AGILE IN PROBLEM-BASED LEARNING CONTEXT

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Abstract: *In universities, education techniques need to be improved depending on timeliness and market demand. Employers want capable team players able to solve real-life problems. So Agile methods can be combined with Problem-based learning on fulfilling these requirements. The question is if these two can be combined in universities and if students want to learn with the help of these two. The answer is in further research, where an experiment was taken with a group of Software Engineering students who learn in Problem-based learning approach.*

Keywords: *scrum, project, team-work, values, performance.*

Introduction

Problem based learning (PBL) also known as self-directed learning is an instructional approach where students learn by solving challenging, open-ended problems. The problems are authentic tasks and are solved in socially and contextually based teams of students. The students rely on their current knowledge of the problem, identify information they need to know to solve the problem, and the strategies they use to solve the problem [1]. In addition to course content, PBL can promote the development of critical thinking skills, problem-solving abilities, and communication skills. It can also provide opportunities for working in groups, finding and evaluating research materials, and life-long learning.

Agile software development refers to a group of software development methodologies based on iterative development, where requirements and solutions evolve through collaboration between self-organizing cross-functional teams [2]. Agile methods or processes generally promote a disciplined project management process that encourages frequent inspection and adaptation, a leadership philosophy that encourages teamwork, self-organization and accountability, a set of engineering best practices intended to allow for rapid delivery of high-quality software, and a business approach that aligns development with customer needs and company goals. We can easily form a link between these two concepts and find benefit when we combine each other.

What if student groups were self-initiating, self-accountable to the learning at the core of the project? This is real when we suit Agile for PBL students. An agile problem-based learning (PBL) ecology for learning deliberately blurs the boundaries between disciplines, between students and teachers, between students and employers, based on the recognition that all of these elements are interconnected and constantly evolving. Agile PBL approach benefits students in several ways. Namely, it:

1. Provides a contextualized learning environment with a clear "why," as opposed to generic assignments with no relevance outside of the classroom;
2. Teaches students how to respond to, and prioritize, the requirements and needs of a client;
3. Affords opportunities to practice effective teamwork and communication;
4. Exposes students to Agile methodologies;
5. Offers frequent opportunities to practice presentation skills;
6. Provide a robust portfolio of projects that students can show to employers after graduation [3].

All in one, students enter the job market with a set of abilities and practices that actual employers want to find in a potential candidate: team-work activity, critical thinking, presentation skills, Agile experience. So, students apply for a job with a substantially benefit over others.

In the following article, is intended to explain the main methods of implementation of PBL and Agile, to understand if this combined concept is real to implement and if students and mentors gain more benefit from Agile PBL than from simple PBL.

Discovering PBL

First of all, is adequate to define the PBL roles. In PBL teacher is an instructor and students are actors.

Rather than "teach" and provide the answer to the problem, instructors take the role of facilitator, coach and mentor to guide students as they develop new skills and knowledge during the problem solving process. The instructor identifies a problem that is purposely complex and vague yet intriguing enough to excite students to inquire about it, do research on it and draw reasonable multiple solutions or conclusions on the problem. The problem should help teach students new skills they will use for a problem that would be too difficult for them to complete on their own. The instructor should organize students in groups that represent different skill levels and diversity in an effort to achieve more successful team dynamics and outcomes.

While experiencing self-directed learning, students collaborate in small teams to explore the presented problem situation. What follows is a method that summarizes the steps students take to solve the problem situation.

1. Explore the issues related to the problem. Read, discuss and analyze the problem and identify its significant parts.
2. List what your team knows about the problem. Discuss your team members' current knowledge and experiences that relate to the problem. Identify the strengths and capabilities each team member can offer as you explore solutions to the problem. Brainstorm possible solutions and accept everyone's contributions.
3. Develop and write out the problem statement in your own words. This description should be based on what you know about the problem and what you will need to know to solve the problem.
4. List all possible solutions to the problem. List ideas, speculations, and hypotheses about the problem – what are its causes and in what ways might the problem be solved? Order the possible solutions from the most likely to the least likely and choose the one your team feels is most likely to succeed.
5. List actions to be taken with a timeline. List what your team needs to know to solve the problem. List what your team does not know about the problem and ask questions such as, "What do we need to know to solve this problem?" or "Can the instructor provide us with more information?"
7. Write your team's report with the solution to the problem that includes supporting documents. This step can act as a preliminary step that involves a draft report or can be the final report. Check with your instructor on his or her requirements.
8. Presenting and defending your conclusions. An important goal in problem-based learning is to present not only your team's conclusions but also the foundation upon which they are drawn.
9. Review and reflect on your individual and team's performance. This reflection is an important step that will help validate what you learned and how you could improve on the process.

