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AGILE LEARNING: USE OF EDUSCRUM IN HIGHER EDUCATION

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Abstract

Eduscrum is a methodology that applies agile project management principles to the field of education. The Scrum methodology is an established approach in software development, where iterative product development is carried out by a small development team in work cycles. Originally, Scrum was an agile framework that originated in software development but has since been adapted to various industries, including education. The idea behind Eduscrum is to apply agile project management principles to education, aiming to be more flexible in addressing the needs of learners, fostering collaboration, and enabling continuous feedback. Eduscrum organizes the learning process into sprints, which are time-boxed periods typically lasting one to four weeks. During each sprint, students and teachers work collaboratively to achieve specific learning objectives. Scrum defines roles which are sometimes difficult to adapt to the educational context. The role of the product owner is often taken on by the teacher, who defines the learning goals and prioritizes the content. The Scrum master moderates the learning process, removes obstacles, and ensures that the Scrum framework is followed effectively. Students take on the role of the development team. Regular meetings, often referred to as "stand-ups" or "Scrum meetings," are held to discuss progress and challenges. These meetings provide a platform for students and teachers to collaborate, share insights, and identify any impediments. The Scrum process includes artifacts, like a backlog to prioritize tasks and charts which track the progress of the sprints. One of the key principles of Eduscrum is flexibility. It allows for adjustments based on student needs, enabling a dynamic and responsive learning environment. Eduscrum promotes regular feedback loops between students and teachers, fostering a culture of continuous improvement. Collaboration is a central theme in Eduscrum. Students work together on projects, share ideas, and contribute to the overall learning experience. The paper describes how the methodology is used in a master's level class for computer science. Content of the course subject is social network analysis. The students work together in small groups. They perform together a self-chosen project and write a research paper together. Every process step is accompanied by the professor and an assistant, in accordance with Eduscrum. Each project group gets constant feedback. The students are guided step by step through the whole process. In the course evaluation, the students state their high learning outcomes, but they find that the projects are a lot of work.

Keywords: *Agile learning, Eduscrum, higher education, science education, social network analysis.*

1. Motivation

Agile learning is essential in today's rapidly evolving landscape as it enables individuals and organizations to swiftly adapt to changing technologies and market demands. "Agile Learning generally refers to the transfer of agile methods of project work, especially Scrum, to learning processes" (Longmuß, 2016). Agile learning proceeds in incremental steps and through an iterative design which alternates between phases of learning and doing. The tutors rather have the role of a learning attendant or supporter (Morcov, 2020).

Agile learning encompasses various approaches that emphasize adaptability, collaboration, and continuous improvement. Scrum-based learning (Fernandes, Dinis-Carvalho & Ferreira-Oliveira, 2021) involves short learning cycles called sprints, regular reviews and adjustments to the learning process based on feedback. Similar to Scrum, Kanban-based learning (Saltz & Heckman, 2020) focuses on a continuous flow of learning. It uses visual boards to track progress, allowing for ongoing adjustments based on current needs. Design thinking in learning (Jamal, Kircher & Donaldson, 2021) integrates the principles of design thinking into the learning process. Learners engage in creative problem-solving, hands-on applications, and collaborative projects. Agile project management for learning projects (Marnewick, 2023) applies agile project management methods like Scrum or Kanban to educational projects. This allows for a flexible and iterative approach to develop learning materials and activities.

Agile coaching and mentoring (Stray, Memon & Paruch, 2020) utilizes agile principles in coaching and mentoring of learners. This may involve promoting self-organization, providing continuous feedback, and adapting to learners' evolving needs. Agile games and simulations (Bruzzone et al., 2014) incorporate agile principles through games and simulations to make learning more interactive. These activities enhance collaboration and deepen understanding of complex concepts. Lean learning (Chatley & Field, 2017) draws inspiration from lean principles, focusing on reducing waste and creating efficient learning processes tailored to learners' needs. Agile e-learning (Chun, 2004) integrates agile principles into the development of e-learning modules. This facilitates quicker updates to content and continuous adaptation to changing requirements. These approaches can be applied individually or in combination, depending on the learning objectives, target audience and available resources. The goal is to create a learning environment that is responsive, dynamic, and aligned with the principles of agility.

Agile learning is necessary to equip students with the skills, mindset and adaptability required to thrive in a constantly changing and competitive environment. It ensures that learning is not a one-time event but a continuous and dynamic process. Research and practical experiences can deepen knowledge in the field of agile learning and clearly outline the strengths and weakness of this methods. This paper follows the approach Scrum-based learning and focusses on the method Eduscrum. This method is explained in the following section. Afterwards, a case study which uses Eduscrum in higher education is described and the experiences are discussed.

