Teaching a Global Project Course: Experiences and Lessons Learned

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ABSTRACT

In this paper, we describe the goals, organization and content of a global project course we have taught for the last six years, as well as challenges and lessons learned. The course has involved two to four sites and 30-40 students each year, both from Europe and the US. The students form project teams spanning several sites, and jointly perform creative tasks, thus learning both the course substance, as well as how to effectively work together in multicultural and multi-disciplinary distributed teams. We hope that our experiences described in this paper will help and encourage other universities to organize globally distributed project courses. In the future, we plan to continue working with this course, as well as search partners to develop a global software engineering project course together with other universities.

Categories and Subject Descriptors

K.3.2 [**Computing Milieux**]: *Computer and information science education*

General Terms

Management, Human Factors

Keywords

Global project management course, teaching global software engineering, collaborative innovation network.

1. INTRODUCTION

Global software engineering (GSE) has become an everyday reality among software development companies. Many companies have at least a few projects involving remote team members or partners, scattered either across a country or the globe. Running such distributed projects is, however, never an easy undertaking. Instead, it includes additional challenges that a collocated project does not have to deal with [5]. Communication is often seen as the biggest problem in distributed development, since e.g., geographical distance limits face-to-face communication and time-zone differences prohibit asynchronous communication.

In our research collaboration with real-life globally distributed software development projects, we have noticed that collaboration and communication practices that work in practice are often discovered using a trial and error approach [6]. Quite often, young project managers make all possible mistakes listed in the GSE literature. The best GSE projects we have seen have been managed by experienced project managers, who have seen several distributed projects, made the mistakes themselves, and now know how to communicate and collaborate successfully.

We believe that the best way to teach university level students to successfully carry out globally distributed projects is to give them real hands-on experience: the students should work in globally distributed project teams and learn by doing what kind of collaboration and communication practices really work and what does not, and how to work with persons from different cultures. Just teaching in the classroom can never deliver the same experience. Nowadays, we have all the needed tools to arrange courses, during which the students can work in globally distributed teams and develop software together. In our own teaching, we have experience both on arranging a globally distributed project course on a different topic, Collaborative Innovation Networks (COINs), as well as on arranging a collocated hands-on software development project course. We

believe that both these experiences are useful from the point of view of building new teaching on global software engineering.

In this paper we share our experiences in teaching a distributed course on Collaborative Innovation Networks over the last six years. It has been taught every year since fall 2005 to teams of students coming from initially two different universities in Germany and Finland, and subsequently extended by students from North American and Southern European universities. During the course, students study and form COINs [1].

The participants during the academic year 2010-2011 are from the USA: MIT Sloan and Savannah College of Art and Design (SCAD); Finland: Aalto University; and Germany: the University of Cologne. The students have a truly mixed background in business management, arts and design, software engineering, and informatics, just like in real-life global project teams. This seminar course teaches students how to collaborate successfully in today's networked knowledge-based economy. Rather than teaching 'best practices and cases', course participants study the collaborative innovation of online communities on Facebook, LinkedIn, and other online social and e-mail networks, as well as in real-world brick-and-mortar organizations by working hands-on in distributed teams. They use and develop software applications for predictive analytics of online networks and write a final paper. The feedback from our students has been very positive. The course requires a lot of work, but at the same time the students feel that they learn a lot and appreciate especially the opportunity to get to know and work with students from several countries.

2. COURSE OVERVIEW
In this section, we give a brief overview of course organization.

2.1 Pedagogical Goals and Content
The course theme is Collaborative Innovation Networks [1], i.e. online communities that create new innovative artifacts. During the course, students are taught how successful COINs form and work. In addition, the students themselves form project teams that carry out demanding projects, thus forming their own COINS, learning firsthand how to create and work in an online community.

The course has two overarching pedagogical goals:

1. To learn techniques and build and use tools for analyzing on-line communities and networks using social network analysis.

2. To learn how to work in a creative globally distributed multi-disciplinary and multicultural project team.

To meet these goals, the course consists of a set of introductory lectures, followed by group formation and project work by the students, as described in more detail in the next section. The projects students do are quite complex, usually they combine practical application of social network analysis with predictive analytics, by analyzing and making recommendations of the organizational structure of real-world companies, or by mining online social networks to discover emerging trends. Students spend upwards of 200 hours per student in their project work. The course usually gets excellent student reviews, but is known as one of the most labor-intensive courses they have taken during their studies.

