HOW SCRUM IMPROVES PROJECT-BASED COURSEWORK AT UNIVERSITY

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Abstract

In this paper, we describe our experience and knowledge from applying the Scrum methodology into the learning process of a study program called Business informatics at Department of cybernetics and artificial intelligence. It combines informatics like software development or data analytics with economical knowledge, such as financial markets trading, enterprise economic analysis or e-commerce. This combination produces valuable graduates for the IT market consisting of cooperating companies from a cluster named Košice IT Valley. Since some of them started to use Scrum in their development processes, they welcomed our effort to familiarize students with this approach. From our point of view, Scrum helps our students to improve their study results and various personal skills.

Keywords: project-based learning, creativity, effectiveness, Scrum.

1 INTRODUCTION

The Buck Institute for Education defines project-based learning (PBL) as “a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks.”. John Thomas [2] explains that PBL requires “complex tasks, based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations”. In general, students work in small groups and act as self-managers. They are responsible for planning, resources allocation, research, implementation, and finalization. The teacher acts as a mediator and a motivator. He supports students with necessary guidelines and feedback but is not involved directly in the tasks implementation. PBL is only possible in classrooms where teachers support students by giving sufficient guidance and feedback. Results and experiences with PBL are mixed.

K. Gary in his work [1] described his experience with MOOC (Massive Open Online Courses) on data science. He states the repeated, sustained team interactions on scalable complex problems as a major advantage. PBL had a positive effect on students with average to low verbal ability and students with little previous content knowledge [3], [4]. Within the PBL, students obtained useful, real-world content knowledge potentially usable for their future tasks [11] and benefitted from improved critical thinking and problem-solving skills [3]. A. Kolmos and E. de Graaff [7] identified following competencies as very desirable for industry and modern knowledge society: ability for critical thinking and analysis; problem solving skills; project management skills; communication, negotiation and conflict resolution skills. Some findings draw attention to the negative aspects of PBL, e.g. different groups’ levels [8] or sustainability [9]. K.J. Chua et al. improved an engineering education with some facilitating methods and divided the students into two classes (experimental and control) [10]. Several studies found that PBL was challenging not only for students, but for teachers too. A collective of authors [6] identified some barriers to successful PBL implementation like it was time consuming, teachers could not control the information flow or it was hard to design an assessment. Nowadays, we can improve the traditional concept of PBL with some new principles like gamification aiming to maximize enjoyment and engagement of the students through game elements [5].

E. Scott et al. in their work [13] analysed a relationship between learning styles and Scrum used by student for the first time. For this purpose, they mined association rules from the students’ interactions with a virtual supporting Scrum tool. Based on the reason that Scrum is one of the most used frameworks in IT sector; some authors focused on filling the gap between industry and academia, e.g. a case from Thailand [14]. The paper [15] describes authors’ eight years of experience in teaching agile to various groups of students at different universities, in different cultural settings, and in a number of courses and seminars. A paper of V. Mahnič [16] offers a review of studies available in...
Scopus database devoted to the application of Scrum to teaching. Santos et al. presents some lessons learned resulted from adopting some Scrum practices in a R&D project and simultaneously using UML models, which are not commonly used in agile processes [17]. Some guidelines how to start with teaching Scrum at the university level are described in work of M. Jeffrey, J. Work and D. Lending [18].

The study program Business Informatics produces graduates with a combination of informatics and economic knowledge/skills in all three levels (bachelor, master, PhD.). The bachelor’s degree study programme graduates are familiar with the importance, role and changing business value of information systems and information technologies in the practice, from standard software for automation of offices, through various enterprise information systems and, systems for support of management and decision-making processes up to the business analytics tools. They are able to participate actively in development, implementation and operation of various types of commonly used information systems (ranging from simple web apps through more complex systems for data processing and analysis, to enterprise information systems, management and decision support systems, collaboration support systems, etc.). This combination is currently intensively required by the members of the ICT cluster named Košice IT Valley¹, located in the Eastern Slovakia region (e.g. IBM, FPT, T-Systems or NESS).

1.1 Scrum and eduScrum

Scrum is an iterative and incremental agile framework for managing software product development. It was formalized originally for software development projects, but now can be used for any complex, innovative scope of work. Scrum was formally introduced in 1995 by John Sutherland and Ken Schwaber [12].

