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Agile Learning for vocationally trained expert workers. Expanding workplace-based learning one sprint at a time.

Jörg Longmuß^{a*}, Benjamin P. Höhne^{b†}

^a*Sustainum Institute, Kreuzbergstr. 37/38, 10965 Berlin*

^b*Beuth-Hochschule für Technik, Luxemburger Str. 10, 13533 Berlin*

Abstract

Ever increasing automation and virtualisation are two interconnected prevalent processes in today's work-life. Consequently, requirements for all occupational groups change and necessary competence profiles shift rapidly within companies. Company leaders as well as the workforce see this change as an opportunity and experienced and skilled employees are needed more than ever for jobs which formally require an academic education. However, so far learning methods and career paths are missing which would allow to acquire the necessary competencies at an academic level as well as within company lines at the same time. Classical training frameworks (e.g. seminars) and educational programs (e.g. bachelor degrees) are usually not tailored for the changing needs of their participants. Thus, we propose the concept of Agile Learning, as a workplace-oriented, problem-based framework for competence development embedded in company structures. Two agile learning projects were implemented at different levels in two major companies. Topics ranged from cross-cutting issues to specific technical subjects. Results, best practices, and evaluation outcomes will be presented in this paper as well as a discussion of restrictions and the remaining challenges of the model.

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* Corresponding author. Tel.: +49-30-2345 7496; fax: +49-30-2345 7497

E-mail address: j.longmuss@sustainum.de

† Both authors contributed equally to this paper. Authorship was determined by a coin flip.

1. 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 growing consensus that university education alone cannot close this skill gap [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:

- A promotion at this level usually leads to a position which requires an engineering education. 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]).
- 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.

Supported by the Federal Ministry of Education and Research of Germany, the project “Brofessio” (workplace based professionalization in the producing industry – see www.brofessio.de) 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:

- To create a learning environment which allows workers to acquire necessary key competencies within their work place, creating an embedded system of learning and working.
- 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.

2. Theoretical background

BROFESSIO set out to create a learning concept that can be implemented on a broad base. The resulting learning framework of Agile Learning 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 in which a development team works as a unit to reach a shared goal. It 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.

2.1. 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 must be modular, incremental, and easily adaptable to changes. The agile learning framework is therefore based on the principles of inquiry based learning (or problem-based learning, [10]) on the part of the learner and a demand-driven and reflexive perspective of the learning coaches which rests on the ideas of *expansive learning models* [11]. Specifically, we chose a mixture of these two methodologies to achieve an environment which gives enough room for self-organized learning and knowledge construction – following the ideas of inquiry-based learning – as well as a structural role (i.e. the coach)

which can guide the learners and provide a systematic framework and order in a new knowledge system. In particular, inquiry based learning has a great fit for problem-oriented and workplace-based learning environments, since it requires a real-life challenge to exemplify problem solving and knowledge construction [12, 13, 14]. Nevertheless, research in the field of cognitive psychology has shown that inquiry-based learning is accompanied by a high demand for working memory which has detrimental effects on the transfer of acquired knowledge into long-term memory [15]. A reflexive guidance can remedy these detrimental effects since it helps to translate problem-based experiences into lasting mental models to solve a specific class of problems: „The goal is to give learners specific guidance about how to cognitively manipulate information in ways that are consistent with a learning goal, and store the result in long-term memory.“ [16, p.77].

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 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 homogenous goals in terms of personal development. 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.

