Applying Blended Learning in an Industrial Context – an Experience Report

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Abstract. This paper, describes the experience made with coaching enriched blended learning in the context of industrial technology transfer projects. Based on numerous applications of our modular blended learning approach for teaching object-oriented software development with UML, an attempt has been made to improve the design, the organization and the execution of the blended learning arrangement. Therefore, we collected data on the learning environment, the learners´ behavior and preferences. The results from the questioning in an industrial setting, although far from being representative because of the small number of respondents, give some interesting insights in the needs and expectations of learners and the usage of different elements of blended learning arrangements which could serve as hypotheses for later in depth studies

Introduction

Model-driven development, using UML, has become the most dominant development paradigm, in software industry. To be correctly and efficiently applied, systematic teaching and learning are key prerequisites for benefiting from new technologies. However, the question of what is the best strategy for planning and conducting training and education activities is still open:

Experience shows that typical classroom education is not as effective and efficient as it should be. Reasons might be shortened education budgets, tight project schedules, or short development cycles. This is especially true for an industrial setting since companies, especially small and medium-sized enterprises, which often have tight development schedules and short re-lease rates, often cannot afford such trainings. Furthermore, trainers often have the problem on how to prepare compact but interesting course material, how to motivate trainees or students, or how to encourage active participation.

Therefore, e-learning approaches are becoming more and more popular due to their promise to enable learning at “any time and any place”. However, as any other technology, e-learning is not a silver-bullet. Typical e-learning problems are a lack of

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social communication or the problem of checking learning progress which, ironically, are strengths in classic classroom education. Furthermore, e-Learning courses require cost-intensive and effort-consuming development projects.

In general, “traditional” and e-learning have both their strengths and weaknesses [4]. An important factor in choosing a specific approach is its effectiveness (i.e., what are success factors?) [5]. Based on various observations and experiences with both “traditional” and e-Learning, we propose a blended learning approach, which mixes traditional classes and e-Learning: E-Learning is used to leverage knowledge and skills in the very beginning, followed by in-depth seminars for teaching advanced concepts as well as for performing group work, and practical exercises. Experiences with applying this strategy to teach object-oriented development with UML, has shown positive results in academia as well as in industry [1]. This leads us to the hypothesis that blended learning will improve the efficiency and effectiveness of education in general and especially in the area of software engineering.

The Blended Learning Approach

Blended Learning proposes a mixture of learning activities consisting of self-steered learning activities, cooperative and collaborative learning activities, learning activities supported by online tutors, social learning activities, and traditional classroom teaching activities [3]. According to this definition, a modular blended learning approach for software engineering education, especially for teaching object oriented software development with UML, was defined and implemented (see Figure 1 for the product levels and phases of the program).

The approach establishes four modular learning product levels. Each level integrates the respective lower level and supplements them with new activities, in the teaching process. This modularity provides a maximum of flexibility for the design of educational programs and assures an optimal appropriateness for the learners in specific programs.

Every educational program that is designed, organized, and performed according to the blended learning approach described in the previous section follows a specific phase schema (see Figure 1, right part). This phase schema transports the various contents of the product levels to the learners. In the first phase, the educational program is designed and organized, integrating a detailed analysis of the learners skills, educational needs, and learning environment. The method used to analyze these fields is the skill profiling and analysis method ”QUALISEM-People“ [3] assuring content and instructional strategy of the program are defined based on objective information. This aims at increasing the acceptance level and thus the effectiveness of the learning program by satisfying objectively identified training needs. In the second phase, the educational program is launched. It starts with a kick-off workshop, which aims at learners as well as tutors getting to know each other, and explaining the organization of the program to the learners. To this the online phase follows in which the learners work with a web-based training of *UML Basis or UML Personal*. The goal of the online learning phase is to reach an equal level of knowledge about the UML notation. This is a prerequisite for efficient teaching sessions in the subsequent

classroom trainings, because the trainer can then concentrate on providing detailed advanced knowledge, such as object-oriented analysis, design, and programming from the product level *OO Practitioner (UML)*. In the third phase, the knowledge acquired is transferred into practice. That is, the learners perform an object-oriented software development project. The tutors, now acting as coaches, support them in their efforts following the principles of scaffolding und fading [2]. Eventually, the acquired knowledge is certified reaching the highest product and thus education level *OO Designer (UML)*.