2.2 Course Organization and Structure
During the years, the course has involved two to four sites annually. The course is taught by a main instructor, who has assistant instructors at each site. In addition, each participating site provides teaching assistants supporting the students. Each participating university runs the course under their own academic program, resulting in somewhat differing requirements for students to pass the course at the different sites, e.g. with respect to required reading, amounts of credits given etc.

The common part of the course is structured into five phases:

2.2.1 On-site instruction
In the first stage of the course, the main instructor travels to all sites to teach the basic concepts. This is to ensure that the basics are taught the same way, as well as to familiarize the students with the instructor in order to facilitate later non-collocated communication. This also allows the instructor to better take on the role of a connector/gatekeeper during later stages of the course. In one year the main instructor was incapable of traveling to one course location for the introductory block course. For the rest of the course, students from this location never were fully integrated, in fact, out of 12 participants, who started with the introductory block course part taught by Web conferencing, only seven continued, and only one student fully completed all parts of the course. This illustrates that the face-to-face introductory part is essential for the successful completion of the later, virtual modules.

2.2.2 Team formation
After the on-site instruction a set of project topics are presented to the students. The students are then required to choose topics and form teams, with the requirement that team members need to come from at least two, ideally three different sites. Students are free to propose their own topics as projects, although most projects are by now brought to the course by external organizations, who "outsource" a research problem, such as optimizing their internal communication, or doing a trend discovery project using predictive analytics.

Initially, team formation was done in a single videoconference session involving participants from all sites. During the conference, project ideas were presented and the students introduced themselves to their colleagues at the other sites. As conflict resolution and balancing team membership evenly among the different locations was a real challenge, this is now done in two subsequent sessions. In the first one the projects and students are introduced. Students then sign up remotely using Doodle (www.doodle.com), indicating which projects they are interested in, in ranked order. A second video session two days later is used to discuss conflicts and conclusively allocate each student to a team.

At this stage, the teams also set up their collaboration infrastructure, agreeing upon what tools to use for communication, as well as how to use them. Since the course focuses on studying and experiencing collaboration networks, student communication is instrumented, analyzed, and fed back to the students.

2.2.3 Virtual mirror
After collaborating for a few weeks, the student teams are shown an analysis of their own communication behavior (see also section 5.8). This is usually an eye-opening experience, as the students are surprised to see how far their "natural" behavior typically deviates from the best practices of COINs that they have been taught during the introductory part of the course.

2.2.4 Data collection

Next, students work on their selected project, collecting data for later analysis. This stage often includes the development of data collection software, e.g. Web crawlers and other software tools to acquire the data later to be used for predictive analytics. This part concludes with a presentation, where students at each site physically meet in local classrooms, in Cologne, Cambridge, Helsinki and Savannah, to create the feeling of a local community. The classrooms are then connected by Web conferencing.

2.2.5 Data analysis and synthesis

The next stage is the synthesis phase, during which students analyze online social networks, and develop recommendations for improved efficiency and productivity of the organizations or networks they have been analyzing. This part concludes with a final presentation, which is again on-site in one classroom at each location connected by Web conferencing. Finally, the student teams write a seminar paper on their project.

2.3 Communication and Coordination

In addition to the meetings and presentations described above, there are bi-weekly status meetings allowing the instructors to check on team progress and provide advice. Students are free to join these meetings from home using the Flashmeeting conferencing tool. At least one member of each team gives a brief status update and gets instructor feedback.

3. INFRASTRUCTURE

Over the course of the last six years we experimented with many different technologies. The goal is always to use the simplest technology that still does the job. For instance, for video conferencing we mostly use Flashmeeting, which allows up to 30 people to actively participate as "talking heads", but does not integrate synchronized (e.g. PowerPoint) presentations. The presentations are just uploaded on a Google site (sites.google.com/site/coincourse2010), which is used as main shared repository.

