Computer Science and Engineering: Learning to Work in International and Multicultural Teams

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Abstract: The world today is a global world. This means that our students, the professionals of the future, should be able to cooperate and work together with people from other countries, with other languages and cultures. And that implies much more than being proficient in English or other foreign languages, it implies developing a high level of international and intercultural skills. To do so, new activities and approaches should be incorporated into the official curricula of higher education institutions. In this paper, we show an initiative carried out as part of the Software Engineering course, consisting of an international project developed in teams made up of Dutch students from The Hague University of Applied Sciences and Spanish students from Universidad Francisco de Vitoria. Scrum is the paradigm chosen for the development and monitoring of the project, which has been developed using online collaborative tools.

1 INTRODUCTION

It is increasingly common for universities with a long tradition of face-to-face teaching to adapt their study programs to specific experiences involving their students, based on four factors: internationalization, for a long time, as an integral part of their study programs and always guided by their professors.

These virtual exchange initiatives are based on the Communiqué of the Conference of European Ministers responsible for Higher Education, Leuven and Louvain-la-Neuve, 28-29 April 2009, which explicitly states that "By 2020, at least 20% of people graduating from the European Higher Education Area should have completed a period of study or training abroad".

But international mobility alone does not guarantee the development of linguistic or intercultural competences of our students. A "maturity" on the part of the student is necessary to learn from the experience and from his or her capacity to absorb the "culture" of the destination country. Both of these needs can be met if the student works on a project that has consequences for his or her qualification and, in turn, does so in a collaborative manner with students from other cultures, other interests or other skills.

There are various initiatives in this area of online training, some aimed at students, others at teachers, and both on public or private initiative. Among these, we can highlight:

- *Erasmus + Virtual Exchange* EU public initiative for students from various universities (Erasmus+ Virtual Exchange, n.d).
- *E-Tandem*, a language learning method that consists of two people communicating online in order to learn each other's language (ETandemLearning autonomous language learning with a partner,n.d).
- *Teletandem*, an online language exchange programme, where foreign language students in one country are paired with native speakers from universities abroad where the target language is spoken (World Studies Media Center, n.d).
- *Cultura*, an intercultural project that connects groups of students online to help them understand each other's culture (Welcome to Cultura, n.d).
- *Evaluate* is based on virtual exchange for teacher training (Daswell, n.d).

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There are also other private initiatives that seek the same results as the above: training by language immersion, participating with other institutions in specific projects, whether in language learning, specific academic training or cultural exchange.

2 COLLABORATIVE ONLINE INTERNATIONAL LEARNING

Higher education cannot ignore today's labour and social trends:

- Markets are constantly changing, with tight budgets and fast time to market requirements.
- There is a growing trend towards globalisation where the ordinary is to run international projects where customers, providers, and even development teams are likely to belong to different cultures and must rely on sophisticated collaboration methods and communication technologies.
- The need to have an interdisciplinary approach considering the scale and complexity of the problems we face.

All these factors together pose to our students a much bigger challenge than the ones faced in the past, when everything seemed better controlled, and lectures and labs provided in our colleges were deemed enough for our professional development.

Nowadays the situation is very different. The number of IT companies that are able to progress without a global vision is low, and the new IT professionals must quickly adapt themselves to new cultures and tools.

This project aims to provide our students with that "training plus" that otherwise they would be required to develop later, once they are involved in their professional careers, within a more stressing context, probably less friendly for reflection and where mistake correction might be more difficult.

The Hague University of Applied Sciences (NL) (from now on THUAS) and the Universidad Francisco de Vitoria (SP) (from now on UFV) start this pilot project with the aim of making it an ordinary part of our programmes in one or two years, therefore hoping that what today seems a cutting-edge challenge soon becomes a standard part of our academic proposals.

The project seeks to develop jointly the practical contents of the Software-Engineering-related disciplines, imparted in both THUAS and UFV during the third year of their respective degrees.

For the time being, the alignment of the theoretical training is left out of the scope of this collaboration, which, despite being quite similar, will remain specific to each institution. It is in the practical part of the course where we see the opportunity to establish an international collaboration experience through the set-up of teams made up of THUAS and UFV Software Engineering students.

Although the development of a project and having to work in teams is in itself a challenge, the project main goal is to help our students to develop conflict management skills, learn to collaborate with different cultures in an international environment, as well as learning to organise and develop a project within tight time limits and learning the challenges associated to communicate with their peers through tools when face-to-face interaction is not feasible.