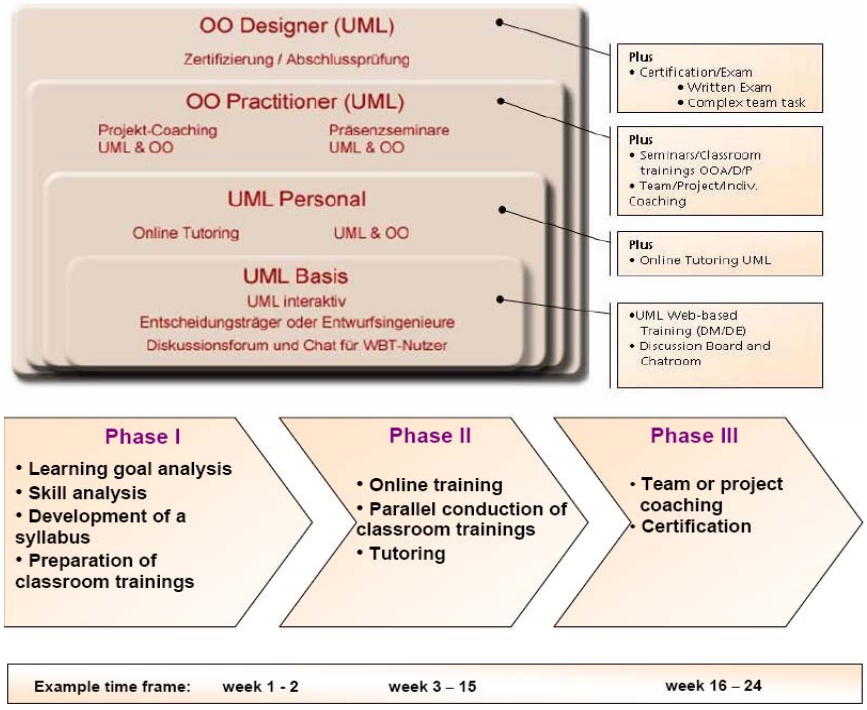

Fig.1. The product levels and phases of the blended learning program

Observations and Experiences in an Industrial Setting

The presented blended learning approach has been successfully tested both in academia and in industry [1]. With the intention to improve the blended learning arrangements and to match the industrial training programs with needs of the participants, continuously evaluation was established. Accompanying to these evaluation activities, participants were questioned about their individual learning needs, their learning behavior and their learning, preferences. The questioning was divided into a pre-questionnaire (before the Online-Learning in Phase II started) and a post-questionnaire at the end of Phase III.

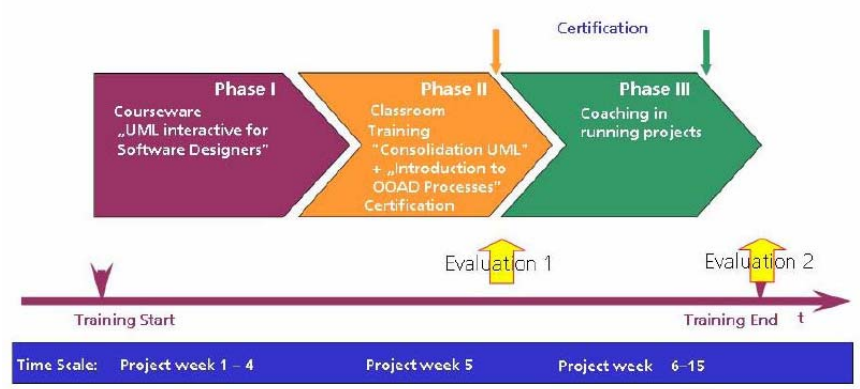

Fig. 2. Phases of the evaluated training program

The results from the questioning in an industrial setting, although far from being representative because of the small number of respondents, give some interesting insights in the needs and expectations of learners and the usage of different elements of blended learning which could serve as hypotheses for later in depth studies. One of these hypotheses states that coaching may serve very well the explored needs and preferences. The presented results were gained during a training program in a large concern (automotive branch) in Germany. A total of 42 employees (software developer, manager, persons in charge) at the age of 20-49 years attended the training program. Most of them were male (~86 percent). All participants were invited to fill out an online questionnaire at the beginning of phase I (pre) and another printout-questionnaire at the end of phase II (post). The reflux of questionnaires (23 pre/14 post) was quite satisfying, although the quantity of data and the group line-up do not allow empirical generalization.

The training program intended to provide the employees with sufficient UML knowledge for the application of an object-oriented approach.

The training program started with an online learning phase, in which the participants worked self-directed with the courseware “UML interactive for Software Designers”. This phase aimed at leveraging the knowledge and skills of the participants in applying the UML, which is a prerequisite for the classroom trainings of the second phase [8]. These classroom trainings cover topics to consolidate UML knowledge and skills of the participants and to introduce OOAD processes. To match the specific needs of the domain and the experiences of the participants, the training materials are based on realistic stuff (documentations, source code, etc.), delivered by the customer. Phase II was concluded by a certification day, where a complex, domain-specific exercise had to be solved by the participants in two-person teams. All participants were still granted access to the online course after finishing phase II. After the classroom trainings and the certification, a several weeks long project coaching phase concluded the training program. In this phase, the coach consulted the participants about how to apply UML in their day-to-day-work. The first questionnaire preceded the training program and aimed at the collection of the learning needs, their preferences and their expectations. The second questionnaire was provided to the

learners at the end of the certification day. The aim of this questionnaire was to check, if their expectations were fulfilled sufficiently and if their learning behaviour was influenced by the methodical setting of the training program.