Fig. 1 visualizes a traditional lifecycle of Scrum containing three core roles like the Product Owner representing the stakeholder and customers. He/she is responsible to ensure that the delivered value will meet the end users’ expectations and requirements. Product Owner holds the vision and control items order in the Product Backlog. The Scrum master is responsible for coaching, teaching and helping a team to overcome barriers. The last one is the team itself. The number of members of which should be between five and nine. This team works in small and sustainable iterations called Sprints. In an ideal situation, a high performing Scrum team is self-organizing and highly collaborative. The team members are able to create the own schedule estimation or to make decisions with the impact on the whole project.

Product Backlog is an ordered list of items that might be needed in the expected product. Product Backlog is never complete; it evolves in time like the expected product. Sprint Backlog contains tasks

¹ http://www.kosiceitvalley.sk/en/about-kosice-it-valley/
² S. Boyer, certified Professional Scrum Product Owner
selected from the Product Backlog for a concrete Sprint. It is like a forecast for the development team containing functionalities for next product’s version. Sprint is a time box, during which partial results are created. New Sprint starts immediately after confirmation of the previous Sprint’s successful closure. During one Sprint, we can clarify the scope with the Product Owner, but have to avoid endangering the previous goals. Each Sprint has a clear definition about what we have to create. Sprint planning is time-boxed to a maximum of eight hours for a one-month Sprint. Its focus is on what we can deliver and what we need for it. Daily Scrum Meeting is a 15-minute time-boxed day-to-day event for the development team to synchronize relevant activities during the Sprint. They improve communication, identify barriers in development, support quick decision making, etc. After each Sprint, a review is held to evaluate a partial result and adapt the Product Backlog if needed. During it, the team and stakeholders collaborate about what was done. In addition, the team has an opportunity to inspect itself and create a plan for improvements in the next Sprint.

In 2011, two Dutch chemistry teachers deployed Scrum in the teaching process and introduced a new paradigm called eduScrum\(^3\). They gave students an opportunity to work collaboratively, more effectively and to develop their soft skills. They identified some key elements like effective and efficient learning, learning to cooperate better, learning to get to know them better, and learning to be co-creative.

2 METHODOLOGY

We decided to use the 6Ps framework of Oates [19] containing the following aspects of research:

Purpose – we investigated potential benefits of Scrum application for the education process. Our motivation was to improve quality, collaboration, systematic work, communication and presentation skills. We selected a course called Analysis and design of information systems offering basic theoretical and practical knowledge about software development life cycle. We focused mainly on analytical and design phases, i.e. from problem definition, through state of the art, user requirements identification and collection to technical specification containing user scenarios, UML diagrams, architecture, and mock-ups. We divided the students into pairs with own assignment focused on any software product. During semester, we combined Scrum with some active learning techniques like retrieval practice or case-based learning.

Products – we prepared this paper with some lesson learned representing our experience and directions for future improvements, e.g. it was quite complicated to apply the original version of Scrum without any customization. We changed Scrum meetings from daily to weekly in accordance with the course schedule. The higher frequency was a sign of better adaptation.

Process – we specified a research topic, i.e. an application of customized Scrum principles will increase an effectiveness of the project-based coursework from the point of view of students and teacher too. We used a case study as the research strategy with following characteristics:

- One Scrum team = two pairs of students (Scrum Master is one of them).
- Product Backlog = list of assignment parts published in Moodle.
- Product = final assignment in accordance with the course requirements (one Scrum team = two assignments).
- Product Owner = teacher.
- One Sprint = one iteration, one partial version of the assignment. The Scrum teams could specify different number of sprints during the semester.
- One Scrum team = one Scrum task board (Fig. 2)

We collected a feedback using the slido, which is a web-based tool for real-time audience interaction. It helped us to overcome the initial students’ shame of presenting their opinion and asking questions.

We had to work with some limitations, e.g. each Scrum team had its own paper task board due to lack of available whiteboards in our premises.

\(^3\) http://eduscrum.nl/en/
Participants – we divided the students into two groups: experimental and control. The first one dealt with Scrum during their work on assigned assignment during the semester. The second group used a typical way to solve the assignment. In both iterations, we worked with about 40 students (20/20).

Paradigm – constructivists believe that there is no single reality or truth. The reality needs to be interpreted and therefore they are more likely to use qualitative methods to get those multiple realities.

