

Be Agile with COZMO - Learn Agile Project Management with a Programmable Robot

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Abstract

Agile project management has arrived in the general corporate practice; a large number of software projects in various industries are already being carried out in an agile manner and seen as an entry into the agile organization. In addition to the training of software developers in agile project management, the training of non-IT departments must take place to an increasing extent - irrespective of how they are integrated into the project. The goal of the "Be agile with COZMO" teaching concept, at the Munich University of Applied Sciences, is to impart skills in agile project management with the help of a robotics project based on the programmable COZMO robot for disciplines without or limited IT knowledge.

In addition to the training of agile project management methods, the focus of the concept is on teaching basic knowledge in software development, programming and robotics. The participants are initially introduced to software development, with the "Scratch" programming environment by a series of mini-projects (so-called assignments), in small groups using the COZMO robot. The focus is on testing the possibilities, but also the challenges. In addition, agile project management is introduced through games and theoretical units. At the same time, knowledge is deepened by means of an integrated case from the idea to its completion. A final project consolidates the insight into the mindset of agile project management and extends the knowledge in programming. The concept described here is successfully implemented at the Faculties of Business Administration and Tourism of the Munich University of Applied Sciences, as part of the bachelor degree programs and is part of the Learning Lab "Digital Technologies" of the Munich University of Applied Sciences.

Keywords: Digital Technologies, Agile Project Management, Programming, Scratch, Robotics;

1. Introduction

"Agile methods continue to be used primarily in software development, but already 40% and 34% of participants use agile methods for "only" IT-related and non-IT activities." ([4]). The study demonstrates that agile project management has arrived in the general corporate practice; a large number of software projects in different industries are already being carried out in an agile manner and seen as an entry into the agile organization [5]. This is why, in addition to the training of software developers in agile project management, the training of non-IT departments must be stepped up, irrespective of how they are involved in the project, in order to be anchored in the company as a whole. Often this group of people is integrated as operative team members, project owner or scrum master.

The goal of the teaching concept "Be agile with COZMO", at the Munich University of Applied Sciences, is to impart skills for agile project management with the help of a robotics project, based on the programmable COZMO robot, for students in subjects without IT focus. In this way, basic knowledge in software development, robotics and the cooperation and communication between the specialist area and IT are built up in addition to the knowledge of project management.

2. Challenges and concept of "Be Agile with COZMO"

Agility is a mindset and describes a universal "way (...) how we (work together), how we organize ourselves and how we change together" ([5], p. 212). Agility has its origin in agile software development, which in the agile manifesto ([2]) founded in 2001 describes "being agile" over four pairs of values and defines it with twelve practices. Agile action thus takes place within the normative value framework of the agile value pairs. If you want to be agile, you have to live these practices and values. Agile (mindset) is distinguished from agile (execution of practices), a discrepancy described by [5] with

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the words "setting vs. imitating methods". Instead of learning an approach, the underlying way of thinking must be modified ([3]).

The concept "Be Agile with COZMO" was the first time carried out as part of a course on agile project management for business administration students and tourism students at the Munich University of Applied Sciences. It is intended not only to awaken an understanding of the processes and result types ("make agile") but also of the values and principles ("be agile") in connection with methods of software development in order to understand not only project management theory but also the practice and the cooperation and communication in the project. Experience and a quick introduction to programming are the focus of the event described below.

- The intensive usage of agile games with a subsequent reflection and the connection to the theory of agile project management in particular SCRUM should promote "experiencing". Furthermore, communication and cooperation within the team is enabled.
- The robot COZMO lets the participants "grasp" the topic. The results of exercises and projects are not only visible on the screen. The haptic experience in comparison to the screen output leads to a deepening of success.
- A quick introduction to programming is possible for both students and lecturers. The hardware of the robot COZMO can be used directly and with a low investment volume. The programming language Scratch and its programming environment are included; a lively community supports the further development. Already with Scratch the participants can get to know programming constructs like loops or variables as well as robotic elements like moving or lifting a cube. In addition, the system has the necessary scalability and extensibility with the programming language Python and its libraries.

3. Schedule of the module

The "Be agile with COZMO" course will go through three consecutive phases (Fig. 1): The pre-phase serves to prepare for the topic and to distinguish it from other project management methods. In preparation for the following main part, students receive further articles for self-study. The main part of the module introduces programming using the Learning Lab "Learn to Code with COZMO" (LC2) and develops the theory of agile project management. Both topics are deepened by means of a continuous case. Afterwards, students are then encouraged to carry out their own project independently.

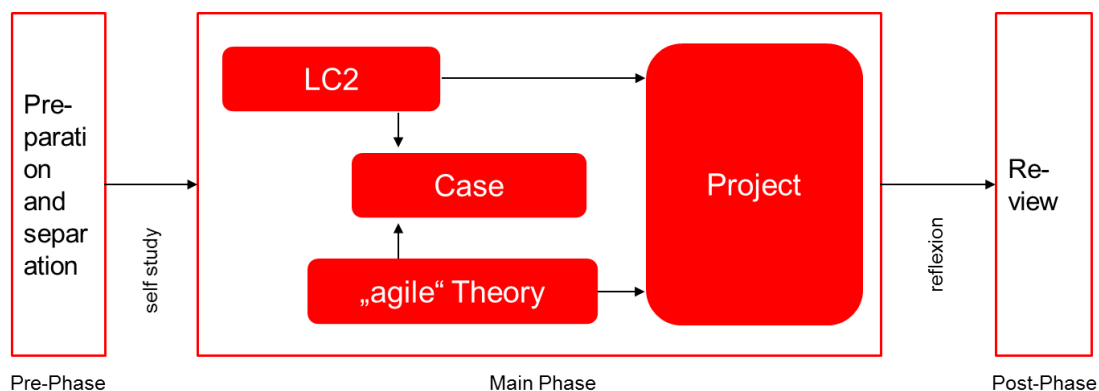


Fig. 1. Procedure of the module

The learning concept for the theory of agile project management provides a mixture of games, reflections and explanation of the theory. In addition to the basic idea and process of Scrum ([3]), activities and work products such as Definition of Done (DOD), vision, personas and scenarios, user stories and backlog, sprint planning with prioritization, effort estimation and velocity, status with a task board and burn down diagram, impediment log, daily meeting, review meeting and retrospective are explained.

