

# Measuring team member performance in Scrum - case study

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**Abstract-** Based upon information received from the industry, one can define the knowledge and skills that are required for an engineer aiming to work in the IT industry. In this paper the authors present a possible method by which the learning process can be made more efficient. The authors highlight some advantages of the project-oriented approach in a programming course at Subotica Tech, an institution that educates professional engineers. In that course the students are developing applications for mobile devices. This novel method is based on the inclusion of the great number of demands from the industry, which the future engineers meet upon entering this sector.

## I. INTRODUCTION

Modern industrial societies generate a huge need for well-educated engineers. The need is especially great for those who completed their computer science studies. Key goals for higher education institutions include the need to educate, to teach, to transfer the up-to-date knowledge materials and techniques. Based on the requirements formulated by the industry [1], Subotica Tech is also trying to adapt the curriculum and the students' competence to the needs of industry.

The growing need, or seen from another aspect, the considerable lack of IT engineers can be explained by the following facts:

- Education is always one step behind in teaching or applying the new, current, or even the latest technologies. ICT is a very dynamic field which produces new technologies at a greater and faster rate than other fields. It often happens that while the curriculum is under development, the described technology changes to such an extent that by the end, when the curriculum is finished, it is not current any longer.
- Education produces different results in terms of competencies and acquired skills. There are numerous reasons for that, including the different teaching methods or equipment used in the learning process, or the difference in the students' level of motivation. Another problem must be mentioned, causing lower knowledge and skill transfer: the motivation of the educators. Their knowledge, skills and motivation are crucial for a successful teaching output.
- Students learn fundamental engineering knowledge, but they do not know how to implement it in real situations.
- Most of the curricula teach schemata for solving problems. The students' creativity is suppressed.

- Besides fundamental engineering skills, there is also a growing need for communication skills and the ability to work in groups.

## II. PROJECT VS. PROBLEM BASED LEARNING

In this section the authors explain the main characteristics of project based learning. First, it must be described what the difference is between this approach and problem based learning. There are certain similarities between these two, though they are not the same. The main similarities are [2][3]:

- Focus is on an open-ended question or task.
- To provide authentic applications of content and skill. Emphasize student independence and inquiry.
- They are longer and more multifaceted than traditional lessons or assignments.
- Build skills for 21<sup>st</sup> century success

The main differences can be described as [4]:

Project Based Learning	Problem Based Learning
Often multi-subject	More often single-subject, but can be multi-subject
May be lengthy (weeks or months)	Tend to be shorter, though can be lengthy
Follows general, variously-named steps	Classically follows specific, traditionally prescribed steps
Includes the creation of a product or performance	The "product" may be tangible or a proposed solution, expressed in writing or in a presentation
May use scenarios but often involves real-world, fully authentic tasks and settings	Often uses case studies or fictitious scenarios as "ill-structured problems"
It is easy to integrate it into the content of the course, while at a problem-solving course, the content is more difficult to define	Problem-solving is hard to integrate into curriculum
Working on a project means managing deadlines and resources	Managing resources is not so specific
The project mainly requires the use of already existing knowledge	Problem-solving emphasizes the acquisition of new knowledge.

Apart from the fact that the terms Project and Problem based learning are very often intertwined, the previously

described differences highlight that these two approaches have different terms of implementation. Nonetheless, both learning approaches are methods which can supplement the classical teaching system.

On the web page of the “Problem Based Learning Initiative” [5] there are interesting cases of applying PBL in medicine. Those cases and from other researches [6][7][8] describe important characteristics of PBL. Some of the prerequisites of using PBL efficiently are:

- Students must feel responsibility for their education. Since this is the approach in which the student is in the centre, it is expected that the motivation for acquiring new knowledge increases if the student feels responsible for troubleshooting, project development and management of these processes.
- Tasks that can solve these approaches must be arranged to allow a variety of ways to reach a solution. What is called in everyday life a “problem”, has complex character, otherwise it would not be called a problem. One of the most important skills that students can acquire through the PBL approach is the problem recognition and defining those parameters that could lead to solutions. If the task is not complex enough, and the way to the solution is relatively well defined, then the students are less motivated to create their own specific solution.
- In the process of solving the problem it is preferred to apply the knowledge from various disciplines, or scientific fields. Different perspectives lead to a deeper understanding of the problem and the creation of better solutions.