When we started the course 6 years ago, Web conferencing systems like WebEx or Adobe Connect were still in their infancy. This means that for the first two years, we were using high-end dedicated video conferencing systems from Tandberg, which had to be run by trained technicians. Fortunately, all of the initially participating schools, Helsinki University of Technology, University of Cologne, and MIT, had dedicated video rooms. There were always problems, however, and although we had learned that we had to test the meeting room connections at least half an hour in advance of the meeting, it frequently happened that we spent another half hour well into the meeting to get sound and video working both ways. By now, fortunately, desktop video conferencing is commonplace and readily available. For video transmission of full classroom sessions (with four parties) we are using WebEx and possible Skype, if voice through WebEx causes problems. We use Flashmeeting for the sessions where students are allowed to participate from home. Flashmeeting is designed to only allow one party at a time to send, which for our course design is of great advantage, as background noise from the other participating locations is cut out easily this way.

The most popular means of communication for project work by far is still e-mail. This has the added advantage, that by simply cc'ing all e-mail communication to a dummy e-mail address we can also collect the social interaction network for later analysis with the virtual mirror tool (see section 5.8). Besides e-mail, students also heavily use Skype, both for voice and chat communication. Particularly for complex discussions and to resolve issues, communication by voice has been found to be most effective. This year, students also started using Facebook groups, sharing ideas and doing brainstorming on the Facebook wall of their group.

To share data, we initially used Mediawiki and Tikiwiki, but these technologies were at the same time too cumbersome to use and too restricted in functionality for collaboration, as students preferred to have a more Website-like experience for their data sharing. For the last two years, we have been using Google sites instead, which turns out to be sufficient for our needs.

4. CHALLENGES

In this section, we briefly describe some of the challenges we have faced when arranging the course.

4.1 Differences in Semesters

Different universities have different number of semesters, differing starting times and length of semesters, making arranging a common course that is a perfect fit with all schedules impossible. For example, the fall semester starts in Aalto University in the beginning of September and ends in mid-December. In the University of Cologne it starts in October and ends in February. We have managed to balance these differing starting and ending times by starting the introduction and advance tasks in Finland earlier, having the students in Cologne join as soon as their semester starts. The Finnish students continue working until the end of February in order to be able to finish the course work, even though their spring semester has already begun.

4.2 Differences in Courses and Requirements

It is normally not so easy to create totally new courses at any university and include them into the curriculum of the students. Thus, we ended up using the existing courses and just creating new contents for them. This of course included some other challenges, since the course already included in the curriculum has differing requirements and differing scope. For example, in Finland the course that was found to be most suitable for this was a seminar course requiring students to do research and write a research paper, based either on a small-scale study or a literature review. Thus, the distributed course had to have these elements. In Germany, the format was that of a research seminar, where students did project work and one final presentation at the end of the seminar. As this seminar turned out to be very popular in Germany, it had to be restricted to at most 25 students, which still meant that frequently in a team there was a group of Germans, collaborating with a single Finn or American. This meant that the people from the US or Finland sometimes felt quite lonely. The most this format can manage is 8 to 9 teams.

4.3 Time Zone Differences

The maximum time difference between the different sites we have had is eight hours, which greatly limits possible time slots for organizing the course. Luckily, the students have been quite flexible in their working hours. Thus, the course sessions that typically last two to three hours normally start at 3 pm in Germany, 4 pm in Finland, and 9 am in the US.

However, we have noticed that long sessions are exhausting, especially for those participating in the evening. Thus, we have had to limit the length of the sessions to a maximum of three hours. When having the final presentations with a large number of

groups, we have had to split the presentations into two consecutive days.

5. LESSONS LEARNED

In this section, we have collected some of the lessons we have learned about organizing a distributed course.

5.1 Balanced Cross-site Teams

For the teams to work well, we have learned that we should aim for "balanced" teams that have at least two members from each site participating in the project. This way, no student is "left alone" risking to be excluded from face-to-face communication taking place at the other site(s).

With respect to the number of sites, from a pure productivity point of view, a minimum number of sites is naturally best. However, as the purpose of this course is to teach global collaboration, we require that teams have members from at least two, preferably three sites. We have also noticed that 5-6 members per team is optimal. Adding the number of team members adds to the risk of "free-riding", i.e., students that do not contribute much to the team work just hang along. Moreover, larger teams make the team internal communication more difficult.

5.2 Commitment to the Project Team

For projects to be successful it is important that all the project team members really commit to the project work and contribute. Every year we have student at all sites who drop from the course. Luckily, this mostly happens it the beginning of the course, when those students notice that there is really a lot of work in this course and the point are not free.

Once the students start working in the distributed project teams, there are fewer drops off. We believe that this is mainly because the topics are really interesting. Many of the projects even have an external customer, which make the students even more committed.

