

Ten Tips to Succeed in Global Software Engineering Education: What Do the Students Say?

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Abstract—When a project had followed advices from the best practices, we can raise a question whether the success (or failure) of the project came from following (or not following) the best practices, or whether there were additional reasons that led to the positive (or negative) outcome. In this paper we analyze a case of a student project performed as a part of our Distributed Software Development course. The project followed the advices from the “Ten Tips to Succeed in Global Software Engineering Education” publication. This paper analyzes the project work with respect to the advices. Focusing on the perspective of a student participating in the project, the paper tries to answer whether following the advices is sufficient for a positive project outcome.

Index Terms—Distributed software development, education

I. INTRODUCTION

Global Software Engineering Education is a relatively new phenomenon that follows its counterpart in industry [1]. The experience in form of best practices in conducting the courses in a global environment is being collected from a series of case studies [2][3][4][5]. In this paper we analyze a course that has been successfully running for 11 years, but this year met new challenges and problems and was not as successful as in the previous years. Our intention with this paper is to analyze the problems and identify the lessons learned. We do that in a specific way: a) we describe the course and the problems from a student’s point of view, and b) we analyze the course and a particular project in respect to the suggestions of the best practices identified in “Ten Tips to Succeed in Global Software Engineering Education” [6]. We analyze how each advice (tip) was implemented in practice in the project and which consequence the implementation of a particular tip had: did the implementation according to each tip contribute to the project success, and the opposite, did the absence of the implementation (or a poor implementation) lead to weaker results?

The rest of the paper is organized as follows. Section II gives a short overview of the project that is analyzed. Section III analyzes the project by going through all tips. Finally, Section IV concludes the paper.

II. THE HOOPSTATS PROJECT

The Distributed Software Development course [7] was organized by three universities (University of Zagreb, Mälardalen University and Politecnico di Milano) this year, in the form of common lectures and common presentations, and

seven globally distributed projects. During the common activities a videoconference system was used, while for the project work the students could choose their way of communication. One of the projects was “HoopStats”¹. The main goal of the project was to develop a flexible system based on open data. The main requirement was to create an intuitive interface for composing custom queries over basketball statistics data obtained from databasebasketball.com. The aim of the project was to enable filtering of the data using user-friendly queries, and then presenting the results in a combination of tables and graphical elements (pie charts, bar graphs, etc.). The project was supposed to be submitted to the SCORE contest [8], so it was only vaguely defined from the supervisors, did not have a real customer, and it was expected that the students would shape the idea and clarify the requirements. Six students from five different countries were involved in the project, three students from the University of Zagreb and three from Mälardalen University. Although the project was approved, it did not succeed with its main goals: the functions were only partially implemented, and the product was not attractive enough to be competitive for the SCORE contest so the students decided not to submit it.

III. THE TEN TIPS AND HOW THEY WERE IMPLEMENTED

The ten tips paper [6] gives a set of advices to succeed in conducting a distributed student project. The tips were not explicitly presented to the students at the beginning of the course, rather most of the tips were systematically introduced and emphasized to the project groups by their respective supervisors. Some tips were given in the form of tasks to deliver concrete artifacts like a project plan or minutes-of-meeting documents, while others were tailored to indirectly guide the project results by boosting the students’ moral and helping them overcome well known issues in the course.

Tip 1: Start communication by brute force

There were two aspects with the purpose of igniting the communication within the team. The first one was the initial group meeting with the project supervisor, and the other was the first concrete task for the project group, defining a project plan.

¹ The authors of this paper are (i) a master student - the project leader, (ii) the project supervisor, and (iii) the course examiner.

The first step towards immediate and intensive communication between the team members was initiated by the project supervisor, a member of the teaching staff at Mälardalen University. Due to the geographical distance between the two groups of students, the only possible way for conducting the project meeting was via an instant messaging platform that supports group chats, such as Skype. The project supervisor led the discussion during the meeting and he focused on the course policies, and the rights and obligations of the students during the project. The supervisor pointed out that every official meeting and decision in the group had to be documented, since it was the most convenient way to spread the information. Topics like respecting deadlines, creating high quality deliverables, and the grading system were pointed out as important aspects that the students should be aware of during the course. The supervisor also emphasized the most common mistakes done in previous projects. Also, teamwork and proper role identification were stressed as central elements of project work.

