

TEACHING SOFTWARE PROJECT MANAGEMENT: THE COLLABORATIVE VERSUS COMPETITIVE APPROACH

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ABSTRACT

The implementation and development process of a software project consists of a cycle distributed in several stages which represent the lifecycle of the project. There is a research done by Standish Group 13 years ago which stands that only 16% of software projects are done with success, 53% have flaws and bugs in them and 31% are canceled. Considering this problem, the subject of this article is the comparison between the collaborative and competitive approaches, considering a team involved in the development of a software project.

KEYWORDS: *Collaborative Approach, Competitive Approach, Software Project Management, Teaching Strategies, Mixed Collaborative Competition Learning*

INTRODUCTION

"Let us put our minds together...and see what life we can make for our children." Sitting Bull

Nowadays, the learning methods have evolved so much that the college teachers have a lot of tools to make their students passionate and interested in the courses that they are teaching. Either they use formal or informal education, the teachers have the goal of developing the abilities and technical knowledge of their students in order for them to succeed.

The goal of the universities is to prepare their students to enter the industrial market and be able to succeed. The IT companies listed on the market need students that have knowledge in every IT field.

The students try their best to gain a little piece of knowledge from every course they study in college and in order to achieve that, they have to work hard and practice alone.

Alongside the technical, engineering part, the students need to develop the ability to work as a team, the ability to communicate efficiently and the ability to deliver before the

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deadline. These needs can be fulfilled since college if the college gives the students the opportunity of working together.

Through this article, the authors want to identify the main characteristics of two approaches: collaborative and competitive. They want to discuss the advantages and the drawbacks based on their own experience.

PREVIOUS WORK

Researchers noticed that competition had indeed a positive impact on performance goals and learning motivation in the classroom [10].

According to a study done by Barkley, E. F., Cross [3], the collaborative approach represents the situation where the students work together in order to “achieve shared learning goals”.

Barkley Cross identified which are the main activities for this approach:

- a) For class discussion: ask the students some questions and let them think of an answer based on arguments. After some time, group them into groups of two and let them talk about the question. If they disagree, tell them they have to reach the same conclusion.
- b) For reciprocal teaching: group the students in groups of 4-5 and give them an important field of technology. In a limited amount of time, they have to become “experts” and teach their colleagues all they know about that subject. For everyone to be productive, every student must have their own role: mediator, spokesman, time keeper, note taker, etc.
- c) For problem-solving: group the students in a group of 2-4 and give every group a problem to solve. After a limited amount of time, every team must present the problem and the solution they achieved. The other groups can ask questions or can come with new ideas so that the final solution is the best solution.
- d) For writing: the students will work in groups and they will analyze a subject in order to write a paper. Every student will come with their own ideas which will be written on paper. After the individual work, they have to face their teammate’s ideas and present them in front of their colleagues. The spectators will ask questions and make suggestions. The presenting team will correctly receive feedback from the spectators and improve their article.

Regarding the competitive approach, researchers reached the conclusion that the collaborative approach brings better results than the competitive one, but there are situations in which this is not true.

Johnson and Johnson (1999) [5] have analyzed and identified that there are some constructive effects of the competitive approach in the following situations:

- a) when there are rules and clear criteria for winning (if the rules are fuzzy, the chances for the competition to fail are bigger)
- b) tasks to be done are easy and simple

- c) there are no dependencies between activities
- d) every competitor has equal chances of winning
- e) the prize is not that important

PROPOSED APPROACH

In order to analyze the two approaches, we looked for college situations where the students have the chance to work in a team or compete with others. We consider it as a relevant environment to study because the future engineers learn how to work in a competitive or collaborative way since college.

For the collaborative approach, we followed projects where the teamwork and team communication were more important than the results, so we chose the software projects from “Software Project Management” course.

The competitive approach implies situations where there is a stake for which students are competing.

Also, to find the best student, it must be a clear separation based on strong rules. In this case, we identified the projects developed on the “Artificial Intelligence” course.

Collaborative approach

The “Software project management” team tried every year to use different approaches in the projects requested from students, in order to demonstrate the advantages and the disadvantages of these approaches. Current year (2017), the course team chose to go with the collaborative approach and focus on the steps of a project lifecycle, not just the final result. The teamwork and the communication, the process of establishing the specifications and design, the development and testing cycle were the only things that mattered.

The project from the second half of the semester was to develop a single-player game, called “Type the words!” which tested the player's’ abilities of typewriting. The technology, the architecture, the milestones and the tasks were chosen by every team of students. Since the very beginning of the project, students concluded that for this project to work they would have to collaborate efficiently. By communicating and exposing all of their ideas to the team, by debating every opinion, they had to reach a common point.

Students walked the project to every step of a normal project lifecycle:

1. Project initialization: using tools of informal education (brainstorming, debates, votes, etc.), students analyzed the project's requests and chose the best possible programming language in which the project will be developed, the test scenarios and use cases. Every point here concluded in an SDD (Software Design Document).
2. Project planning: after establishing all the details, students chose the responsible people and the deadline for every task, such that they obtained a plan and a Gantt diagram of the project. Using Microsoft Project, they identified the activities on the critical path and treated them carefully, they were able to modify every

resource based on availability, they saw in a graphic manner the involvement of everyone and they used this as a tool for better time management.