### III. MOTIVATION

Three years ago, the authors introduced Project Based Learning at Subotica Tech. The new approach was implemented in a course about development Android applications. The reasons for using PBL are:

- Mobile phone applications are solutions for real world problems.
- The applications are complex in nature.
- There are many solutions to the problem.
- Development requires knowledge from many fields of information and communication technologies.

While the previous list described advantages of using PBL from the students’ point of view, here follows an account of how the teacher can also benefit from it.

From the teacher’s perspective, presenting the capabilities of Android OS and the implementation of that knowledge in the app development requires far more time than is available in the semester.

Even if the teacher reduces the material about the Android operating system, the problem still remains, because it is possible to develop a wide range of different types of applications. For example, the teacher can focus on developing games, or geolocation apps, or some entertainment app (listening music, chat etc.) or even financial apps. Different types of applications use different features of Android operating system. One semester is sufficient for a deeper understanding and acquiring skills to develop one type of application. Since this is a complex

area, the question arises as to whether a teacher has to decide what kind of applications the students need to learn to develop?

The opportunity for students to choose which type of app they want to develop, means additional engagement and learning for them. The motivation for these additional activities can be easily achieved because they will develop whichever type of app they prefer, the one that they prefer the most.

The teacher’s role in the PBL approach is changed. The teacher takes on the role of a mentor or a coach. He teaches only those part of curricula which are needed to start the development. The rest of the required knowledge necessary for the project is then learnt by students.

Transfer of responsibility for learning is useful for students as well as also for the teacher. From the perspective of the teacher, this means that the pressure of constantly monitoring the changes in the IT technologies is reduced. Also it reduces the collision with the competencies that students can have in the given field.

Students’ competence in specific IT area may be larger than the teacher’s, because students can spend much more time studying the given technology which they are interested in. Less confidence due to the lack of competence, can lead to a lower quality of education.

### IV. IMPLEMENTATION OF P(ROJECT)BL

The students’ work load in the college course in which the students learn the technologies related to the Android mobile applications is:

- Learning the theory needed to start developing mobile applications.
- Parallel to the previous theory, they learn agile project management methodology.
- After completing the theory, they start with the developing phase.

During the semester the application development is managed using the Scrum methodology (or framework). Scrum is an iterative and incremental agile software development framework for managing product development. It defines "a flexible, holistic product development strategy where a development team works as a unit to reach a common goal", challenges assumptions of the "traditional, sequential approach" to product development, and enables teams to self-organize by encouraging physical co-location or close online collaboration of all team members, as well as daily face-to-face communication among all team members and disciplines involved. [9].

Implementing Scrum in education needs to be done in a different way than in the industry, because the participants are students with little experience in developing software, and there is also a difference in rewards or penalty methods. The other aspects of Scrum were implemented as if it was a real software developing firm: students used all available tools and events provided by the framework. The only major difference between the suggested and the applied method was the number of student in the group. The suggested size is between 5 and 9 people, but in the college course the authors worked with smaller groups. Depending on the project’s complexity, the number of students varied from 4 to 7.

The projects which were developed throughout the semester were client-server type applications. The client application was a mobile app, which does some task locally and communicates with the server. The server manages the communication with the client: it stores the received data, presents some statistics, or sends data from database upon client requests. All the applications have logging and integrated security options.

The entire huge theory of all the technologies required for the developing process cannot be presented in a single semester in one subject. This is why the students have to do additional work by themselves: they become responsible for the project's future, and in order to achieve success, they have to learn some of the material on their own. Additional learning thus entails additional motivation. The Scrum project management framework tries to help in this process with the following features:

**Team work.** Development is a group task. The group selects a project from the list of problems independently and without external pressure. As mentioned before, in this way, the group will be developing a project that matches the interests of the team members. Each member of the group has the equal rights within the team. Everyone has a responsibility towards the other members and is jointly responsible for the successful implementation of the project. The failure of the project is a failure of the team.