The Learning Lab "Learn to Code with COZMO" (LC2) serves as a low-threshold insight into programming and is based on the conviction that learning is most effective when knowledge is acquired independently, experienced in one's own actions and applied in experiments ([6]). This change of perspective from knowledge transfer didactics to didactics of self-directed acquisition of knowledge and competences leads to didactic demands: from input to infrastructure (design of

stimulating learning environments), opening of the subject classification to situation dynamics (learning at situation-typical key situations), from instruction to self-directed learning ([1], p. 5 f.). The developed learning lab (learning infrastructure), which is temporarily set up in an event room with flexible furnishings and reflective walls, is therefore based on a special didactic setting. The assignments, which can be worked on independently, allow a playful introduction into the world of programming languages and are characterized by incomplete tasks. By detailing the solution steps, the degree of difficulty of the assignments increases continuously. After a playful introduction to the robot, theoretical inputs follow with the challenge of writing the first programs. The physical execution of the program sequences by COZMO enables a haptic and visual component in the digital world characterized by immaterialization. Programming languages thus become "tangible". Fast successes motivate the students working in teams collaboratively, whereby among other things learning strategies as well as time management (independent control of the own learning pace) are individually arranged by the small groups. The lecturer (learning process companion) is on site as a coach. Reflection work of the learning process and lessons learned elements complete the individual assignments. In order to work with COZMO, a smartphone, a tablet and software are required in addition to the robot. For iOS and Android devices with WLAN function the manufacturer Anki offers an app for controlling COZMO for download. The Smartphone App uses the visual programming language Scratch ([7]) and makes it possible to design programs for COZMO with the help of instruction blocks. The robot has a number of sensors, such as camera, clip sensor, accelerometer and gyroscope, as well as actuators for controlling the caterpillar drive, the lifting device and the vertical pivoting of the camera. The robot set also contains three cubes.

To deepen the first programming experiences and experiences of the agile procedures, the students work on a continuous case. Students are introduced to the structure, advantages, but also challenges of agile project management. Furthermore, the students experience the consequences through their immediate implementation. In the following, the student group is divided into autonomous teams of about seven to nine people, each of whom is to carry out their own project from the vision, user stories through to implementation. Each group has its own product owner, scrum master and project team.

4. Learn to Code with COZMO (LC2) implementation results

From a didactic point of view, it was shown that the LC2 workshop is highly motivating. 91.1% of the students stated in the evaluation (N=45) that working with the robot was fun. Along with an informal approach to the subject matter, learning at one's own pace is made possible. Moreover, the independent group work had several positive impacts: 68.2% of the students stated that they understood the subject matter more easily thanks to their independent working methods. In addition, 77.7% of the students were motivated to solve assignments independently, and lastly, 80% of the students had a sense of achievement.

From an organizational point of view, the quick physical setup of the mobile learning infrastructure and the high degree of reuse of the assignments in the various professional contexts deserve special mention. Thus LC2 represents a didactic setting, which can make different professional learning possible.

5. LC2 as part of the Learning Lab "Digital Technologies"

"Learn to Code with COZMO" (LC2) is part of the Learning Lab "Digital Technologies" (www.LL4DT.org). The Learning Lab was initiated by Prof. Dr. Lars Brehm and Prof. Dr. Holger Günzel at the University of Applied Sciences in Munich and is designed to offer different directions (so-called streams). Figure 2 gives an overview of the currently available streams. All directions are based on the use of easily procured, inexpensive and expandable technology modules. Currently, new streams such as additive manufacturing or artificial intelligence are already being built up.




Digital Technologies Essentials (DTE)	Learn to Code with Cozmo (LC2)	360° Virtual Reality Collaboration (360VR)
Understand digital architectures	Learn programming & robotic basics	Understand virtual reality
		
Raspberry PI 3 SenseHat	Cozmo Scratch and Python	Gear 360° camera VR Glasses
2,5 days 23 assignments	1 or 2 days 11 or 22 assignments	1 days 12 assignments
... IoT, database, cloud	... agile development	... intern. project

Fig. 2: Streams of the Digital Technologies Learning Lab (5/2018)

The concept of the Learning Lab also includes the establishment of an active community of lecturers, which further develops the Learning Lab in terms of both content and subject matter and also makes it accessible to students from various fields of study. The community includes numerous colleagues at Munich University of Applied Sciences (from several departments) as well as other national and international universities. The advantages are: a complete and proven didactic concept, short preparation time and - if required - quick adaptability.

6. Summary and Outlook

With the use of "Be agile with COZMO" it is both possible to facilitate the entry into programming for non-IT students and to experience agile project management. In addition to the further development of the content of the stream and the "Digital Technologies" Learning Lab, the focus will be on accompanying research to ensure quality and measurement of competencies. All interested universities are invited to actively participate in the growing community.

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