3. Project implementation: developing features, defining test scenarios, defining use cases, testing the project, bug fixing, weekly meetings and final presentation.
4. Project monitoring: done by watching the Microsoft Project planning and through other tools like Git. Other tools for monitoring the project were the weekly meetings and online discussions.
5. End of project: there was a final presentation in front of the other teams when students received questions and feedback and presented a demo. The constant feedback received from the assistant was helpful because it made the students more efficient and better motivated.

A proof of constant collaboration between the students' team members can be seen in the charts below, charts taken from Gitlab platform, which shows how the project has been modified through time:

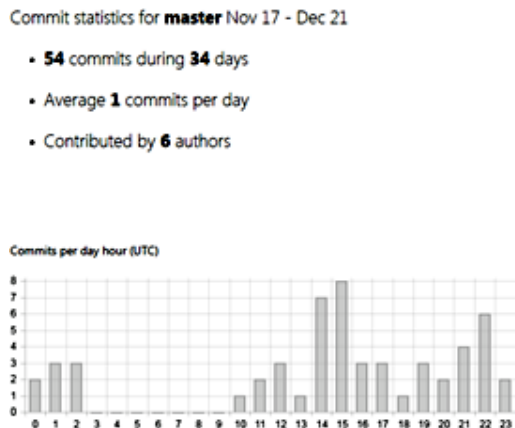


Figure 1. This figure shows the involvement of all the 6 members of a team who worked from November 17 to December 21 with an average of 1 commit per day

For every commit inside the master branch, there was a merge request to solve. Every team member has done his/her work inside a personal branch, making sure that everything was functional before committing the code inside the master branch.

Another advantage of this way of working was that the person responsible for the merge request could give the committer feedback about the readability or even bugs that could pop up. Alongside this, the face to face or online debates helped students clear their thoughts and develop a cleaner and meaningful code.

Another advantage of working in a team is that students learned from each other. For example, they chose web programming as the main technology although there were people which were not familiar with AngularJS. The people who didn't know the framework beforehand had the chance to learn something new that could be useful at some point. Finally, the project used 70.83% Javascript, 24.98% HTML and 4.19% CSS according to Gitlab statistics.

Using the collaborative approach, students were able to simulate the lifecycle of a real project and go through every step involved. In IT companies, every project is done working in a team under a framework of Project Management (SCRUM, AGILE, Waterfall), so this project prepared the students for the real life.

Alongside the environment for implementing the project, the practical class of “Software project management” helped students bound with each other, know a little bit about everyone, learn to listen and learn to accept other people’s opinion. This was something new, something that the college didn’t teach them. The general impression from college until then was that everyone should work individually on his homework, any attempt of speaking or share thoughts about the homework with any other people could be considered as plagiarism.

Concluding the collaborative approach part of the article, we would like to specify that this course brought a lot of benefits to enrolled students and prepared them for a real IT company life, helped them bound, make friends and develop their technical abilities.

Competitive approach

Competition is “a social process that occurs when rewards are given to people, on the basis on how their performances compare with the performances of others, doing the same task or participating at the same event. “ [9]

In order to discuss the competitive approach, we will choose as a subject of matter the “Artificial Intelligence” course inside the Automatic Control and Computer Science Faculty of “Politehnica” University of Bucharest.

In order to pass the class, the students need to sum up a certain number of points along the semester. There are 3 homework projects which are published along the semester and each of them is worth 100 points. There is a special amount of points called bonus points (up to 20) which are given for the homework projects that stands out, measured by having the best (minimum) execution time or the best highest score. Also, the bonus points are given only to the first half of the leaderboard in a gradual manner: the first place would get the maximum number of points, the second place would get the maximum number of points minus a small percentage and so on.

We will present below the 3 homework projects to be performed by a student:

1. The first homework implied the generation of all possible texts, being given a Morse code without separators. The difficulty of the homework consisted of telling precisely where to place the space character in order for the Morse code to become a natural language sentence. The bonus points were given for the best minimum execution time of the program.
2. The second homework implied an algorithm for a cleaning robot. The difficulty of conceiving such an algorithm was the fact that the robot had a certain amount of substances in his inventory, substances which would be consumed when cleaning a room. The bonus points were given for an algorithm which obtained the best score in a certain amount of time.

3. The third homework implied an algorithm of clusterization of a very large set of documents (with approximation 2000). The difficulty of the homework consisted in choosing the best clustering algorithm and choosing the best algorithms of text preprocessing. The bonus points were given for an algorithm that could get the best purity percentage (the obtained clusters that reflect reality the best, have a bigger purity percentage).