**Transparency.** During the semester the students are developing the selected project. They specify the project options and priorities in the development process with the teacher. The Scrum tools and events help to track the state of the development, how efficient the group or a given student is. In terms of motivation, it is very important for the group members to have a clear picture of each other's contribution in reaching the common goal. In Scrum, one should not speculate how much the others contribute to the project. There should not be an atmosphere in which an individual thinks he or she is doing more than the others, because it causes a lack of motivation and uncertainty in the project's realization

**Motivation.** The group is formed by the students. There is no external influence on the structure of the group. Students receive the description of the project in the form of short sentences. Those sentences describe the options that the customer wants to be implemented in the project. A brief description, called a 'story' in Scrum, contains only sparse information about the required option. By default, the customer knows only what he wants as an option in the application, but does not know which IC technology to use in order to develop that option. Due to the lack of specific orders, there can be several suitable solutions. This is convenient for the students, because they can design their own solution.

There are a number of aspects which have positive impact on students' motivation. For example, the group member determine the task distribution and the resources needed for accomplishing it unanimously. Thus, every member can be allotted a task which is exciting them. The pace of achieving the goal is also determined on a group level. By this, the task distribution and the load are equal in the group.

This approach takes into account the fact that in the group, there are students who have different areas of interest, as well as various skill sets. The heterogeneity of

the group is desirable because all members bring their different perspectives to the task, making it therefore easier to understand the problem, and leading to better solutions.

As briefly summarized in the previously sections, the implementation of the PBL approach and Scrum methodology leads the authors to expect that students will be motivated to learn independently and apply what they have learned. This way, they will acquire the ability to identify problems and skills for designing one possible solution. It is worth mentioning that through teamwork, students also practice communication skills. Further, on Sprint Demo events, they have the opportunity to test their skills as presenters of the project. These are skills that are also among the fundamental engineering skills required in the real world.

## V. RESEARCH RESULTS

The main goal of the research was to define the method for objectively marking the students' contribution through project developing.

Before this research, based on the Scrum suggestion that it is only the group that counts, the authors formed the mark for the students on a group level. It means that the project's development was the key parameter which defined the mark for the students. Unfortunately, because every student in the group was given the same mark and no difference was made between the individual students' contribution, some dissatisfaction appeared. This motivated the authors to look into the group dynamics and the functioning of the group and its individuals.

The study is based on data from questionnaires filled in by the students in the previous three academic years. The number of questions and types of questions in the questionnaire was changing because authors experimented with the applications of the Scrum framework in the learning process. In the current academic year, certain questions were added in order to gain a better insight into developments and the contribution of the individual to the success of the team.

The study involved third-year students of Subotica Tech. The questionnaire varied in length, the shortest questionnaire included 22 questions, while the last in the series was the longest with 39 items. There were MCQ type questions, those with the Likert scale of five degrees and those where students could write answers in textual form.

Many of the questions were related to the Scrum project management system and its options. The answers to these questions are not relevant for this study and therefore they will not be presented within the scope of this paper.

One of the question from the questionnaire was: *How noticeable was the positive contribution of the individual in the group?*

A large number of students answered that they noticed when "certain members" contributed more to the success of the project than others (Fig.1). The answers are probably the result that every individual believe that they were the ones who pushed the group the furthest. The answers also point to underlying problems within the group. These problems have to be solved, because in the long run, they reduce the motivation of team members.

