

Agile learning: Bridging the gap between industry and university
A model approach to embedded learning and competence development for the future workforce.

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Conference Key Areas: University-Business cooperation, Continuing Engineering Education and Lifelong Learning, Engineering Education Research

Keywords: agile learning, qualification, lifelong learning, vocational training

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INTRODUCTION

The rapid technological development accompanying the fourth industrial revolution [1] leads to an ever-increasing virtualization of industrial work environments. At the same time, experience-based knowledge becomes more important in solving complex problems in highly interconnected factories. Specifically, there is an ongoing debate in Europe and the US over the lack of skilled and experienced workers in engineering and how it is affecting the industry [2][3]. Admittedly, which skills are needed most is still widely disputed, but there is a growing consensus that this skill gap cannot be closed by university education only [4]. Highly qualified, experienced workers with a vocational training background like technicians would be ideal candidates to fill this void. However, this approach faces two major challenges: (1) A promotion at this level would lead to a position where usually an engineering education is required. Yet, for financial or family reasons, these workers are unlikely to attend university at some point after their vocational training (in Europe only around 3% of students have a vocational training background [5]). (2) Companies report that their vocationally trained workforce is not ready to meet these new challenges albeit their technical experience and skills, because they lack key competencies (e.g. thinking in interconnected systems). Therefore, learning methods and career paths should be developed allowing these qualified employees to acquire missing competencies at an academic level outside of higher education institutions.

“BROFESSIO” (workplace based professionalization in the producing industry) is a research and development project aimed at prototyping new avenues for higher education inside company lines with partners from research institutions² and the industrial sector³. Supported by the Federal Ministry of Education and Research (Germany), BROFESSIO currently investigates strategies and methods that allow implementing this approach into the industrial practise with a specific focus on blended and online learning environments to support and promote a seamless integration in existing company structures. Thus, the goal of this new learning approach is twofold: (1) To create a learning method which allows workers to acquire necessary key competencies within their work place, creating an embedded system of learning and working. (2) To ease the path for workers with a vocational training background to reach higher qualification levels, therefore opening new opportunities for advancement within their field.

1 THEORETICAL BACKGROUND

BROFESSIO sets out to create a learning concept that can be implemented on a broad base. It is based on the experience and success of agile project management techniques, in particular the SCRUM-Method [6]. SCRUM is an iterative and incremental agile software development methodology for managing product development. It defines a flexible, holistic product development strategy where a development team works as a unit to reach a shared goal, and enables teams to self-organize by encouraging physical co-location or close online collaboration of all team members. Scrum is already widely established, well described [7] and apt to be transferred to the field of learning in a company environment. It contains only three roles and a few well defined steps to move forward. They determine a framework for team centred project work that can be mapped to learning projects as well. The

² University of Bremen – Institute for Technology and Education; Beuth – University of Applied Sciences Berlin; IG Metall, the German Metal Workers Union; and Sustainum – Institute for a sustainable economy.

³ Mainly Bayer Pharma and Hella Fahrzeugkomponenten (HKF), as well as associated partners like MAN and Festo, the VDMA (engineering employers association) and the German Society for Scientific Further Education

challenge of extra-occupational learning in the digital age and agile project management are comparable: Employee qualifications must keep pace with the reorganization of industrial manufacturing in process chains.

1.1 Agile Learning Framework

On this basis, an agile learning framework has been developed which takes advantage of best practices from agile project management [8][9]. In such an environment, learning objectives have to be modular, incremental and easily adaptable to changes. The agile learning framework is therefore based on the principles of *inquiry based learning* [10] on the part of the learner and a demand-driven, empowering perspective of the learning coaches ("Give what is needed when it is needed"). Further, it becomes increasingly important to facilitate cooperation and exchange within heterogeneous teams (e.g. in terms of demographic and qualification structure). Thus, a centrepiece of agile learning is the collaborative exchange in *adaptive teams*, which are founded on the grounds of common development goals. Specifically, those teams are designed to have a heterogeneous structure in terms of age, gender, or professional background but a homogenous layout in terms of personal development goals. The resulting team structure is thought to encourage a broad spectrum of exchange between employees as well as support gender and cultural mainstreaming within company lines. In summary, the roles and tasks in agile learning are depicted in figure 1.