In addition, our students will become familiar with Agile methodologies, which are showing great results in the industry today and are becoming the common standard for development teams. The adoption of these methodologies constitutes in itself an asset for the students. Specifically, the selected Agile methodologies for this activity are DevOps and Scrum for THUAS, and Scrum (Schwaber and Sutherland, 2020) for UFV.

2.1 Project Goal

The differential value of this project lies in providing the students with a set of conditions that allows them to understand the challenges and the opportunities associated with working with people from different countries. Both THUAS and UFV wanted to create for our undergraduates an experience where future professionals discover and acknowledge that even in close countries like ours -both European and belonging to the EU- there are cultural nuances that you need to deal with if you want to collaborate successfully.

The project thus caters for this purpose, but it must not neglect that we want to educate future IT engineers. Regarding team collaboration, and in the spirit of experiencing Agile practices, we agreed to take advantage of the Scrum framework, not only for its accredited success in helping to develop complex products faster in various domains, but, as well, for its effectiveness to structure non-hierarchical collaboration. Together with commitment, focus and courage, Scrum promotes the values of openness and respect, which fitted perfectly with our purpose and helped us to lay the foundations for proper interaction.

Finally, we also needed to specify what would be the concrete aspects of the collaboration, it’s tangible outcome. The project should reinforce software

engineering concepts in the areas of architectural design and modularity, testing, maintainability, security and configuration management, among others. In this respect, we agreed that the teams had to develop a web application according to a set of minimum requirements:

- A readable and maintainable Web-based application, developed in C#, and architected according with the Model-View-Controller (MVC) Web pattern (Fowler, n.d). The outcome must be sufficiently documented, so that it could be handed over to a different team to maintain and evolve it.
- The application must be accessible from different devices according with responsive design principles.
- The application must support open authentication through at least an external identity provider (i.e. Google Identity Provider or FaceBook). It must as well conform with General Data Protection Regulation (GPDR, n.d) requirements in relation with personal data.
- Data persistence will be provided by means of a SQL relational database, containing at least one one2many and a many2many relationship and supporting CRUD operations.
- Version control of the code will be done in GIT through the Azure DevOps environment
- The students must develop automated test suites and user acceptance tests to verify and validate the application, being the quality of these tests a key factor for evaluation.

These are technical or implementation aspects that definitely affected more the Dutch participants who are evaluated on software development as well as Scrum practices. However, many of them need to be taken into consideration by the Spanish students in their product owner (PO) role (see 2.3.1).

2.2 Project Organisation

2.2.1 Preparations

In order to run the collaboration project smoothly, it is important to have things planned ahead.

Firstly, as mentioned in section 2.3.1, it is of utmost importance to ensure that both university programmes are compatible and that both parties can meet their goals and expectations.

Once this point is solved, it is important to agree on the schedule and the set-up for the project. In our case, we decided to run it over a ten-week period, using one-week Sprints. Special attention must be paid to make bank and mid-term holidays visible, as they are likely to differ between both institutions and capacity must be adjusted accordingly in the weeks affected. If, as it was our case, the academic load differs significantly, it is also important to make clear the availability of the students with a lighter programme involvement.

Material aspects, as infrastructure and tool support, also deserve attention. In our collaboration project, this was provided by THUAS through their partner Delta-N (see 2.3.4).

It is important as well to agree on the tools and approximate schedule to have coordination between teachers, independent of the coaching sessions held with the students. The breadth of available choices is enormous, and it is not complicated to find a solution that will fit your needs. We decided to use Slack to have separate channels for each group and a general one, which proved to be a satisfactory approach to collect feedback from the various coaches and coordinate efficiently among us. In addition, we had meetings over Skype every other week.

2.2.2 Selection of Candidates

Though the Preparations section could cover this point, we believe it deserves special attention, because a wrong choice would affect not only to the participant but as well to the other students in their team.

An obvious requirement is that the students must be able to communicate comfortably in English. In our opinion, B2 is a strict minimum, but the students will take full advantage of the experience if they have a C1 level or higher. Please bear in mind that the participants need to deal with cultural nuances frequently expressed verbally. If they are not fluent, there is a high possibility that they will become more introvert and the overall team performance will be affected.

The students should have a sound academic record (with particular attention to the competencies involved) but even more important is to select candidates with an attested sense of responsibility who can commit to the success of the experience. The project demands a significant effort, and some of our students have to make their studies compatible with part-time jobs, so they will need to manage their schedule tightly and make sure they keep the pace of the team.