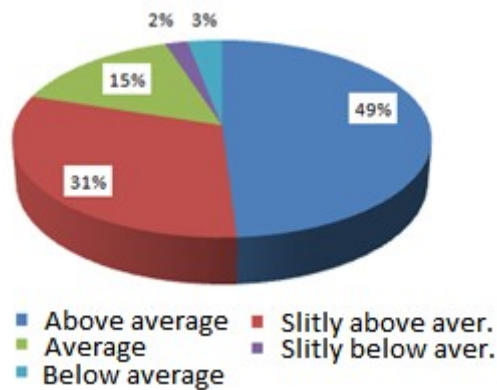


Figure 1. Contribution of the individual

Another question was formulated with a similar content: *How noticeable was the negative contribution of the individual in the group?* Through the answers one can gain information about how satisfied the individual was with the quality and quantity of tasks done by other members. The answers, as for the previous question, showed that there was a problem in the system, because, despite the fact that the tasks were assigned under the coordination and with the agreement of all the members, most of the students think that a lot of the members were doing less than the student answering the question. The obtained answers highlight that 41% of the student agree a lot, that there is a member in the group who does not contribute enough. Another 20% of the students agree with the previous opinion, and 31% do not have an opinion. The rest of the students stated that everybody contributed the same.

The previous two questions highlight the problem that the implementation of the project management system in the learning needs some adjustments. The teacher cannot help in those situations, because he does not see the whole picture of all the happenings within the group. Usually the students solved any arising problems themselves. Because the whole team is responsible for the project, those solutions usually mean that somebody in the group takes the task over from the others. This is a typical students' solution, and it is not sustainable in the long run.

The next question relevant for analysis referred to the acceptance of the new methodology in learning: *Estimate how important it is to have someone in the group who will lead the project?*

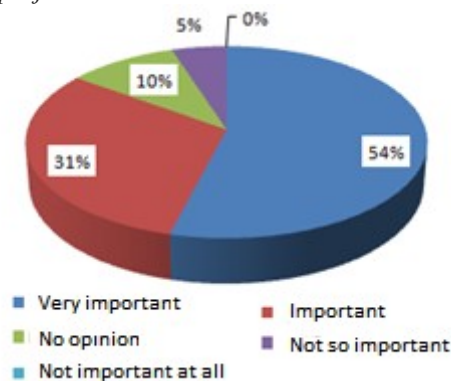


Figure 2. Importance of having a 'leader' in the group?

Although many students liked the idea of working in a group, where there was no hierarchy, the answer to this

question shows that students still need someone, a classic 'boss', who will manage the project development (Fig.2)

This can be explained by the fact that the students do not know how to fully adapt to the method in which they themselves are responsible for their own learning. Their educational processes, in primary, secondary and higher education were mainly of the frontal type. The students always had a "person who manages everything". Maybe this is a sign that the PBL approach should be implemented increasingly in primary and secondary schools.

Since this year, the questionnaires also included questions in which the group members could assess the work of their colleagues in the same team. Some of the questions on which each member of the team could grade the others with a score from 1 to 5 are:

- How reliable was he/she in the team meetings?
- Has he/she always accepted the job they were assigned to?
- If someone asked for help, did the he/she offer assistance?
- On team meetings, did he/she have constructive suggestions?

Unfortunately, most of these questions did not provide specific information. Also, the lack of previous PBL experience had some effect on these answers. For example, an experienced person can responds more easily to the question of how trustworthy someone was at the meetings than a student with no previous work experience.

To the question about assigned task acceptance, students gave the same grade to everybody in the group. Further research is needed to gain answers as to why someone gave, for example, the mark 2 (a very low mark) for everybody and also for himself. The same questions could be asked in the case when the answer contained the highest mark. Only 5 out of the 60 students' questionnaires contained answer in which the team members were graded with different grades.

The authors also found that there are contradictions between answers to different questions in the questionnaire. The examples include the following:

One the one hand, the answers showed that most of the students were satisfied with the communication within the group. Later, when asked how the group could be more effective, the answer was 'with better communication'. Also, those students, who stated that the communication was good, later when asked about the poor quality of the product (not all groups were successful in their development), answered that 'the communication was bad'. Further contradiction can be found in the questions when the students first gave a bad rating of the teammates' contributions, but afterwards, in another question, they stated that all of the options of the project have been maximally achieved.