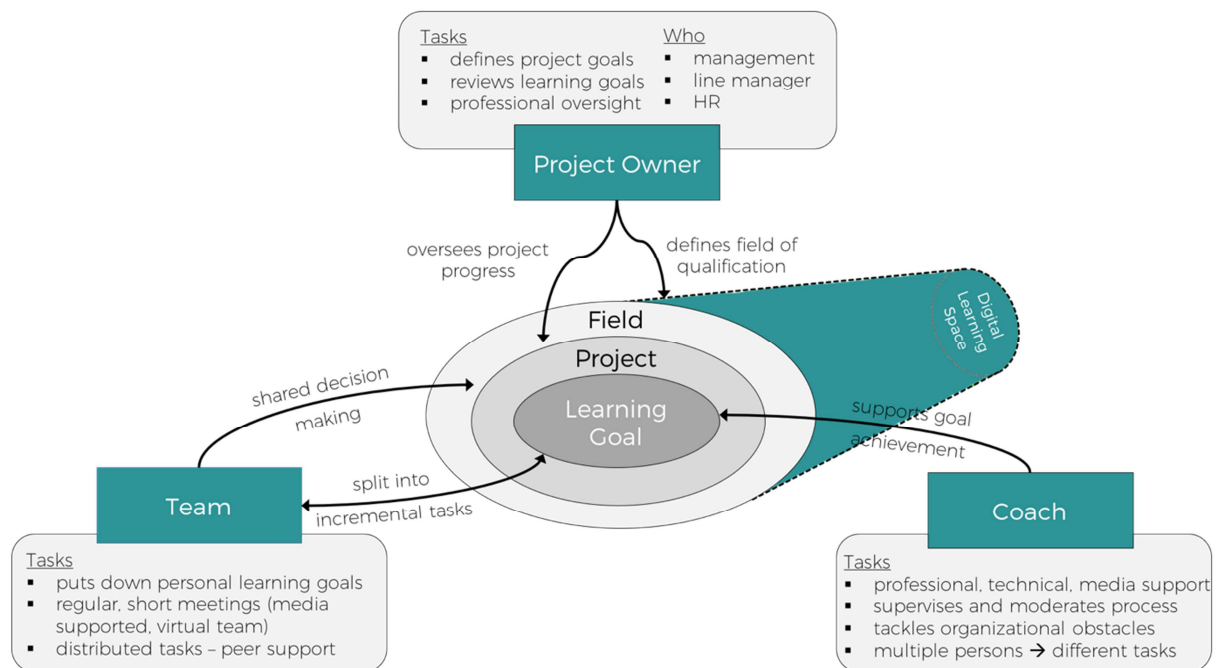


Figure 1. Agile learning and its core roles in the context of a company based embedded learning environment.

1.2 The learning process

The digital shift in everyday life leads to the emergence of *digital spaces* for nearly every member of society. Digital spaces can be understood as situations in which communicating and cooperating with others is either more comfortable or has to be done via digital media [11]. This skillset of *digital literacy* becomes ever more important for the workforce of tomorrow and thus has to be integrated in a future-oriented learning framework. Agile learning aims to incorporate the corporations'

digital infrastructure into the learning framework – incorporating project cooperation, collaboration procedures and tools – as realistically as possible. Specifically, members of the learning team are called upon to put down their personal learning goals on a digital platform and organize their communication and exchange based on the appropriate company tools (e.g. corporate boards, learning management systems, digital file sharing systems, etc.).