Following the above requirements, 50 THUAS students and 10 UFV students were selected.

2.2.3 Project Execution

The project spans over ten weeks of the term

corresponding to the affected courses. The weekly programme is as follows:

Week 1: This week is mainly devoted to team allocation. Each university groups and balances the candidates in various teams. Attention should be paid to team size for effective collaboration. Scrum, for instance, recommends no less than three and no more than nine people per group for this purpose. We decided to have teams composed of seven people (two product owners[4], one scrum master and four developers).

Though the students will meet face to face, it is a good idea that they get in touch with each other (e.g. by exchanging a short clip where they introduce themselves) as this will help to accelerate the team-building phase during the second week.

This week can be used to hone the final administrative arrangements, like creating the accounts in the support systems, so that students can start working smoothly right after the kick-off meeting.

Week 2: This week is when the students meet each other, and we believe it is crucial for the success of the project. It helps in generating a friendly atmosphere among them, as well as among the teachers (who should participate in the event at least the first year you run the project).

We highly recommend having a face-to-face kick-off meeting. Despite the convenience and breadth of collaboration tools available today, we believe that the opportunity to meet personally is irreplaceable, not only because interaction around the project is much easier when people sit together in a single room. Having access to a whiteboard, stickers, and other non-electronic devices certainly make ideas flow more easily. The students will share their proposals and will agree on which of them they will carry forward. It is the time to put some flesh into the vision and start building a first draft of the product backlog that will drive their efforts.

Besides, it opens the opportunity to socialise around breaks, and, if possible, allows for having a specific social event (e.g. a casual dinner) where the participants may talk beyond the academic purpose of the collaboration.

In our case, two teachers travelled to the Hague with our students. This time proved to be an excellent investment and helped the students to develop the trust and commitment needed to feel more relaxed in the coming weeks when they have roll-up their sleeves and discuss the specifics of their projects.

[4] Please see section 2.3.5 for clarifications on the decision of having a dual PO role

Weeks 3-9: These weeks represent the core of the project, where the students interact remotely using several collaboration tools.

For practical reasons, it is better to have a fixed development framework. In our case, THUAS proposed using DevOps Azure, which is an excellent environment for our courses. It allows the students to have a single tool to support most of the activities required. It provides product and Sprint backlogs, which connect seamlessly to Sprint goals, acceptance tests, etc. The team has access to a variety of boards that allow them to track their performance. Finally, it is very simple to deploy the increments for inspection and approval by the stakeholders, helping the students to familiarise with the reality of Continuous Deployment.

When it comes to other collaboration tools, the teams were free to choose whatever suit them better, so some of them decided to hold meetings using Skype, Zoom or Discord. The only relevant criterion here is convenience. On the teacher's side, we decided to collaborate using Skype for video conferencing and Slack for asynchronous communication, as well as to record significant findings through the project.

Apart from developing the code, this period is where the students shall get familiar with Scrum practices and events. At the very least, all students must set aside some time to participate in Sprint planning, review and retrospective meetings. Daily Scrums are only mandatory for members of the development team. Additional time must be reserved for backlog clarification and grooming.

Even with four groups as we had, providing constant support can be challenging for the teachers, so it is good to agree on how many meetings they will participate as stakeholders. In our opinion, it would be advisable to support them on at least two review and retrospective meetings. More than with planning, the students tend to struggle with understanding value and how it is delivered. They also need some guidance to reflect on their performance and to identify potential improvements to include in the subsequent Sprint.

Week 10: This week is devoted to the presentation of each product. The teams shall work on a slide deck, where they must communicate the original vision, the actual outcome and providing a roadmap on how they would proceed if the project were to continue.

With this event, the students get the opportunity to enhance and complete their training by showing

their ability to defend and market their product, beyond the technical, collaboration, and management skills acquired during the project.

The exercise is held facing a committee composed of THUAS and UFV teachers, together with Delta-N representatives, thus providing the academic and market views. The defence is public, and all the teams can watch their contenders. The set-up could be somewhat intimidating for some students. Therefore, and to provide a meaningful experience for all of them, we advise finding a balance between academic rigour and positive atmosphere so that constructive feedback flows to all participants. One way we found to achieve this goal is by running a poll by the end of the event to find out the application preferred by the audience.

