized in Table 1 and serve as a starting point for institutions or faculty wishing to use a GV team experience as part of their program.

Institution	Faculty	Student	Course Structure
• Support of institution leadership (Deans, Department Heads, etc.)	• Co-ordination of start/finish times, holidays, lecture times.	• Commitment to complete extra course work in GV experience.	• GV team size and student make up.
• Adjust university policies to reflect virtual instruction & varied semester start finish times.	• GV team meetings with participating faculty to address any course concerns or issues.	• Strong English language skills or, for native English language speakers, second language skills.	• Creation and insertion of cross-cultural and virtual communication technology instruction into course.
• Update and align software, hardware and facilities to accommodate needs of GV courses.	• Review course evaluations from students to determine how to improve course & instruction.	• Take time needed to establish team member relationships and understand team member skills & abilities.	• Modifying instruction to include soft skills and participation of international students.
• If possible, align semesters and course time schedules.	• Distribution & collection of course materials, assignments & exams.	• Establish team roles and procedures.	• Constraints on project size and content.
• Provide resource people for technical support & trouble shooting.	• Search for new technologies and methods for presenting hard and soft skill course instruction.	• Identify and schedule team meetings, local holidays & critical time periods (i.e. mid-term exams).	
• Provide students with credit for course participation.	• Seek for ways to integrate other courses (i.e. study abroad, language training, etc.) into GV experience.	• Take time to reflect on hard and soft skills gained during the course - integrate into resumé.	

		• Maintain and expand contacts from international partners (i.e. via LinkedIn, etc.)	

Table 1. Summary of roles and responsibilities of key stakeholders and course structure in a GV team experience.

Conclusion

Using effective GV teams in engineering courses requires advance planning, course co-ordination and support during the course, and students willing to work beyond normal course requirements. However as institutions and faculty examine the strengths they have in their program and seek to advance those strengths through the use of GV teams, wonderful things can happen. Students grow and develop in ways they had not previously considered. GV team collaboration provides students with a meaningful, but cost effective cross-cultural and virtual team experience. Students and faculty are stretched in their understanding, resourcefulness and abilities. Students also prepare themselves for the global workforce.

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