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ADAPTATION OF AGILE METHODOLOGIES FOR REMOTE WORK IN THE IT INDUSTRY AND PROJECT-BASED E-LEARNING EDUCATION DURING THE PANDEMIC

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Abstract. Under the COVID-19 pandemic, the IT industry and higher education abruptly shifted from conventional in-office to remote work and distant learning. For professional agile IT teams, this rapid turn has not been as difficult as for higher education with its traditional offline formats. The main challenge of remote work has been overcoming the lack of face-to-face interaction to effectively communicate, collaborate, motivate, inform, and make presentations. Using advances in communication technology, the IT industry has successfully adapted the Agile processes to stay productive in the remote-work environment. One of the main tasks of higher engineering education is to teach students practical skills to help them integrate into the industry. Before the pandemic, the Moscow Polytechnical University introduced several new practice-oriented IT programs to prepare students with practical skills of project teamwork based on agile principles. The pandemic presented some program challenges because education has switched to distance e-learning. This paper describes how IT students and educators in the IT Department at the Moscow Polytechnical University adapted Agile practices for distant e-learning and remote teamwork on the assigned projects. It compares it to how the US professional IT teams modified Agile methods to fit their remote work.

Keywords: Agile methodologies, project-based education, motivation, online learning, pandemic

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АДАПТАЦИЯ ГИБКИХ МЕТОДОЛОГИЙ ДЛЯ УДАЛЕННОЙ РАБОТЫ В ПРОМЫШЛЕННОСТИ И ПРАКТИКО-ОРИЕНТИРОВАННОГО ЭЛЕКТРОННОГО ОБУЧЕНИЯ В УСЛОВИЯХ ПАНДЕМИИ

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Аннотация. В условиях пандемии COVID-19 в ИТ-индустрии и высшем образовании произошел стремительный переход от традиционных очных форматов работы к удаленной работе и дистанционному обучению. Для профессиональных ИТ-команд, знакомых с гибкими методологиями, эта трансформация оказалась не такой сложной, как для высшего образования с классическими офлайн-форматами. Основной проблемой удаленной работы было преодоление недостатка личного взаимодействия для эффективного общения, сотрудничества, мотивации, информирования и проведения презентаций. Используя достижения в области коммуникационных технологий, ИТ-индустрия успешно адаптировала гибкие процессы, чтобы оставаться продуктивной в среде удаленной работы. Одной из главных задач высшего инженерного образования является обучение студентов практическим навыкам, которые помогут им интегрироваться в отрасль. Московский политехнический университет еще в 2014 году ввел новые практико-ориентированные программы подготовки студентов, нацеленные на развитие навыков командной проектной работы на основе принципов CDIO и Agile. Пандемия обозначила некоторые методические проблемы, поскольку обучение пришлось полностью перенести на дистанционные платформы. В этой статье обсуждается ряд вопросов, связанных с процессом адаптации гибких методов к проектному обучению, его дистанционным форматам и удаленной совместной работе над заданными проектами. Авторы делают попытку сопоставить базовые принципы проектного дистанционного обучения с тем, как профессиональные ИТ-команды в США модифицировали гибкие методы, чтобы приспособить их к удаленной работе.

Ключевые слова: Agile-методологии, практико-ориентированное обучение, мотивация, онлайн-обучение, пандемия

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Introduction

In 2020, under the COVID-19 pandemic, the IT industry and higher education abruptly shifted from conventional in-office to remote work and distant learning. For professional agile IT teams, which have been using Agile methodologies since the early 2000s and are more adaptive to a fast-changing business environment, this rapid turn has not been as difficult as for higher education with its traditional offline formats. For higher education, it presented a more significant challenge. During the pandemic, educators have tried adapting Agile methodologies and IT industry remote work practices for project-based distant e-learning by IT students. Although e-learning is a widely researched field, there is still a lack of information on the effectiveness of using Agile practices in distant e-learning by higher education students compared with the IT industry's projectized remote work.