The first concrete task in the course for the students was the creation and delivery of a project plan that included detailed information about the project meetings, project members' roles, development methodology, development infrastructure, tools and technologies utilized in the project, etc. To be able to provide all this information and meet the one week deadline, the project team members had to intensify the communication. After the initial meeting with the supervisor, several more project meetings were held to define the project plan. In order to successfully complete the task, the work was divided between the team members. After the completion of the individual tasks, all the individual parts were merged into a single document and the issues that emerged were solved. Finally, the document was polished and the group was ready for the project plan presentation.

The student's opinion: The implementation of this tip in the form of the initial project meeting with the supervisor and delivering the project plan document and presentation had immediate impact on the communication between team members. The main goals were accomplished – the project plan was completed on time and communication was started. However, this occurred too early in the project, therefore this task did not have much impact on the team spirit and increasing the coherence in the group.

The opinion of the staff: The goal has been achieved since the communication started. The staff actually did not expect to get a great result from the first version of the project plan.

Tip 2: Get the students to be familiar with each other as soon as possible

Loyalty, trust and collective responsibility are characteristics which distinct great from average teams. Based on previous projects, the course staff had mechanisms to introduce these features into the project teams. To increase the

coherence within a team, the team members had to get to know more about each other. In order to introduce themselves to the teammates, all the team members were required to provide a biography that was published on the official course Web page. The biographies were composed on one side from the students' technical skills and interests, while on the other side the biographies contained personal information like age, country, hobbies, a photo, and communication channels through which the student could be reached. While the personal information was used to build up the team spirit, information such as students' skills and interests had more technical implications on the project. The project manager assigned roles to the students to comply with their skills and interests in order to stimulate their motivation and commitment towards the project. This technical information was also used later in the process of assigning tasks to the team members. Their skills and interest had major influence on the type and complexity of the tasks.

The student's opinion: Although this tip was fully implemented in the HoopStats project, the results were not completely positive. The provided information helped the students to familiarize themselves with their colleagues, but it was too formal. The key factor for building loyalty and trust within a team lies in informal communication between the team members. The lack of informal communication at the beginning of the project slowed down the process of building a coherent team. So, this tip should also include a mechanism that would help initiate a deeper informal interaction between the team members.

The opinion of the staff: We have noticed that the information placed by the students should not be taken literally, and indeed that the concrete action for placing information about the students was necessary but far from sufficient.

Tip 3: Keep communication levels consistently high

Once the communication had been started, the main challenge was to keep it consistently high. To foster an intense communication level through the entire project, the project team had to produce a communication plan and detailed reports after every project meeting.

Conducting a voice or video chat was experienced to be inconvenient in teams composed from many nationalities, because of the many different accents of English. In order to reduce the chances for misunderstandings, the project group decided to use chat sessions as the primary tool for conducting project meetings. In this fashion, the information flow was significantly reduced, but on the other hand the consistency of the information was much higher. Although group chat was the primary tool for the meetings, video and audio conferences were not excluded as possible options for conducting a meeting. They were utilized in certain circumstances when the information flow needed to be on a very high level. The communication plan included two regular weekly project meetings for discussing the current state of the project and

summarizing the achieved results. Beside the regular project meetings, the communication plan included emergency meetings which were scheduled in cases of significant changes in the project, when consensus of the project members was required.

After each project meeting a minutes-of-meeting (MoM) document was produced, summarizing the relevant information from the meeting, including the actions and conclusions. The actions included information such as the student(s) responsible, description of the task and the deadline for its completion. The MoM documents were intended to help the project team to avoid later misunderstandings and to improve project management.

Creating dedicated communication channels was another feature for maintaining high communication between the members working together with specific assignments. In addition, the project manager encouraged ad-hoc communication between the team members and insisted on informal communication to additionally increase trust and team spirit.

While informal and ad-hoc communication was exercised within the team, for contacting the external project stakeholders more formal communication was used, mostly via the project manager, but not excluding the possibility for other team members to contact the external stakeholders directly.

The student's opinion: By implementing the proposed tips, the project team kept the information flow on a satisfactory level. This resulted in every project member being aware of their tasks, aware of the tasks assigned to other team members, as well as being aware of the discussions with the supervisor. However, there were still problems beyond the communication plan that had significant influence on the quality of the information. During the meetings several students were passive, receiving information but not being proactively involved in finding creative solutions.

The opinion of the staff: The supervisor recognized the passiveness of some members and by talking with all members tried to increase the involvement of the passive students, but succeeded only partially. The lesson learned is that frequent communication is not enough, and that the students' engagement plays a crucial role. However, how to achieve this remained a question.

