Design of Active learning Strategy through Agile Development Methodologies: a technological view

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Abstract. *In this paper, a new learning methodology based on Active Learning and Scrum paradigm is proposed. The main idea is related to the definition of a Scrum-Flow process to support the Active Learning process. This will improve traditional learning flow by making it an Agile based Active Learning flow. This methodology has been applied to an undergraduate Computer Science course, which is part of the Information Engineering at University of Rome Tor Vergata in Italy. This work describes the general process scheme and how it is applied in the educational example. As result a comparative analysis between traditional learning approach and our Agile approach has been shown in term of the corresponding activity chart.*

Keywords. Agile Development, e-Learning, Active Learning, Scrum Flow Process

1 Introduction

Active Learning is an emerging idea which assumes that learning process is based on a increased participation by students in the sense that they share with teacher some of the learning tasks in order to improve learning activity and experimentation especially on technical arguments. The aim is to foster students to assume responsibility for learning as shown in paper [3], by developing their ability to assess their own learning. Although there has been a big interest in active learning strategies, no supporting methodology has been yet introduced to manage the required activities. The problem is related to the complexity needed to manage active learning process. In particular this will be required especially for courses in which there is a high level of experimentation and technical content which could be autonomously analyzed by the students from the teacher point of view.

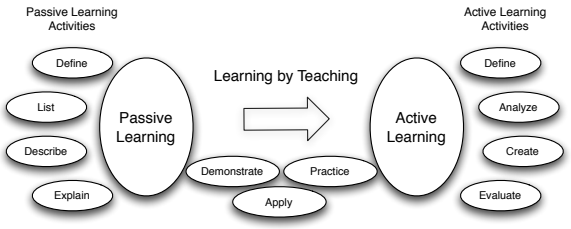

Figure 1: Learning Activities Evolution

Hence the problem is to study how to better involve students in the learning process and a possible solution could be derived by applying Agile Development Paradigm to standard Learning Process Flow. From a general point of view it holds that traditional learning schemes in which learners participate in a passive way must be replaced with new active learning scheme in which learning tasks are shared with teacher thus increasing participation in learning activities. To illustrate this new Process flow, Figure 1 shows the evolution from **Traditional Passive Learning Scheme** to **Active Learning Scheme** in terms of activity transformation. This has been additional explained in Figure 2 that shows the evolution from Traditional Passive Learning scheme to Active Learning scheme.

The new scenario is organized by setting task performed in a course each week in a way such that

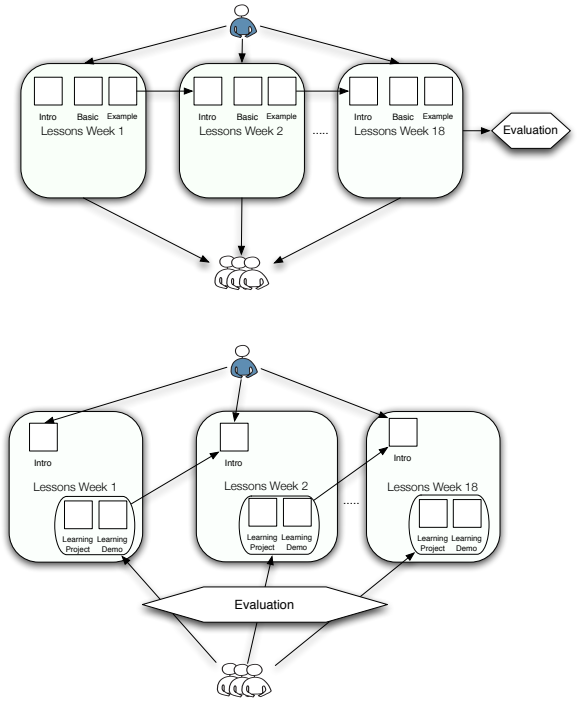

Figure 2: Learning Process Evolution

technical content could be managed by students in a collaborative and active way. This Active Learning process Model hence will provide a new Active Learning Scheme with the following issues (or aims):

Active Learning process design active learning is designed by viewing technical based learning modules (classified as basic and examples) as active learning process tasks (Learning Project and Learning Demo).

New evaluation process evaluation phase generally done at the end of the course, will be pushed in advance as consequence of the active learning paradigm, hence this will increase overall activity.

To support this type of active learning scheme it occurs to introduce a suitable workflow management to keep trace of the activity and corresponding functions. Due to the iterative approach and the need to have as soon as possible a log of learning activity we make use of the *Scrum paradigms* from Agile Software Development to provide a general purpose Active Learning framework.
The paper is organized in the following way. After an overview in section 3 we give a description of the learning Scrum-Flow process and in the section 4 how it is applied in an educational example. The resulting discussion with evaluation analysis is shown in section 5 and in section 6 some furthers exploitation will be shown. At the end some conclusions are given.