5.3 Informing Others

It is important that the students remember to inform the rest of the group about their other activities, that might prevent them from participating some course activities, e.g., work related to other course, or if they are sick or on vacation.

Sometimes some students have just disappeared for a while, e.g., left for a vacation without communicating it to the rest of the teams, or even to the teachers, and being practically kicked out of the team during their vacation, since the rest of the team has interpreted their lack of communication during the vacation as lack of interest in the project. Thus, it is important to remind the students that it is their responsibility to communicate to the rest of the team and agree how the work is taken care of while someone is away.

5.4 Meeting Agendas and Instructions

Creating good agendas for each meeting with exact presentation schedules and clear instructions for what to prepare is necessary to arrange effective virtual meetings. Especially in the beginning, when the student groups gave their status or final presentations the schedule might slip quite a lot, which was not nice for teams at the end of the agenda. First groups easily had too long presentations leaving too little time for the last groups, and finally the whole day was longer than planned and people were tired and upset.

We solved this problem by giving each group an exact timeframe for their presentation that they had to keep. The teacher stopped the presentation, if it was taking too long. We also gave the students more detailed instructions for their presentations, e.g. for bi-weekly status up-dates questions that they had to answer.

5.5 Early and Frequent Deadlines

Student groups need to start collaborating early on, since learning to collaborate and to create a common understanding takes time. A good way to encourage them to do so is to give the groups early deadlines that they have to meet together as a group. Therefore, besides giving the final presentations, the student groups give several intermediate presentations regarding their results, as well as deliver bi-weekly status up-dates. Thus, for our four-month long course they have quite a lot of small deadlines that "force" them to work and collaborate during the whole course, thus bringing better results. This makes it also easy for the teachers to notice early on if some of the groups are encountering problems.

5.6 Building Global Trust

There is no substitute for global trust. While trust is built-up fastest in face-to-face interaction, it can also be built up by consistent behavior over extended periods of time. If team members consistently deliver on their promises, and warn team members from other locations ahead of time if they will not be able to keep their commitments, this will also build up mutual trust.

Students usually do not meet face-to-face during the course. They might meet if a customer invites a team to its site, but as a general rule the course instructor is the only one who has met all the students face-to-face. This means that he acts as a hub of trust and proxy for the rest of the course participants. The virtual mirror, described in section 5.8, gives additional feedback for each participant on her communication behavior.

For instance, in one year we had students from a southern European country participating in the course. As it turns out, their understanding of being on time and keeping deadlines is very different from Northern Europeans and North Americans. For example, when a video meeting was agreed on for a certain time, they would usually be at least thirty minutes late, which means that the meeting might be already over. They also had a far more relaxed attitude towards deliverables such as intermediate presentations, which means that they did not really carry their weight in collaboration with the other team members.

5.7 Understanding Different Cultures

In this course we initially had students from Germany and Finland, later extended by participants from a southern European country and from the US. Communication problems started right with the language. "Finnish English", "German English", and "Southern European English" are very different from American English. Non-native speakers of English tended to delegate the task of presenting results to native English speakers, thus undermining one of the goals of this course. This was easily fixed by asking team members to take turns in presenting. But there were more subtle challenges of intercultural communication. Finns have a reputation for being somewhat introvert but to the point, while Germans communicate sometimes with "brutal" honesty. Americans, on the other hand, try to convey unpleasant things in a nicer way, which might be understood by Finns and Germans as evasive. Coaching of instructors helped to overcome such intercultural communication challenges.

The cultural patterns of Southern Europeans on the other hand posed challenges that proved to be insurmountable. As the format of this course required frequent synchronous remote interaction by Skype, the different understanding of punctuality and the

inconsistent delivery of promised results led to the expulsion of Southern European team members by their colleagues from more punctual cultures. It is interesting to note that the team members from the Southern European country who successfully completed the course had already been exposed to Northern European culture in prior internships and consulting engagements.

5.8 Improving Communication through the "Virtual Mirror"

Through analyzing their own communication behavior, students develop a better understanding of their self-image, helping them to become better leaders, collaborators and communicators in virtual teams. In the course we employ the concept of the "virtual mirror" that shows how responsive each participant is, and how well-balanced as a sender and receiver of messages she acts. In prior work and based on results of this course we have defined metrics of well-balanced communication [3, 4].