2. Eduscrum

Scrum (Sutherland, 2014) is an agile project management methodology widely used by software companies worldwide, but applicable to any area. The Scrum methodology is an established approach in software development, where iterative product development is carried out by a small development team in work cycles. Originally, Scrum was an agile framework that originated in software development but has since been adapted to various industries, including education. The main concepts behind Scrum are team empowerment (the team manages its own work and periodically reviews its internal processes in order to continuously improve), sprint-based scheduling and planning (at the beginning of each sprint, a set of tasks are chosen from the project’s backlog, i.e., work to be done, and a work plan is defined for the sprint) and periodic client feedback. Scrum follows a set of well-defined procedures and events to guide the development process.

The product owner creates and maintains the product backlog, a prioritized list of all desired features, enhancements, and bug fixes for the product. The Scrum team (product owner, Scrum master, and development team) collaborates to select items from the product backlog for the upcoming sprint. A daily 15-minute meeting is scheduled, where the development team discusses progress, plans for the day, and any impediments. The development team works on tasks from the sprint backlog to create a potentially releasable product increment. Every sprint contains the phases planning, implementation, review and retrospective. At the end of the sprint during the review phase, the team demonstrates the completed work to stakeholders, receives feedback and discusses any adjustments needed for the product backlog. In a retrospective meeting reflects the Scrum team on the sprint, identifies what went well and what could be improved and develops action items for continuous improvement. This cycle repeats for each sprint, typically lasting 2 to 4 weeks. The process is iterative, and feedback from stakeholders, team members and the product itself is used to continuously improve the product and the development process. The scrum process results at the end in a completed product. The Scrum framework provides a structured, yet flexible approach to product development.

Scrum defines specific roles, events, and artifacts to help teams work together more efficiently. The Scrum master is a facilitator and servant leader for the Scrum team. This role ensures that the team follows Scrum practices and removes any obstacles or impediments that may hinder the team's progress. The product owner represents the stakeholders and is responsible for defining and prioritizing the product backlog. The development team is a cross-functional and self-organizing group responsible for delivering a potentially releasable product increment at the end of each sprint.

Eduscrum is an adaptation of Scrum to education (Neumann & Baumann, 2021) (Delhij, van Solingen & Wijnands, 2015). The idea behind Eduscrum is to apply agile project management principles to education, aiming to be more flexible in addressing the needs of learners, fostering collaboration, and enabling continuous feedback. Eduscrum organizes the learning process into sprints, which are time-boxed periods typically lasting one to four weeks. During each sprint, students and teachers work collaboratively to achieve specific learning objectives.

Scrum defines roles which are sometimes difficult to adapt to the educational context. The role of the product owner is often taken on by the teacher, who defines the learning goals and prioritizes the content. The Scrum master moderates the learning process, removes obstacles, and ensures that the Scrum

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framework is followed effectively. This role is taken on sometimes by a student, sometimes by a teacher. Students take on the role of the development team. The Scrum procedure is adapted to Eduscrum: The teacher creates an educational backlog, a prioritized list of learning objectives, activities, and assessments. The Scrum team collaborates to select items from the educational backlog for the upcoming educational sprint. An educational standup is a regular, brief meeting, where students and educators discuss progress, plans for the next few days and address any challenges or questions related to the educational tasks. The educational sprint is the learning period: Students actively engage in learning activities, collaborative projects and assessments outlined in the sprint backlog, with teachers providing guidance and support. At the end of the educational sprint, students showcase their learning achievements, discuss their experiences, and receive feedback from educators and peers. The educational retrospective is a reflective session where students and educators discuss what worked well, what could be improved, and collaboratively plan adjustments for the next educational sprint.

This iterative learning cycle repeats for each educational Sprint, allowing for a student-centric, adaptive, and collaborative approach to education. The Eduscrum framework emphasizes active student participation, continuous feedback, and a focus on achieving educational objectives.

Regular meetings are held to discuss progress and challenges. These meetings provide a platform for students and teachers to collaborate, share insights and identify any impediments. The Scrum process includes artifacts, like a backlog, to prioritize tasks and charts, which track the progress of the sprints. One of the key principles of Eduscrum is flexibility. It allows for adjustments based on student needs, enabling a dynamic and responsive learning environment. Eduscrum promotes regular feedback loops between students and teachers, fostering a culture of continuous improvement. Collaboration is a central theme in Eduscrum. Students work together on projects, share ideas, and contribute to the overall learning experience.

3. Case study

In a master's degree class of the computer science department, the Eduscrum concept is implemented in a course which contains subjects of Social Network Analysis (SNA). SNA is an interdisciplinary field of study that investigates social structures and relationships by analyzing the patterns of connections among individuals, groups, organizations or even countries. SNA enables researchers to visualize and quantify the complex webs of social interactions that shape human behavior and outcomes. SNA draws on theories and methods from sociology, psychology, anthropology, economics, computer science, and mathematics to study social networks. SNA is a useful tool for studying a wide range of social phenomena, from the spread of diseases to the adoption of new technologies, from the emergence of social movements to the evolution of organizations. SNA has been applied in various fields, including sociology, political science, communication studies, marketing, management, and health care (Fu et al., 2017). It has also been used to study online social networks, such as Facebook, Twitter, and LinkedIn (Schötteler et al., 2022).