Pre-Questioning: Prerequisites and Learning Needs

- Asked about the importance of an training program on object-oriented software development with UML for their future project work, more than a third of the participants replied that it is urgent to learn more about UML Furthermore, asked for their individual goals and expectations concerning the training program, the vast majority of answers provided (80 percent) could be summarized as 'be able to apply UML in future projects actively'.
- Apart from one person, none of the participants had any experiences with any kind of eLearning resp. online training.
- The participants were asked which element of the blended learning approach they would expect most of, they referred to classroom training, coaching and the WBT in the given descending order.

Asked, which learning mode is most effective in their point of view, the participants decided in favor of more or less informal communication with their peers. Nearly at the same high level they considered classroom training involving a tutor who is also available after the training as a project coach (see Figure 3).

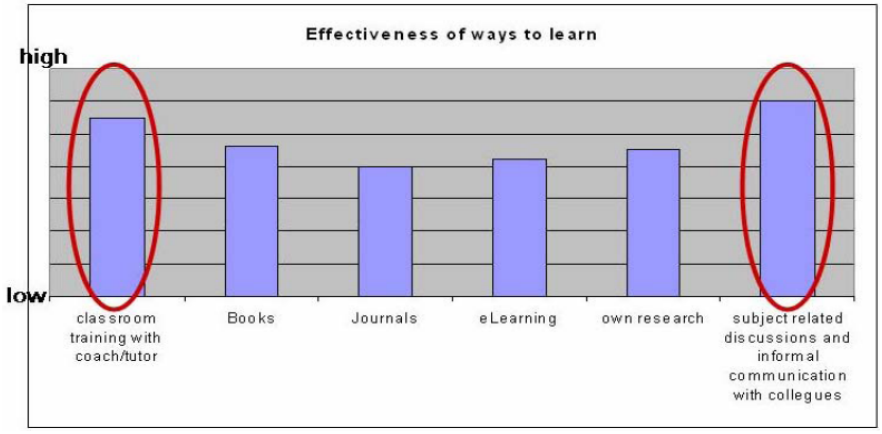

Fig. 3: Estimated effectiveness of ways to learn

Post-Questioning: Assessment of Satisfaction and Learning Behavior

- In the second questionnaire the participants regarded project coaching after classroom training the most important learning mode in the program. Therefore,

providing means for communication between learners and between learners and tutors/ coaches as well as providing a tutor / coach during a specified period after the training at all should be essential parts of an training program.

- Asked, which element of the training program did support their individual learning process most effectively, the participants named classroom teaching and coaching, the illustrations of the courseware and the informal discussions with their colleagues.
- After the training, most of the participants (~ 85 percent) did not consider any of the parts dispensable. Therefore, all elements of the blended learning approach should be present in a training program.

Summary and Conclusions

With the rapid rate of innovation in object-technology, teaching/learning of that technology has become the most challenging issue. Classroom training and online-courses both have their strengths but are often cost-intensive or not specifically adapted to the needs of a specific organization. However, the synergy effects when used in combination clearly outweigh the isolated benefits of the approaches. This paper has briefly outlined a blended learning approach, in the context of teaching the UML, which promises highly effective and efficient training of software professionals in object-technology.

Recently blended learning approaches (i.e., a combination of e-learning and classroom-oriented learning) have become quite popular, since they promise to allow for learning anywhere and anytime. Thus, they make training affordable especially for small and medium size enterprises (SMEs). Although, this is a step into the right direction it still bears one major question: How can the effect of such a training be made sustainable or in other words how can it be ensured that trainees can practically apply their new knowledge in their daily work. Ironically, this problem is neither new nor specific for blended learning approaches. Thus, solutions from other areas of education might apply here as well. One such means is ‘coaching’, a technique for observing, the current functioning, assessing the strengths and weaknesses, and developing measures for addressing needed changes. Thus, in the context of technology transfer projects coaching has to be integrated into the daily work of the trainees (i.e., workflow-oriented) in order to obtain significant improvements.

From our experience in conducting blended learning programs, every educational program needs several factors to be fulfilled in order to be successful. The first and most importance issues is a full management commitment. That means that the supervisors of the personnel being trained set incentives for successfully participating in the learning program. This could be as simple as reserving an adequate amount of time for the learners to prepare for and participate in the trainings. Secondly, a “champion” whom people trust at the company and who can explain the benefits of knew knowledge for the upcoming daily work is beneficial for motivated learners. Finally, in all blended learning projects on OO & UML conducted so far, regardless of being at academic or industrial level,the upcoming certification makes people take the online and classroom trainings serious from the beginning and prepare for

seminars and the certification. We currently plan empirical studies to investigate the return on investment of the suggested strategy. Moreover, we are looking for tools to support it. Both are necessary ingredients to drive the adoption of the approach in practical situations.

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