2.3 Project Challenges

In the following sections we would like to comment on various challenges that are worth considering when establishing a similar collaboration project.

2.3.1 Course Alignment and Integration

One obvious challenge is to find a partner University that has a compatible course/programme not only regarding contents, but also having an academic calendar which can be aligned with your own courses.

In our case, we were lucky to find THUAS, which mostly met the aforementioned requirements. We have a substantial syllabus overlapping that allows us to consider and establish the collaboration. We both introduce or develop Software Testing, Software Evolution, Software Reuse, Configuration Management and Agile practices to our students in the same year and semester. For the latter, we both do so with special attention to the Scrum framework and managing the product backlog with user stories.

Taking into account the courses involved, we both decided that the best way to establish the teams was to have UFV students playing the product owner (PO) role and THUAS students playing the Scrum Master (SM) and Development Team (DT) roles, though we had to make minor adaptations to adapt to the reality and circumstances of the participants (see 2.2.4).

2.3.2 Credits Involved and Expectations

On THUAS side, they run this project integrating several courses (IT Operations, Global Cooperation and Process and Project Management) totalling up 15 ECTs. For us the only course involved is Software Engineering II, accounting for 6 ECTs.

The academic load difference between the Dutch and Spanish components is not a minor challenge for a project spanning over ten effective weeks. The Dutch students have a projected capacity of 25 man-hour per week, while the Spanish would have 10 man-hour per week.

This fact presents some challenges, but, if properly exploited, they can enrich the team experience. The problem might arise from the larger group, with a higher dedication, expecting that their remote colleagues should be as available as their local ones. As we mentioned, the academic load is quite different for the two groups, which turns out in Spanish students not being as available as Dutch ones. In practice, this meant that that the SM and DT need to adapt to the PO's schedule. On the other hand, POs need to be very efficient in their interactions with the team if they do not want to impact the Scrum team performance. Both situations reflect quite well the environment the students will find when they start working in a real company, as these situations are commonplace.

The situation is also good for the students to flesh out some of the theoretical notions they learn in their courses. For instance, you have to perform with the resources you are given, both in terms of people and time. Moreover, they see Tuckman's model for team-development ideas in practice and funny concepts as storming, norming, etc., acquire, all of a sudden, a real meaning.

The project certainly demands an extra effort from the participants, but the feedback got from them is that the experience is certainly worth the pain.

2.3.3 Collaboration and Coaching Sessions

In our opinion, the main challenge here is to accommodate schedules and to dimension capacity. In our case, courses were held in the morning for Dutch students and in the afternoon/evening for the Spanish ones.

Once the project is running, for the most part, collaboration among teachers can effectively be carried out asynchronously, using tools such as Slack. The main point is to be attentive to issues that may pop up at each site and share it quickly so that the corrective actions can be timely applied. Once the teachers get familiar with the tools, you rarely need to organise videoconferencing sessions, though you can still run them if you deem it appropriate.

Collaboration tools allow you to decouple the individual's schedules, which is not a minor point to neglect, as it is not easy to find time slots when everybody is available. Besides, all the teachers get a record of the significant events in the project, which the different parties can include in reports as they see fit.

Capacity, to give adequate support, should be another concern, which largely depends on the

maturity of the students and the number of groups involved. It is true that juniors (third-year students) are largely autonomous, but anyway we are dealing with skills that are not usually honed until you have some years of professional experience.

Sprint reviews and retrospectives offer an excellent opportunity to coach the teams. The first event focuses on how value is being incorporated into the project, while the second is centred around the performance of the collaboration within the group.

However, if you consider one-week Sprints as we did, and eight teams, it might be unfeasible to attend these events for each group and every Sprint, unless there are a lot of teachers/coaches involved, which we believe is not commonplace. Even for the parameters considered, two or three teachers from each site are needed to guarantee minimal support. It is therefore important to foresee two or three milestones in the project timeline where this support should prove more effective and reserve some additional time around them to make it work.

2.3.4 Tool Support

In a technical discipline like Software Engineering, where part of the project is the development of a web application, having the right infrastructure and tools support for the students is critical.

In our project, one key factor for success was counting on the THUAS partner Delta-N who provided a Microsoft Azure DevOps platform for the students plus lectures on the DevOps practices.

The Azure DevOps environment is a perfect option for running this type of project. Besides offering all the development tools, it provides a lot of product management and collaboration tools. In particular, for the POs, they could easily manage their product backlogs. The environment allows them to hierarchically structure the user stories, assign values, priorities, collect estimations with the DT using poker planning, etc.