Figure 1 shows the social network of the course 2010 participants. The teams, marked in different colors, are clearly recognizable. The main instructors, recognizable as black dots in the blue inset, are in the core of the network, but teams communicate mostly among themselves, and also reach out to colleagues from other teams, to previous course participants, and to the customers.
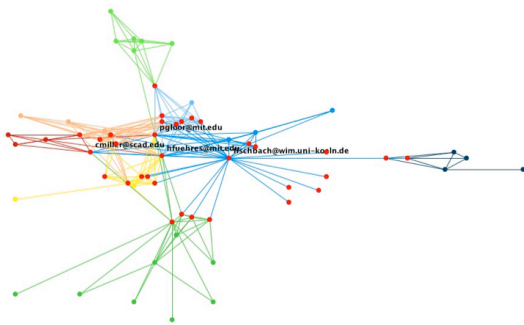

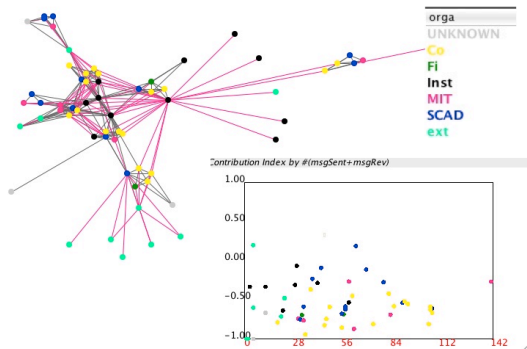
Figure 1. Social network of 2010 teams

Figure 2. Contribution Index

Figure 2 shows the contribution index [3,4], illustrating that the German course participants communicate the most, while the Finns are more introvert. Americans are somewhere in the middle. By mirroring insights like these back to participants, they much better understand how they fit in, and where and how they might change their behavior to become even better collaborators.

5.9 Creating Long-term Relationships

One of the "side-goals" of the course is to teach students that in today's knowledge-based economy, life-long learning and lasting relationships are keys for sustainable success. Towards that goal, some of the students who participated in the very first version of the course are still part of the extended social network that grew out of the course. As the virtual mirror shows, students are reaching out not just to other course participants outside their own team, but also to customers, as well as former course participants.

Frequently, students team up with communities they analyze, and assist them reaching their goals. After the course, they go on to work on research projects and papers on these topics, or even collaborate on an idea for a startup company.

6. FUTURE PLANS

With respect to this global project course, participation has been steadily growing. We have had external participation with students from Korea and China, but in this case the current format reaches its limits, as it gets impossible to get students to meet even virtually at the same time because of time zone differences: students from some locations would always have to get up in the middle of the night. We are therefore experimenting with extending the course in a looser format to integrate additional locations from additional time zones. We also have additional requests from universities located in compatible time zones, but the current course has reached full capacity.

We hope that our experiences reported in this paper can help stimulate other instructors to pursue similar courses, as well as to help us find universities interested in jointly teaching GSE with us.

7. ACKNOWLEDGMENTS

We are grateful to all our students who have made teaching this course an invaluable and truly rewarding experience.

8. REFERENCES

[1] Gloor, P. Swarm Creativity, Competitive Advantage Through Collaborative Innovation Networks. Oxford University Press, 2006.

[2] Gloor, P. Coolfarming - Turn Your Great Idea Into The Next Big Thing AMACOM, NY, 2010

[3] Gloor, P. Paasivaara, M. Schoder, D. Willems, P. Correlating Performance with Social Network Structure Through Teaching Social Network Analysis. Proc. Pro-Ve 06, 7th IFIP Conference on Working Enterprises, Sep.25-27, Helsinki, 2006.

[4] Gloor, P., Paasivaara, M., Schoder, D. and Willems, P. (2008) Finding Collaborative Innovation Networks Through Correlating Performance with Social Network Structure. International Journal of Production Research, March 2008, Vol. 46, Issue 5, p. 1357-1371.

[5] Mockus, A. and Herbsleb, J. Challenges of Global Software Development. Proceedings of the Seventh International Software Metrics Symposium, (METRICS 2001, IEEE), 182-184.

[6] Paasivaara, M. and Lassenius, C. (2003) Collaboration Practices in Global Inter-Organizational Software Development Projects. *Software Process Improvement and Practice*, Vol. 8, p. 183-199