Through problem-based learning students learn to become partners in the teaching/learning process where they accept responsibility for much of their learning, work successfully as a team member, deal with new and changing situations and develop lifelong learning skills [4].

Discovering Agile

Agile approaches are based on an empirical control method — a process of making decisions based on the realities observed in the project. Stemming from the values and principles of the Agile Manifesto, it was created as a response to the inadequacies of traditional development

methods such as the Waterfall method. The software industry is a highly competitive market due to the fact that software is something that can be continuously upgraded. This means that developers need to constantly improve and innovate their products to keep on top of the game—and the linear, sequential approach of the Waterfall method just wasn't cutting it.

If to interpret correctly in PBL can be used Agile project management. What does this mean?

Agile project management is a methodology that is commonly used to deliver complex projects due to its adaptiveness. It emphasizes collaboration, flexibility, continuous improvement, and high quality results. It aims to be clear and measurable by using six main "deliverables" to track progress and create the product. The deliverables:

1. Product vision statement: A summary that articulates the goals for the product.

2. Product roadmap: The high-level view of the requirements needed to achieve the product vision.

3. Product backlog: Ordered by priority, this is the full list of what is needed to be done to complete your project.

4. Release plan: A timetable for the release of a working product.

5. Sprint backlog: The user stories (requirements), goals, and tasks linked to the current sprint.

6. Increment: The working product functionality that is presented to the stakeholders at the end of the sprint, and could potentially be given to the customer.

There are various frameworks within Agile project management that can be used to develop and deliver a product or service. Two of the most popular ones are Kanban and Scrum. Scrum is based in three main dimensions: team roles, ceremonies and artifacts. The team is composed of the Scrum Master (project manager), product owner and team members. There are three main ceremonies, sprint planning, daily scrum and sprint review. Finally, the Scrum approach includes three main artifacts: product backlog, sprint backlog and Burndown chart [5].

Agile PBL

In this paragraph, best practices of these two concepts will be analyzed and will be described the practical part of the article.

From Scrum can be taken sprint periods, sprint planning and Burndown charts. A burndown chart is a graphical representation of the work that is left to do versus the time you have to do it. Using one as part of your agile project management plan enables you to forecast when all the work will be completed. Also, reflection can be practiced, at three levels: individual, team and class.

For the understanding if Agile PBL is good for students, a simulation game was organized for a group of Software Engineering students at TUM, who are studying with Problem-based learning. The name of this game is Easter Egg Challenge and the exercise runs in two rounds: waterfall round & agile round (in that order). The goal of the game is to provide as many colored, paper eggs as possible. The aim of this game is providing clear evidence on how productivity can radically increase when better work methodology is applied.

After Scrum management was simulated in game, a feedback was taken. In the first part, students felt frustrated by the fact that they can't choose the role they want to be, also they considered feedback part useless because they can't change something in production of eggs. From facilitator perspective, they were less organized and interested.

Students mentioned that per overall they felt that they were more productive in the second part and also saw that after facilitator counted the eggs: with 20-30 more eggs than first round. This impress them and they started asking questions about Scrum and its system of values, because one group faced an argument, but all was solved during retrospective faze. They liked the possibility to improve their actions during planning at the beginning of sprint and they said they felt more confident after each sprint. In second part, some minor changes in requirements didn't bother them in second part.

Their common feedback was that they are willing to introduce some techniques from Scrum in PBL projects and that they are interested in obtaining knowledge about this type of project management. So, they are ready to try Agile PBL and improve their learning process.

Conclusions

Problem-based learning is an educational approach of finding solutions to real-life problem. Agile project management is based on making decisions during product development according to circumstances. Agile is welcome to introduce in problem-based learning, because it has multiple benefits on students and teachers. Combining these two concepts can prepare students for being future productive employees and even find a job as Scrum Masters. Much more, Agile PBL can be a good way of personal development for students, because their key-values are individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan for Agile and practicing team-work from self-directed learning.

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