After two years of the pandemic going over, one can see changes in working and studying patterns, which may lead to long-lasting working and learning effects. Resulting changes in the cognitive behavior of higher education students present a particular interest for educators.

This paper describes how IT students and educators in the IT Department at the Moscow Polytechnical University (MPU) adapted Agile practices for distant e-learning and remote teamwork on the assigned projects. It compares it to how the US professional IT teams modified Agile methods to fit their remote work.

Methodology

The agile project methodology was born out of the desire to keep up with a rapid and frantic pace in technology. Guiding principles for this methodology have been defined in the Agile Manifesto (http://agilemanifesto.org/). It outlines four values:

- Individuals and Interactions over Processes and Tools.
- Working Software over Comprehensive Documentation.
- Customer Collaboration over Contract Negotiation.
- Responding to Change over Following a Plan.

Twelve practical principles of the Agile methodology were developed based on this guidance (for more details — https://www.youtube.com/watch?v=K31zhyBeJTQ&t=2623s). At least half of these principles focus on efficient teamwork. These principles emphasize such critical for efficient teamwork soft skills as self-organization, collaboration, communication, motivation, information, and presentation. A lot of these skills implied physical face-to-face in-office interactions. This worked well before the pandemic struck. The pandemic brought forward the necessity of remote work for agile IT teams. Adapting Agile practices for remote work has presented several new challenges for project teams. The main challenge of remote work has been overcoming the lack of face-to-face interaction to effectively communicate, collaborate, motivate, inform, and make presentations as it used to be when the team was co-located.

The shift to a remote work environment dramatically changed agile IT teams. Although there is still hope that these changes will not be permanent, the IT industry teams have successfully adapted the Agile processes to stay productive in the remote-work environment. Therefore, it is essential to prepare IT students to adopt these modified Agile processes to be successful in their professional post-education work in the IT industry.

There is a known dilemma with e-learning. On the one hand, students' engagement in e-learning is lower than in face-to-face teaching (Dietz-Uhler et al., 2007), but, on the other hand, e-learning can help students to study more effectively. Effective e-learning is, among all, a well-organized, self-directed, and self-regulated process. However, it demands additional components and competencies from students to show positive results. Marcus Crede and L.Alison Philips (2011) named three components of self-regulated learning: meta-cognitions, motivations, and behaviors, as the essential determinants of high academic performance. Transitioning MPU programs to an online format has also changed educator and student roles by adding new dimensions (Table 1).

Traditionally, one of the main tasks of higher engineering education is to teach students practical technical and soft skills to help them integrate into the industry. In 2014, the IT department of the MPU introduced new practice-oriented educational programs in web technology, cybersecurity, corporate information systems, and other IT technologies. One of the main tasks while implementing these programs was to promote a new learning approach, CDIO (Create – Design – Implement – Operate), throughout the university (for more details: Kachestvo obrazovaniya, p. 26). The programs were built by the curator-teachers from MPU in collaboration with experts from the IT industry. Compared to the traditional academic environment, which involves the interaction of only two actors: educators and students, the new approach involves a four-sided communication scheme. In addition to educators and students, it included an IT industry representative and the educational program director. The director facilitated communications between industry representatives and the academic community. IT industry representatives played the roles of customers or subject matter experts (SMEs).

During the programs, IT students worked in teams, using Agile methodologies and ceremonies, developing hard and soft skills, and creating a portfolio of projects. Each semester they demonstrate the results of their projects to the academic community and industry experts during their exam sessions. Later they have an opportunity to showcase their project portfolios to potential employers.

The entire cycle of students' agile project work comprises five stages: 1) pre-project (formulating problems, suggesting solutions, stating the scope of work), 2) documenting the project (writing technical specifications, describing technology stack), 3) developing the project (incrementally designing, developing, testing, deploying, and demoing the results), 4) presenting final results to the IT industry customers and academic community 5) post-project (receiving feedback from the customers).

This program worked well before the pandemic struck. The pandemic presented some program challenges because education has switched to distance e-learning.