2.3.5 Methodological Adaptations

The creators of Scrum emphasise that "Scrum's roles, events, artefacts, and rules are immutable and although implementing only parts of Scrum is possible, the result is not Scrum. Scrum exists only in its entirety and functions well as a container for other techniques, methodologies, and practices.". These advised-against adaptations are sometimes referred to as *ScrumButs*.

Although we wanted to implement the framework as close as possible to its original design, we detected that minor changes were required if we wanted to take into account the circumstances of the participants.

In particular, when it comes to role descriptions, the Scrum Guide dictates that the PO must be a single person. Without questioning this point in real organisations, we agreed, after some discussion, to relax this requirement for pedagogical purposes. As mentioned in 2.3.1, Dutch students play the SM and DT roles and the Spanish ones the PO role. Putting just one student amidst 6 or 7 peers could be somewhat intimidating, especially when they have not met before. Besides, Agile practitioners often acknowledge that this type of collaboration is better suited for professionals with significant experience, a condition rarely met in undergraduates. Therefore, we decided that two students would play the role but ensuring that they interacted with a single voice with the rest of the Scrum team. According to the observed results, we can confirm that the change did not negatively impact the project, neither in the ability to deliver the product nor in the Scrum framework learning experience.

2.3.6 Performance Assessment

Another challenge is how to evaluate the activity academically, considering the way the project integrates with the affected courses. It seems to us that the easiest and fairest approach is to set clear criteria that match the contents of the course(s) involved and to decouple the appraisal from your partner university as much as possible. We believe that it is valuable to share those criteria and get feedback from your peers, but, in the end, each site needs to define how the activity helps the students to attain the competencies associated to the course. In our case, we decided to focus on three areas:

- A general one, related to attitudes and collaboration
- A second one, associated with the product owner role, and
- A final one, assessing the students' ability to communicate what they had achieved.

As just mentioned, each site should be independent to meet their local requirements. However, we experienced the benefits of sharing our criteria, and we got valuable feedback to articulate our product owner assessment, aligning it better with the Scrum guideline.

3 RESULTS

As we have seen in the previous sections, adapting to a virtual learning process, like the one shown in this collaboration does not come without challenges, not

only for the students but for the faculty too. We have mentioned different academic load, schedules, cultural nuances, courses and programmes compatibility and so on, add up to a context where none of the participants communicates in their native language.

Our experience shows that a fluent communication between teachers aimed to create a friendly and respectful atmosphere among the participants will remove most of these potential obstacles. Such an environment soon triggers in the students a sense of excitement that encourages them to move forward despite the additional workload associated with the project.

The feedback we get from our students is very positive and encouraging to keep promoting this kind of experience. For most of them, this is their first experience working with Scrum in a highly autonomous way. They were particularly encouraged by the sense of responsibility of having to mould and prioritise the product and see how it came to reality as part of a collective effort.

An aspect that may not be so evident for them but that to our minds has a lot of importance is that the participants could experience in a controlled environment many of the situations they will find once they graduate. For instance, some of the groups were affected by different circumstances, which reduced their initial capacity, forcing the teams to adapt on the fly to the new conditions. In some cases, this meant that they had to lower their original ambition, focusing on what was essential and giving up other user stories, which might be fancy but not that critical. Learning to identify the critical-to-quality aspects of the product, to identify the right criteria for prioritisation, as well as doing this preserving the team cohesion, seems to us an excellent take-away from the project.

Finally, another fact that is also telling is that once the "experiment" was over, the students from both universities made plans to visit their respective countries and meet again, an unmistakable proof that the relations between them were not only academic or professional, but also aroused cultural interest.

4 CONCLUSIONS

The experience presented in this paper shows that there are new approaches that can be used in the training of the engineering students which are closer to ways of working that they will find in their future professional environments. These activities and methodologies allow, on the one hand, to more easily develop the competencies that the companies are searching for and, on the other, to provide a more motivating and engaging learning context for the students.

Specifically, we have focused on the international skills necessary to work in a globalized world, incorporating international projects (developed in collaboration with students from other foreign universities) as an evaluable activity in a Software Engineering course. The learning experience and the quality of the results obtained by the students show that the proposal works. We are going on with this initiative, incorporating metrics to obtain and analyse quantitative results to validate it from a more objective perspective.

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