The students of the master's degree class worked in teams about three to five persons on a project which they had to choose themselves. It was their task to define a research question, collect data, analyze and interpret this data. The result of their project is a research paper which describes their project work. They took over the role of the development team. The role of the product owner was taken over by the professor, who defined the requirements. A PhD student, who is an expert in the field of social network analysis, took over the role of the Scrum master. The PhD student assisted the students answering a lot of technological questions and guided them through the development process.

After the definition of the roles, the tasks for the backlogs were formulated. The tasks for the single sprints and the time slices (between 1 and 4 weeks) were defined by the professor. This is an adaption of the process. because the course must fit chronologically into the structure of a semester. The professor sets the subgoals to be achieved, to reduce the complexity of the project for the students. Another adaption of the model was the fact that the students got professional input about the learning materials before every sprint.

The course was structured as follows: In the first lesson, the professional input contained the theory of SNA. The students learned what social networks are and how to analyze them. The methodological input was how to formulate a research question. Students got their first task: the definition of their research question. This was their first sprint.

For the second sprint, the students got input how and where to find relevant literature and how to write literature excerpts. The task was the systematic search for relevant literature in the particular research domain. The expected result of this sprint was an overview of the relevant literature in their research domain.

During the next sprint, the students had to write a research exposé about their projects. They heard explanations of relevant metrics and their meaning in SNA. The students learned how to conduct a SNA, which tools they can use for it and how to interpret the metrics. The students learned how research exposés were structured and had to write their own exposés. In feedback loops (the review phase of the sprint), the exposés were discussed with the professor.

The following sprint included planning and executing the data collection and designing a hypothesis model. The students heard explanations about statistical methods for their data work. They learned how to produce and interpret statistical metrics. They learned what they have to consider for their data collection when they execute surveys, interviews, observations and data scraping. This sprint lasted 4 weeks because of the work load. In the review phase, the partial results were discussed.

The next sprint was the data analysis and the interpretation of the results. Over a number of iterations, the results were discussed between the team, the professor and the PhD student. Subsequently, a sprint which included the writing of the research paper followed. The last sprint was the final presentation of the students' work.

4. Evaluation and limitations

While adapting the classical Scrum process to Eduscrum, some limitations were observed: The selection of tasks from the educational backlog is often dependent on a sequence, so that the tasks had to be chosen in a given order. In this project, the selection of tasks for a sprint was done by the professor and not by the development team itself. In this presented course concept, the selection of the learning content was not part of the scrum process. Alternative course concepts may allow students the choice of the learning content. That depends on the specific conditions: whether one can leave that to the team or to the teacher.

The educational standup was not held as a daily meeting because of the class time tables. In our course, it was a weekly meeting. Therefore, it was not a short meeting to discuss the daily task, but a longer meeting to talk about the progress of the project. The review phase of the sprints usually included a number of iterations, until the expected results were reached. The retrospective phase of the sprints was mostly the responsibility of the teams. It depended on the team itself whether this phase was done effectively.

Up until now, three runs of the course with 41 participants organized in 11 teams have been done. The professor and the PhD student worked with the students on their projects in the course of the semester. The outcomes have had a high effect: three research papers have already been published about the self-chosen SNA projects of the students. However, for this concept, two teachers are necessary: one in the role of the product owner and one in the role of the scrum master. Alternative concepts may transfer the role of the scrum master to the teacher or to a student team member.

Like any project-oriented teaching/learning method, agile learning reaches its limitation when the goal is the systematic coverage of a pre-defined curriculum. Because of the high expenditure of time for the coaching of the teams, this format is not suited for large classes.

5. Future work

In the next steps, at our university we will widen this concept to the bachelor's degree program and enable bachelor's students to work on their own research projects according to Eduscrum. As part of this research project, students should create a learning game about a startup company. For the requirements engineering phase, interviews will be conducted with startup companies to generate ideas for the case studies. Afterwards, concepts of gamification will be examined for their suitability, which are best suited for application to this case study. A prototype for a computer-based learning game will be created and tested. First, studies with test persons will be carried out to analyze the attention of the players and the usability of the user interface of the learning game. Findings from the eye-tracking analysis will be used to improve the user interface of the learning game. Afterwards, a questionnaire will be conducted to collect feedback from the participating students about their learning success. The data from the questionnaires will be statistically evaluated to evaluate the success of the project. This project will also be conducted with Eduscrum.

In agile learning, the participants may gain new competencies that are, unlike in classical formal education, directly linked to their work context. In pursuit of individual problem-solving as well as in exchange with the learning team and the coaches, their increase in competencies becomes readily apparent, so that successful learning strategies can also be harnessed in the future. Therefore, the main potential of this approach lies in the practical relevance of the acquired competencies and the demand-oriented communication of contents, techniques, and skills.

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