The competitive approach in this bonus points was a little bit hidden. Every student, found himself in the situation of asking other colleagues: “What is your execution time for test X?”, “What score does your robot obtain for test Y?”, “What is your purity for the clusters?”. The answers to these questions would determine two situations:

1. One in which the time/score/purity would be lower than the student who asked; in this case, the student who asked left relaxed.
2. One in which the time/score/purity would be higher than the student who asked; in this case, the student who asked gets determined to continue the work on the homework in order to achieve a better, more efficient application.

This would be the first advantage identified in the competitive approach: the students who have a competitive spirit are determined to self-improve through this approach, in order to beat the others and be the best. Usually, competitions bring prizes for their participants, encourage them to play and try to hit the podium. In this course, the prizes were designed only for those who knew they could do more. The students who only wanted to pass the class were not even interested in the performance of their colleagues.

To determine the competitive spirit students, we analyzed the results of the first homework for all the 73 students involved. The best minimum time was 0.006913 seconds, the biggest time was 15.480385 seconds and the average time was 3.249812 seconds. 52 students out of 73 obtained a better time than the average. From these results, we can conclude that 71% of the participants of the “Artificial Intelligence” course have a competitive spirit and did their best to win.

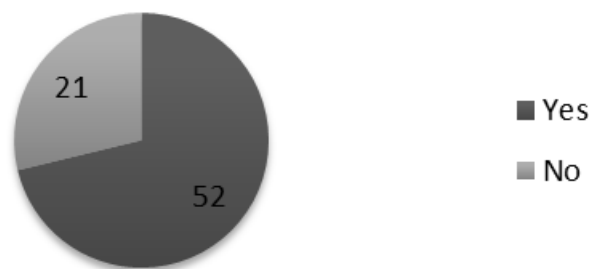


Figure 2. Competitive Students

The figure 2 shows how the 73 students, who solved the first “Artificial Intelligence” homework, are separated. Only 21 students got a smaller than average time.

From our point of view, if more than 50% of the students participated in this competition for the bonus points, we can say that the competitive approach reached his goal. Another

advantage of the competitive approach is that not only the main person is encouraged to self-improve, but even the others.

Inside a team, the competition is not beneficial since it leads to forgetting the team objectives. Forgetting the team objectives might lead to forgetting the personal objective. In this case, it can lead to conflicts and misunderstandings between colleagues, and the people with a high competitive spirit can lose their potential. Although, Triplett [11] found that cyclists perform better when racing with or against other people, than alone.

According to the examples above, both the collaborative and the competitive approaches are efficient. From our point of view, the collaborative approach is focused on people, while the competitive approach is focused on knowledge. In a real life job, the best approach possible is one that focuses on both the development of the employee knowledge and the personal growth of the individual.

By looking for situations that represent a mix of both approaches, we found opportunities for students in which they could work in a team competing against other teams.

First, we identified the hackathon concept. According to Wikipedia [8], a hackathon is an event where multiple programmers and other people who participate in the software development cycle (designers, project managers, etc.) work together in order to develop a software project in a limited amount of time. The participants work in teams and obey the rules in order to win a prize. Examples of such competitions organized by the “Politehnica” University of Bucharest are Innovation Labs, eeStec Olympics, BEST Engineering Marathon, IT Fest.

These competitions are created especially for students with a technical background, in order to teach them how to work in a team for developing an IT project.

CONCLUSIONS

In this article, authors analyzed the collaborative and competitive approaches considering real examples from our host university. In order to identify the advantages of the collaborative approach, we used the software projects proposed by “Software project management” course and for the competitive approach, we discussed the “Artificial Intelligence” homework’s bonus system.

By doing this comparison, authors believe that a combination of these two approaches is the best for IT projects. As [12] states: “One benefit of the competitive-collaborative approach is that the failure of a team in the final functionality does not produce the failure of the entire project, a scenario very likely for a large project built on a collaboration basis”.

Although software companies are mainly focused on strategies that encourage the collaboration, people are different and have different needs. Some people will feel better if they are appreciated, accepted and useful, others consider that only the best succeed and they act so. If we were to select one of the two approaches, we would choose the collaborative approach because the competitive approach might be dangerous and hard to manage.

For a competition to be fair, the participants must have equal knowledge so that the best would win. In real life projects, the resources are like the pieces of a puzzle who sums up to the project's success. People work with other people to do things they cannot do on their own, so this is why other people's support is very important in reaching the project's purpose.

That being said, authors conclude by underlying the fact that the benefits of the collaborative approach are more than the benefits of the competitive approach and we hope that in both academic and professional environment there will be a balance between the two, such that they reach both their benefits.

FUTURE WORK

The future work will focus on discussing and analyzing how the two approaches could be integrated into the student projects, in order to determine students grow both personally and professionally.

Also, authors will try to discuss with some of their university teachers the possibility of creating homework that facilitates working in teams for the first year students. Also, we will analyze the possibility of creating homework which has a small bonus part (with approximation 20%) obtained for the best performances in order to encourage the students with high competitive spirit, as the "Artificial Intelligence" course's homework did.

Another future work area will be to focus on the collaborative approaches mixed with competitive approaches as discussed in voting-based strategies [20][21][22][23].

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