Table 1

Educators and Students in project-based offline and online education

Format	Educator's role		Student's role	Competencies and Tasks
Online / Offline	Lecturer	Offline group work	Audience	Traditional formats of knowledge assessments: tests, exams
Online	Online lecturer	Videoconference streaming		
Online / Offline	Academic representative	Knowledge transferring	Members of the junior academic community	New formats: Virtual conference (VC) and interactive platforms tests
Online / Offline		Competencies development	Members of the junior project team	Practice/research results demonstration
Online / Offline	Moderator of the training process	team work organisation		Team work results demonstration
Online / Offline	Academic courses author	Methodical work, planning, and structuring	Focus group, target audience	Analyzing the studying year results, editing the course, adapting to new demands of the industry – updated course
Online / Offline	Trainer	Implementing individual approaches	University representatives in the outside activities	University representation in hackathons, conferences, etc.
Online / Offline	Leader of the scientific research	Scientific approaches training	Researchers, co- authors, members of the research team, focus group	Research work, science activities participants
Online / Offline	Leader of the project	Sprints planning	Project team members	Project work results demonstration
Online / Offline	Online courses author	Course adaptation to online formats		

It modified the roles and functions of both educators and students. The change has instantly affected how remote students approached self-organization, collaboration, communication, motivation, information, and presentation while working on projects in agile teams.

Results and Discussion

We have observed how the professional agile teams adapted to the fully remote way of work during the pandemic.

First, agile teams had to adopt various remote work tools quickly. Most of the team has already been using the remote work tools. Others had to adjust to the tools themselves or with the help of their teammates. Visual management, virtual whiteboarding, instant chat, and video conferencing are essential tools.

Second, communication has been dramatically affected by shifting to completely remote work. It required revisiting and reconsidering the ground rules for interaction that were in place when the team was co-located. For example, call another team member by name when you want their feedback during a virtual meeting. Leave a live video feed while working at the computer to maintain a face-to-face relationship. In the remote work environment, being respectful and polite with teammates is essential because many teammates may be stressed working from home, distracted by family members, or overworked. Electronic communications could be misunderstood, mainly when the team consists of teammates from different cultures. Some teams adopted a rule that every electronic communication has a positive intent. If someone thinks a message was inappropriate, they address this issue privately with the manager first. Such practices create a safe environment for the team to collaborate and innovate.

Third, many Agile ceremonies had to be modified to adjust to the remote work and communication style. For example, the team doesn't have face-to-face in-person collaboration sessions, and it is not easy to capture all ideas using remote collaboration tools. So, the team often assigns a person to document electronic notes during a virtual brainstorming session and store them in one designated place. The process applies to documenting any virtual team discussion, meeting, backlog refining, or conference calls. Such ceremonies as daily scrum, sprint planning, backlog refinement, sprint review, and sprint retrospective become longer. Therefore, some of them are broken into shorter blocks. Presentations are required to be more concise and precise. Preparation work is encouraged, and media materials are used. The nature of communication is different in the co-located versus remote team. It is asynchronous, and the remote team must adjust to it.

Finally, working remotely in isolation is hard for a human. Burnout is a real problem. Many US IT teams adopted the practice of virtual happy hours and other fun and socializing activities. This cultivates bonding and morale and results in higher productivity.

In the remote environment, managers and team leaders solicit an individual's feedback or check on team members' well-being more frequently. Many project managers make sure to have a short virtual one-on-one conversation with each team member at least once weekly. Remote project work required project leaders to inform and present results and solicit feedback from stakeholders more often using various virtual electronic platforms. Project leaders and teams have become more proactive in demoing sprint results, broadcasting on social media and software portals, and conducting simple surveys and polls. One-on-one communication with upper management and customers has become more often too.

Like the professional agile IT teams, educators and students alike had to adopt various remote e-learning platforms and tools very quickly during the pandemic. While lectures were held in Zoom, Teams, Webinar.ru, Webex, and Google Meets, students have also started using Trello, Miro, and Jira tools to collaborate during their project work. This technology shift was not so dramatic for the MPU's IT students compared to students from other departments. Many IT students are used to working online, are familiar with the remote tools, and help other teammates to learn them.