An essential part of agile learning are the *learning goals* for each sprint episode. Learning goals are sought to resemble *user stories* [6] as known from the SCRUM process. Therefore, they follow a formalized structure to support the intended learning outcomes (see also [12]): (1) Goal formulation follows the SMART system [13] and should result in a single sentence which captures the essential goal and is phrased by the participant. (2) Goals are further specified by several *success criteria* which capture competence-based and measurable outcomes after goal completion. (3) During a sprint episode every team member has to break down his/her learning goal in incremental steps. If, at some point during this process, an individual realizes that it is missing an essential prerequisite to attain the next step, it can add a new *success requirement*. Success requirements can be understood as an obstacle for goal completion and should trigger action by the learning coaches, and if necessary by the project owner, to ensure that all necessary resources are provided. The following table gives an example for a team-based learning goal in an early stage of the process.

<i>“The team has mastered the learning project’s formal and digital setup.”</i>	
Success Requirement	Success Criteria
<input type="checkbox"/> Please put down missing requirements for goal completion	<input type="checkbox"/> The team understands how learning goals are formulated and can put down own learning goals. <input type="checkbox"/> The team understands all learning goals and the timetable for goal completion. <input type="checkbox"/> The team can effectively organize its communication and collaboration within the digital workspace (LMS, learning material, etc.).

Following the SCRUM process, agile learning proceeds in incremental steps and through an iterative process which alternates between phases of learning and doing. A control committee with members of the coaches and the product owner will be accountable for steering the learning process and making necessary changes to ensure the success of the learning project (see fig. 2).

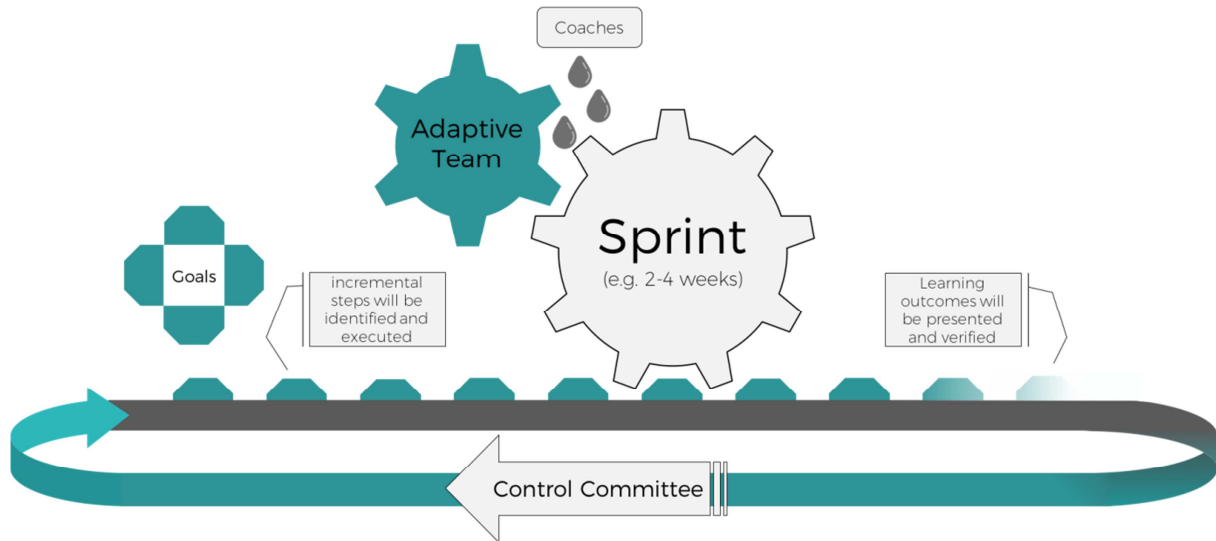


Figure 2. Iterations, guidelines and interactions in an agile learning process.

In summary the key elements of agile learning are:

- *Adaptive Teams* of peers with similar development goals and a broad spectrum of backgrounds
- *Coaches* (internal / external) to support the learning process
- Company stakeholders (management, human resource department, workers council etc.) represented by a *project owner*.
- All learning objectives will be broken down within the team into personal learning goals (cf. *user stories* in SCRUM). This process and the results will be closely guided by the *coaches* and after completion verified by the *project owner*.
- Working along tasks from the actual working context.
- Sprints to reach sub goals / milestones.