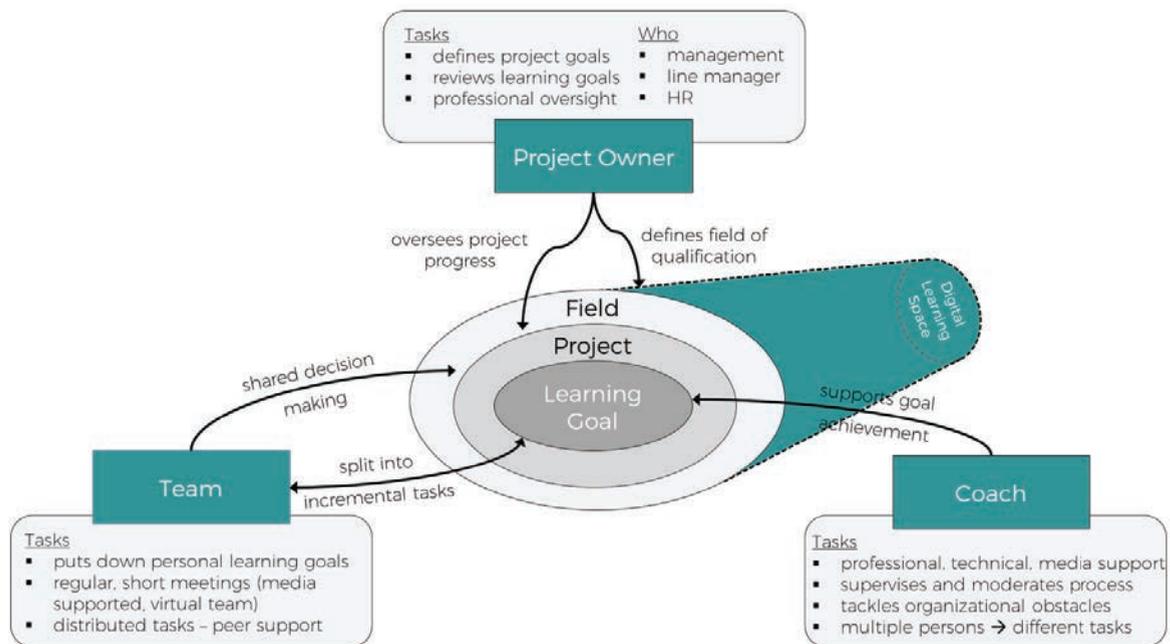


Figure 1. Agile learning and its core roles in the context of a company based embedded learning environment.

2.2. 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 via digital media with others is either a necessity or at least more comfortable [17]. Thus, the requisite skillset of digital literacy becomes ever more important for the workforce of tomorrow and should be integrated in a future-oriented learning framework. Agile learning aims to incorporate companies’ digital infrastructure into the learning environment – including project cooperation, collaboration procedures and tools – as realistically as possible. Specifically, members of the learning team are encouraged to document their learning goals on a digital platform as well as

organize communication and exchange based on the appropriate company tools (e.g. corporate boards, learning management systems, digital file sharing systems, etc.).

Another 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. To allow an easy integration of these goals into the workplace-based learning setting, two simple questions guide goal formulation:

- Which tasks do I want to get done in the upcoming sprint?
- Which resources do I need to achieve this?

Usually answering the first question can be done quite autonomously by the participants since the time horizon and the problem-based nature of the learning project allow for a self-guided step by step plan. However, answering the second question is much more demanding and needs more professional and pedagogical guidance by the coaches, due to the expansive nature of the learning field. Participants might be able to deduce the next logical steps in solving a problem but often struggle to grasp all preconditions to achieve their goals. In addition to the learning goals, participants are encouraged to keep a log which they update after each sprint to put down what lessons or best practices they took away from the last sprint to ease transfer.

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

In summary, the key elements of agile learning are:

- *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*.
- Learning objectives which are broken down within the team into personal learning goals. The *coaches* will closely guide this process and after completion the results will be verified by the *project owner*.
- Working along tasks from the actual working context.
- Sprints to reach sub goals / milestones.