Presentation – we discussed achieved results with our colleagues and people from cooperating IT companies. They expressed a positive acceptance of our approach. Finally, we prepared this conference paper.

3 RESULTS

After two first instances, student’s feedback was mostly positive. They were satisfied with a regularly work during the whole semester and motivated by the collaborative approach. Following two tables contain a result of the satisfaction survey at the end of iterations.

Table 1. Students’ feedback from first iteration.

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good idea, the subject was more interesting as previous.</td>
<td>We were not satisfied with a paper version of the Scrum task board.</td>
</tr>
<tr>
<td>It contributed to our systematic work, with which students had problems.</td>
<td>Lessons were only once per week.</td>
</tr>
<tr>
<td>It motivated us to work effectively during the semester. Finally, we had a less stress.</td>
<td>The involvement of each member was different, so the final effect was not 100%.</td>
</tr>
<tr>
<td>It was interesting; we met new people and learned new things.</td>
<td>The self-planning and tasks arrangement was sometimes complicated.</td>
</tr>
<tr>
<td>We solved the partial tasks continuously. It was a good experience for future jobs.</td>
<td>It was more time-consuming that I expected.</td>
</tr>
<tr>
<td>Teamwork allowed us to help and advise each other.</td>
<td>In one Scrum team, we solved two assignments with different topics (1 pair per assignment).</td>
</tr>
<tr>
<td>We improved our communication and presentation skills.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Students’ feedback from second iteration.

<table>
<thead>
<tr>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>We could use a method popular and trendy around the world. The lessons were improved by practices currently used in IT companies.</td>
<td>I do not like it, because the two assignments in one Scrum team were compared.</td>
</tr>
<tr>
<td>Scrum forced the whole team to work fully. I personally liked to see how many task I accomplished and how many I have in plan.</td>
<td>We had problems to arrange the f2f meetings because of different schedules. Scrum is better for company, in which people work in the same place.</td>
</tr>
<tr>
<td>The experience with Scrum was interesting; it helped us with the assignment to some extent.</td>
<td>For me, Scrum master was sometimes stressful and exhausting.</td>
</tr>
<tr>
<td>We appreciate to try something practical that can help us in the future. It was not only about the theory.</td>
<td></td>
</tr>
<tr>
<td>For me, Scrum master was a good experience, e.g. I learned how to manage the team.</td>
<td></td>
</tr>
<tr>
<td>The collaboration was good; we could help each other. We were motivated by the progress of the rest of our Scrum team and other students.</td>
<td></td>
</tr>
<tr>
<td>Sometimes, it was annoying to prepare the particular results every week, but in general, the systematic work was good.</td>
<td></td>
</tr>
</tbody>
</table>

Some students proposed to replace the traditional paper form of the task board with electronic one; to organize mandatory Scrum meetings directly after the lessons; to control progress not only after the whole Sprint, but also after each week at the lesson.

We can conclude that the groups with Scrum achieved better results that control groups in general, but differences in quality also emerged between them. However, the main advantage was that each pair successfully submitted expected result.

4 CONCLUSIONS

This paper is devoted to the application of the Scrum methodology in the conditions of Slovak university education. Since Scrum is one of the most used frameworks in IT sector, we want to prepare our students to be familiar with it. Overall, this approach is not very widespread in Slovak university education, but the situation will be improved alongside the cooperation with the IT sector.

In summary, the Scrum application had a positive effect on students’ content knowledge and personal skills like collaboration. It increased their motivation and engagement, but we need to continue working on their critical thinking and problem solving. In some cases, they only passively collected required information without any critical review that resulted in lower quality results. Other important factor was nomination of the Scrum Master. In some cases, the students understood this position very well and managed the team effectively. The team members contributed to this positive model with their enthusiasm and willingness to try something new. Some Scrum teams had sometimes problems with effective functioning, mainly caused by unwillingness to do something extra or by lack of managerial skills. We decide to solve these issues with new motivation factors and parallel course devoted to the Project management.

From teacher’s point of view, it was challenging to prepare the whole model and implement it during the course, e.g. Sprint review three times per semester for all assignments. However, the positive feedback from students was the best benefit.

In the future work, we will focus on combination of Scrum and CRISP-DM that represents one of the widely used methodologies for data mining process. It divides the process into six phases with interactive and iterative character, so we observe a potential for an effective combination profiting from the benefits of both approaches.
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