Tip 4: Ensure that students keep the other site in mind

Concrete measures proposed by the course staff to keep the remote students involved in the project were adopted in the HoopStats project. To support the students in collaboration, the course polices demanded using software configuration management (SCM) tools. The main purpose of these tools was to support managing the changes in the documentation and code.

Using Apache Subversion (SVN) was an explicit requirement for each project group. In the HoopStats project, SVN was used for managing the code. In order to avoid

conflicts and to support proper usage of the repository by the team members, the SVN manager produced an SVN usage policy document. Despite this, managing code versions and changes in real-time caused conflicts and errors in the repository. The tip for having a responsible student for resolving these issues proved to be beneficial for the group.

The project team had more freedom in choosing a tool for document management. Google Drive was used as a platform for sharing documentation in progress. Combined with Google Docs, Google Drive enabled the students to concurrently work on the documents.

The project supervisor was located at Mälardalen University, which meant that having immediate personal contact was only possible with the local group of students. In order to decrease the potential of the remote students feeling left out, detailed reports from the meetings between the supervisor and the local students were shared during the project team meetings. Also, all official e-mail messages sent from the supervisor to the project manager were forwarded to the entire project group.

Exceptionally this year the project supervisor had an opportunity to meet in person the part of the team located at the University of Zagreb, which is not an often case in the course. These personal meetings were evaluated as a very positive experience by the students.

The student's opinion: All of the suggested tips were implemented in the project, which eliminated the issues related to not being aware of the remote student group. Due to the fact that the tips were successfully implemented, the distribution of the team in two locations did not influence normal functioning of the team, and the problems encountered in the group did not come for the distribution factor.

The opinion of the staff: Due to the good frequent communication, the awareness about the other side was good, and there were no surprises – all members were aware about the project state, though several students did not make serious attempts to improve their work.

Tip 5: Keep the students highly motivated

As pointed out in [9], motivation is a complex phenomenon which can be observed from two aspects: (i) becoming motivated and (ii) remaining motivated.

At the beginning of the project, the excitement and motivation in the team was on a high level. This was due to the euphoria and high expectations that all team members had regarding the course, project and teamwork. An opportunity to participate in a software engineering contest gave additional motivation to the students. These factors boosted the students' moral at the beginning, but through the history of the DSD course it has been shown that keeping the students motivated during the entire project is a far more difficult task than to ignite the initial spark of motivation. Based on their observations, the course staff pointed out several factors that can keep the student motivation on a high level.

The team members could choose the software development technologies and methodology. Additionally, the team members were involved in the process of specifying the requirements. By having freedom in selecting the technologies, the students were able to choose technologies they were already familiar with, and spend most of the time implementing the deliverables. However, due to different backgrounds and skills, there were students that needed to invest substantial effort in learning activities. The students who were familiar with the chosen technologies proved to be more motivated than the students who first needed to learn. This was due to the fact that they started to produce right away and the results of their work were immediately visible. The team members who had to learn the technologies first, showed less motivation to participate proactively in the project. Their main focus was completing the assigned tasks while upgrading their knowledge.

Involvement of the project team members in the process of clarifying the requirements had both positive and negative impacts on the project. Only a few students showed to be creative and had ideas how to concretize the requirements. It was evident that a considerable number of the team members did not understand the problem completely. This can be attributed to a lack of knowledge and planning skills, but also it can be a result of not being proactive, accompanied with a lack of motivation to invest more than a minimally required effort. Freedom and a lot of space for creativity boosted the moral among the team members, but it also caused negative effects. Some pitfalls such as wrong definition of the requirements and estimation of time needed to fulfill them caused major changes in the project. These changes were the main cause for dropping some important requirements which resulted in a low overall grade for the project team.

The grades and a positive competition was a strong motivation for some of the students, while for others the main goal was to pass the course. The SCORE contest was used as an external factor to additionally increase the motivation of the most ambitious students, but this motivation faded away for several students as the work was getting tougher. The motivational factors introduced by the course staff did not improve the overall motivation, as the team members had different sources of motivation, and did not manage to unite under a single common motivational factor.

The student's opinion: From the students' behavior we can conclude that motivation was quite individual and it was highly dependent on the students themselves. The students' engagement was very different; while some gave a minimum effort and just performed the tasks assigned by the project manager, others were active in planning and involved in the design work.

The opinion of the staff: Obviously a lack of motivation was one of the main reasons of the project problems. One explanation why the motivation of the majority of the students was low, were unclear project requirements, and (wrong) expectations that the course is easy to pass.