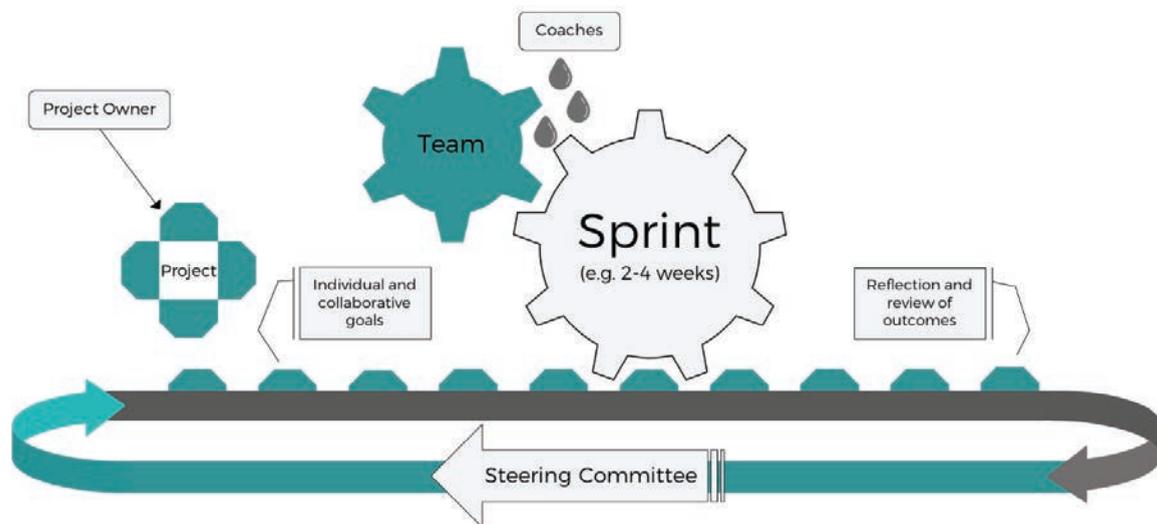


Figure 2. Iterations and interactions in an agile learning process.

3. IMPLEMENTATION

We implemented this model at the companies MAN and Bayer Pharma at different levels and to a different extent. In those different implementations, employees embarked on learning projects with time horizons ranging from a few hours to several months. The projects' topics equally varied from cross-cutting issues to specific technical subjects. In both cases, learning content as well as external technical expertise was provided by Beuth University for Applied Sciences, Berlin and by the Sustainum Institute.

- 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. Following 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 with which the participants clarified the level of already existing knowledge and their specific competence needs. Based on these answers, tailor-made workshops were carried out in which the department members worked along tasks out of their daily work. This process provided a framework in which participants learned from experts and self-study materials as well as from their colleagues.
- At Bayer Pharma AG Berlin, the target group were 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, a pilot project was launched to address this topic. In a first phase team members worked on a project task from a general company background to familiarize with each other, the web based learning management system and the basic concepts of project management. In a second phase, team members chose a specific real life project from their working environment. The level of the input provided as well as the expected level of results met academic standards.

As described in the learning model, in both companies the teams analysed their learning needs and ascertained which knowledge already existed within their group. Different sources provided the topical learning content to achieve the best fit between complexity and employee needs:

- peers within the team,
- sources within the company (e.g. guideline documents, internal experts, internal learning materials),
- external sources on the internet (e.g. online tutorials, open education platforms, MOOCs),
- technical experts from outside (e.g. specialists from participating universities and beyond).

4. RESULTS

Both company projects were evaluated through interviews with the project owners, senior management, teams, and coaches and through analysis of team documents and presentations. Evaluation results were structured with a five-dimensional model. Namely, we assessed how **sprint goals** facilitated learning, what issues in the **learning process** helped or hindered learning, how the different **actors** (project owner, team, and coaches) worked together, how well the **team** was able to coordinate and collaborate, the usefulness of the accompanying **media support** as well as the domain-specific **quality of solutions** for the learning project. In summary, the results are very encouraging in most aspects but also show specific challenges for a long-term implementation of the concept. The analysis of the evaluation led to the following conclusions:

- Participants were generally highly motivated and showed a good team spirit. Learning from one another and as a team worked smoothly and successfully.
- Learning within the actual working context is highly appreciated. This process does not only raise motivation, but also eases transfer into other tasks. In particular, strategies to deal with new problems can be acquired.

- Practitioners are usually very good at practical problem solving but have difficulties in systematically reflecting their actions. It might take some time and insisting by the coaches to start a profound reflection process.
- A 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 longer transitional period would have been necessary to allow participants to gradually familiarize with this new way of learning.

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.
- Real work tasks require excellent solutions, while a learning process always needs more degrees of freedom – e.g. to make mistakes. Therefore, project owners should be encouraged to be patient and tolerate detours. Finally, the objective of a learning task is not mainly to just provide a good solution but to acquire the competence to solve a specific class of problems.
- 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, who can also provide guidance within a new field.
- Because 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.

Presently, the project team works on a training programme for actors in the field of agile learning: coaches, project owners and other stakeholder in company centred further education.

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