There is a belief that students' engagement in e-learning is lower than in face-to-face teaching, but well-organized e-learning can help students study more effectively (Dietz-Uhler et al., 2007). The combination of e-learning platforms, project collaboration tools, and other electronic communication tools has tremendously facilitated communication between educators, students, and project customers during the pandemic. Although, all of them have had to adjust to the asynchronous communication style.

In the modern knowledge-driven economy, Lifelong Learning (LLL) is a crucial factor in maintaining the employability of workers and a source of personal satisfaction for individuals. E-learning supports the LLL concept. Before the pandemic, researchers had already seen blended (mixed) learning as a promising educational format. For example, Lan Umek, Aleksander Aristovnik, Nina Tomaževič & Damijana Keržič (2015) from Slovenia studied the satisfaction aspect of e-learning. They analyzed the correlation between the proportion of the courses available on the Moodle e-learning platform and the students' performance satisfaction.

The collected data revealed a positive correlation between e-learning opportunities and personal fulfillment. Motivation is one of the essential determinants of high academic performance in e-learning (Marcus Crede, L. Alison Philips, 2011). The practical aspect of the MPU's program has always been an excellent motivator for IT students. Having accomplished real-life IT projects and building a portfolio they would be able to present to potential employers has been a significant advantage for students enrolled in the program. Satisfaction and learning outcomes tend to be positively correlated (Hayashi et al., 2004). The quality, usability, and value of e-learning courses and the e-learning platform determine users' satisfaction. There is a positive relationship between users' satisfaction and the intention to continue the e-learning process (Pereira et al., 2015). Satisfaction breeds motivation. Transition to all distance learning and project work had no diminishing effects on students' motivation. Our survey conducted in April 2022, during the pandemic, showed that

most IT students enrolled in the MPU's program, especially seniors, would prefer to continue distance classes and project work.

Honing presentation skills is the most challenging part for many people. Putting a presentation together and speaking convincingly in public are essential soft skills for members of professional agile teams. Teaching IT students practical presentation skills has always been the focus of the SoftSkills Module in the MPU IT Department's programs. The students enrolled in the program have been regularly involved in in-person public speaking practice. They learned how to engage with the audience and read their reaction and body language. The pandemic and hence shift to distance learning has dramatically changed this practice. Preparing for a compelling online presentation without seeing the audience's reactions or for an "elevator pitch" combined with a video using a remote communication tool are new presentation skills. We have added these skills to the educational programs' curriculum. For example, our Written and Oral Communication competence course has been broadened to include online interpersonal communication through language and sociocultural knowledge, rhetoric principles, and different presentation formats. It teaches students to form coherent, logical, reasoned statements to transfer information during online communication effectively.

Studying and working in isolation is challenging psychologically for students as it is for IT professionals. MPU's students in the e-learning program cited a lack of socializing with classmates. Hayashi et al. (2004), in their research, using the Computer Self-Efficacy (CSE) and Expectation-Confirmation Models (ECM) on e-learners who learned IT skills, concluded that computer self-efficacy is not a critical factor influencing learning outcomes. Meanwhile, other researchers emphasized social presence as a significant factor in knowledge transfer (Topchyan, 2016). Possible mitigation could include virtual social events and offline school activities.

During the pandemic, the sudden shift to a remote-working environment and distance learning dramatically changed agile project teams in the IT industry and higher engineering education. Despite a view that these changes won't be permanent, remote work and e-learning are becoming lifelong experiences. Professional agile teams and students involved in project-based e-learning education can sustain an agile culture by recalibrating processes to support Agile objectives while working and learning remotely.

It gives a new perspective to competence-based approaches in educational programs that prepare students for working in a rapidly changing environment. The most necessary soft skills the students must acquire are self-motivation, interpersonal online and offline communication, conflict management, and negotiation using remote communication tools. Therefore, the university should not only transfer technical knowledge but also ensure students' personal and social growth.

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