2 IMPLEMENTATION

Currently BROFESSIO is implementing this model at the companies MAN and Bayer Pharma at different levels and to a different extent. In those different implementations, employees embark on learning projects with time horizons ranging from a few hours to two hundred. The projects' topics range from cross-cutting issues to specific technical subjects. In both cases, learning content as well as external technical expertise is provided by Beuth-Hochschule für Technik Berlin – University for Applied Sciences.

- At MAN Diesel & Turbo Berlin, an entire department had determined its learning needs through a process of interviews and workshops, discussions with management and the HR department and a workflow analysis by external experts. Out of this, in a participatory process the department identified their three most important fields for competence development: spreadsheet processing, basics of material sciences and key elements of process technology. BROFESSIO provided a web-based tool where the participants clarified the level of already existing knowledge and their specific competence needs. Based on these answers, tailor-made workshops were carried out where the department members worked along tasks out of their daily work.

This process provided a framework in which they learned from experts and self-study materials as well as from their colleagues.

- At Bayer Pharma AG Berlin, the target group are technicians and master craftsmen from all divisions. This is the highest professional level employees with a vocational training background usually reach in German companies. An extended work place analysis led to the identification of five key work processes, posing diverging challenges to the target group. The most important field for competence development was project management. Therefore, in May 2016 a pilot process was launched to address this topic. In a first phase team members work on a project task from a general company background in order to familiarize with each other, the web based learning platform and the basic concepts of project management. In a second phase, team members will choose a specific real life project from their working environment. The level of the input provided as well as the expected level of results meet academic standards.

As described in the learning model, in both companies the teams analyse their learning needs and check which knowledge already exists within their group. The topical learning content is provided by different sources in order to achieve the best fit between complexity and employee needs:

- peers within the team,
- sources within the company (e.g. guiding documents, internal experts, learning material from company owned academies),
- external sources to be found on the internet (e.g. online tutorials, open education platforms, MOOCs),
- technical experts from outside: specialists from participating universities and beyond.

3 PRELIMINARY RESULTS

First results are very encouraging in some aspects but also show specific challenges for a long time implementation of the concept past the context of a research project. In summary, the participants' feedback emphasises the following points:

- Participants are generally highly motivated and show a good team spirit. Learning from one another and as a team works smoothly and successfully.
- Learning within the actual working context is highly appreciated. First reports show that this process does not only raise motivation, but it eases transfer into other tasks. In particular, strategies to deal with new problems can be acquired.
- Splitting learning goals into incremental steps allows orientation in a complex system and facilitates self-efficacy as well as personal commitment for goal achievement.
- The main problem for many participants is that they lack strategies of self-directed learning. Since the agile learning framework partly relies on self-directed learning, a transitional period should be designed very carefully allowing participants to acquire necessary strategies at their own pace.

On part of the project owner, the agile learning approach provides a focused and work-embedded learning context as opposed to traditional training courses. This allows for a tailor-made competence development that is aimed at specific future work requirements within company lines. However, for many superiors it is difficult to understand the scope of competence development beyond lecturing technical content. Thus, it is essential to discuss prerequisites, methods and resources as well

as the intended outcomes in detail before engaging in the process of an agile learning project.

Generally, the implementation of agile learning in company structures poses some challenges, which include but are not restricted to the following points:

- With a heterogeneous team from different departments and with different backgrounds it is crucial to find a project task that engages all participants equally.
- Since learning topics are tailored to the specific needs of the company and participants, learning contents tend to get very specific at some point. This makes it important to acquire the proper materials and experts, which can also give an overview.
- As a consequence of the latter, training the external experts to fill the role of a coach as intended in the agile learning framework (not to lecture but support self-directed learning) makes extensive preparation necessary.
- Finally, shifting focus between different areas of learning (e.g. technical, interpersonal and structural) can make it hard to keep track of the different aspects of the learning process.

Currently, the project team works on technics and guidelines to deal with these issues.

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