There are also thought-provoking answers from students who have come from another study program, and they had obviously less knowledge of the required computer science techniques. They cut down their own scores realistically when asked about their contribution. However, at the same time, when asked what they would change for better efficiency, the answer was: nothing.

Also, they stated that the project development process was well done, besides their poor contribution.

## VI. CONCLUSION

Agile project management and PBL approach was applied at Subotica Tech since the academic year of 2014/2015. For the past three years more than 170 students participated in the development of more than 50 ICT projects. Based on the answers to the questions from the surveys that the students filled in at the end of the semester, it follows that the Scrum agile management system is accepted by the students:

- 67% of them is satisfied with the possibilities of the Scrum.
- Approximately half of the students were satisfied with the structure of the group, with the work in the team and the way as the development was done.
- 47% of students were satisfied with the fact that they were allotted the task that best suited them.

In addition to the positive experiences, there are also some shortcomings that can be deducted from the questionnaire but also observed through conversation with the students. Differences in motivation for creating application, quality of developed solutions, working habits, level of teamwork skill, learning approach and ultimately individual goals lead to different levels of contribution in project realization.

The project management system contains options for solving these problems, but these solutions also work well in industry where team members have a different status, and there are better methods for influencing someone's motivation.

Applying project management in an educational environment needs specific implementation. The data from the questionnaires was used to gain more specific information about Scrum implementation and happenings within the group.

The authors also researched how the number of students affects the project success. The number of students in the group changed from 7 to 5 and finally, at the third year of Scrum and PBL implementation, to 4. With the lowering of the number, the authors expected a better insight into the team's functioning. The assumption was there would be fewer opportunities for hiding someone's low-level contribution. But this step generated new problems connected to the PBL approach:

- The solutions do not have adequate quality because there is no real discussion, brainstorming about the solution in the group.
- The solution from the student who accepted the task becomes the one single solution
- Due to the small number of students in the group, it can be said that teamwork, helping each other etc. does not work well.

The problem of the objective evaluation of a student, based on the questionnaire data, has not yet been resolved. The grades that present the acquired knowledge and skills are still formed based on the student's achievement during an oral exam. A paradoxical question arises: should an individual be measured in a team work? Many project management experts unanimously say there is no need for that.

The Scrum spirit means that everyone jumps in to help; ideally, all team members work together on all of the stories. Different skill levels or types contribute to the best of their abilities. To create metrics for individuals, besides being inaccurate, would probably cause competition and division within the team. Individuals should work as a unit, be tracked as a unit, and succeed or fail as a unit. [10]

Many will agree with the previous statements, that there is no need for any metric to track individual performance. But, if there is no measurement of individual performance, therefore it may work negatively for a person who is a high performer. People need to be rewarded by their contribution in the team, otherwise, they will stop working more than what is expected from them.

Another important question arises from applying the Scrum spirit: How can an agile company promote employees? There will be no promotion and career development if nobody pays attention to each team member individually. In order to promote employees one must use any metric or technique that is not only "working time at the company." [11]

There is a suggestion to use the following five metrics for measuring team member performance [10].

**Attendance.** First and foremost, it is important to look at whether a team member shows up to work or not.

**Helpfulness.** Helpfulness is important for fostering a culture of teamwork, allowing your team to perform better when tackling difficult tasks together.

**Efficiency.** Team members need to be able to complete their work on time - Look for missed deadlines, or work that suffers as a result of cramming for deadlines, for clues as to how efficiently a team member is working.

**Initiative.** It is nice when those you work with ask what is needed and where they can help. It is even nicer when they see a need and take steps to meet it on their own. Initiative is definitely a sign of team satisfaction and engagement.

**Quality.** Members who care about what they do and are engaged in work will likely perform better, and it is a good idea to recognize the resulting achievements.

After defining these metrics to measure one's performance, there is still a doubt about implementation, because for example, how can we quantify the performance of the 'rock star' member of the team?

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