Tip 6: Remember: we are different

The project team was composed of six students from five different countries (Croatia, Germany, Macedonia, Portugal and Nepal). Also, the students had already obtained their bachelor degrees at their home universities, so differences in their level of technical knowledge and skills were to some extent expected.

Mechanisms for dealing with cultural differences proved to be successful in the HoopStats project, since the members showed high cultural tolerance.

In order to increase the overall productivity, the project manager tried to build groups within the team based on the level of skills in a particular technology. Each subgroup was responsible for a particular aspect of the project. The students who were skilled in designing and building the database were responsible for the persistence and the logic of the application. The more creative students were working on the user interface and the students who had substantially lower level of knowledge and skills were responsible for non-critical tasks like quality assurance.

However, due to the different academic and professional background of the students, the project team experienced a number of issues related to the knowledge and skills of the students. The knowledge gap between some students was more than evident. This resulted in decreasing the motivation of the most skilled team members which negatively reflected on the quality of the project deliverables. Although the weak students were reported on time to the course staff, there was no efficient mechanism to drastically improve the situation regarding these issues.

The student's opinion: The implementation of the teachers' tips prevented issues related to cultural difference in the project. This clearly indicated that the tips were good, their implementation successful and the students were tolerant towards cultural differences.

The opinion of the staff: With respect to cultural differences, there were no problems or misunderstandings in the project. However the differences in technical skills were significant and the overall motivation of some students was too low to cover for the deficiencies in their knowledge.

Tips 7-10: Tips for the staff

The last four tips in [6] (*Tip 7: Be flexible – overcome the differences, Tip 8: Be flexible – beat the administration, Tip 9: Be alert, and Tip 10: Be enthusiastic*) relate to the challenges faced by the teaching staff and are not primarily addressing the students. In comparison to the previous instances of the course, the most significant difference was the participation of Politecnico di Milano. While this change introduced some new elements in the course management, and more discussions between the teaching staff from the three sides, from the students' point of view there was no significant change in comparison to the previous year. The projects were organized

between two sites, and there was no significant difference between the results with the respect to the sites. The students were not aware of the administration supporting the course. Some minor technical problems in communication happened, such as occasional lower quality of the sound and video, but these issues did not influence the course performance in general.

Taught from the previous projects, the course staff has learned that working with students requires from them to be constantly alert. Due to the permanent contact with the project team members, the project supervisor was the first person from the course staff who was able to detect issues and to react. In the HoopStats project, the project supervisor recognized the weak performance of some of the team members already in the first half period of the project. In order to resolve the issue, the project supervisor arranged meetings with the project team members and professors. Beside the meetings, some additional measures such as reassignment of project roles were taken to increase the performance of the “problematic students”. The implemented measures had an immediate impact on the performance of the low productive students. However, in most of the cases it had only a temporary effect and the low performance reoccurred.

As more and more issues were arising in the team, the students’ motivation was decreasing. The lack of motivation was evident from the low quality of the code and documentation. As a result of this, the supervisor lowered the initially imposed high standards for the project, which reflected on the grades after delivering the final product. The supervisor’s motivation to encourage the students to achieve the best possible results and to be competitive in the SCORE contest declined with time, and became instead directed towards helping the students fulfill the minimal requirements to pass the course.

The student’s opinion: The tips related to the administration did not have impact on the results. The staff and the project manager actively followed the project state, intervened quite promptly, and probably helped that the project did not show even poorer results.

The opinion of the staff: Due to the repetition of the course during several years, the risk of taking the course as a routine increases, and to some extent that happened this year. The staff was slightly surprised by the lower enthusiasm from the students, which eventually spread out to the staff.

IV. CONCLUSION

The lessons learned from the project and the entire course are the following:

a) The people, their skills and their motivation are the most important factors in success. This is valid both for the students and the teaching staff. In a discussion with the students who were highly motivated and skilled (in most of the cases these two characteristics were in line), the teaching staff

was asked why the student groups have not been composed in the way that the best and the most motivated students work together. That would have certainly resulted in significantly better results in the projects consisting of the best students. However, such compositions would also have consequences that there would be clear winners and losers, and that is not a goal for education in general. This is a dilemma that does not have a final answer, but depends from case to case – and this is also partially related to the expectations from the educational systems in particular countries.

b) It is not the cultural differences that cause the most difficult problems, but the differences in the skills. It was clearly shown that the motivation is tightly related to the skills, and that a too large gap in knowledge between different students causes the main threat to project success.

c) We have experienced that the proposed tips how to succeed in teaching in a distributed environment are significant, but not sufficient. The overall composition of people and the processes (supported by the tools) determines the final result.

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