2 Related Works

Scrum methodology has been described and applied to software engineering development in [7], where the main objectives are to demonstrate the quality improvement applying Scrum paradigms . The product gain has been shown through examples and burndown analysis in several works. In particular [5], shows examples taken from a real-time systems course and argues to compare scrum based on learning against traditional learning throw the final analysis tasks developed. Moreover student collaboration through team management techniques as shown in [1], is another important active learning issue that must be considered to improve the quality of learning
Active learning and its results have been discussed and analyzed in several papers([2] and [6]). All of these are focused on different aspects related to the learning improvements (student involvement, interest increase and participation)[4].

3 Agile Learning Framework Description

To manage Learning activities in an iterative way it occurs to have a suitable description of the underlying process organization. Our approach is to apply a General Scrum-Flow Process to a set of learning activities thus obtaining a **Learning-based Scrum-Flow**. This application is given by introducing the Learning Scrum-Flow scheme shown in Figure 3 and characterized by the following issues:

- The learning process organization is viewed in a 3-phase scrum cycle organized as:

- Subtopic Introduction executed in one session called **Learning Sprint Planning Meeting** (often equivalent to 1 Lesson) and composed of a learning part (Topic Introduction) and Sprint Planning part.
- Learning Project Development executed in a multi session called **Learning Scrum-Flow** (which is equivalent to a multi-week learning project) and composed of a sequence of learning scrum meeting (daily and just for checking intermediate learning products)
- Learning Demo Presentation corresponding to **Learning Sprint Review Meeting** (often one or more discussion meetings instead of traditional lessons). These are quite uncommon with respect to traditional learning and with an high degree of active learning.

- For each task there is a weekly sprint composed by a set of daily scrum meetings.

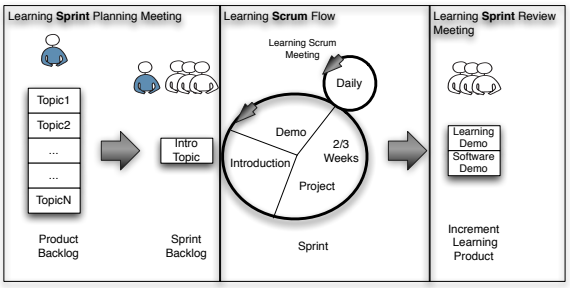

Figure 3: Scrum-Flow Process in a Real Course

The **Learning Sprint Planning Meeting** is composed by:

- *Product backlog:* Tasks are in the product backlog, and the Scrum Master, in this case the teacher, decides which task could be processed and he goes to the next phase, the Scrum-Flow.
- *Sprint backlog:* Teacher decides which task must be analyzed and the assigned team, called group here, starts working on it.

The **Learning Scrum-Flow** correspond to the second scrum-phase that is the core of the Scrum framework, in which task is really processed.

- *Sprint planning meeting:* Each Task is performed in at most two weeks (Sprint period) in which there are at least 2 daily Scrum Meeting. Each Group discusses possible task/work improvements and work details occurring for their demo-project. Group decides what could be improved in this task and what kind of work they have to do for their demo-project.
- *Sprint:* We have a 3-phase iteration, composed by Subtopic Introduction, Introduction for short, Learning Project Development, Project for short, and Learning Demo Presentation, Demo for short. Introduction means that teacher presented the topic provide to the class a list of subtopics that could be carry on. The main part is the Project in which groups could work on the subtopic and daily performed it with daily Scrum. The last part is Demo and this is the final product of their learning Scrum-Flow in which students are directly involved.
- *Daily Scrum meeting:* Meeting in which groups have to daily work on their own task.

Note that each scrum meeting in the Learning Scrum Flow has the objective to understand in a complete way the daily work of each involved team. This is basically defined in terms of what it has been done, things that are daily planned and problems arising in the workflow.

The **Learning Sprint Review Meeting** is composed by:

- *Demo and retrospective:* After the Scrum-Flow the learning product has to be reviewed and evaluated in this third phase. The results will be evaluated by assuming that each Sprint might require one or more that one daily Scrum meeting.

4 Educational Example with Agile Learning Application

To evaluate the impact of Agile learning we have applied the Learning Scrum Flow Process to an ex-

ample of six-month Master Degree course held in our University and as result a comparison analysis with discussion has been shown.

4.1 Educational Context

The selected Course Program is on Web Information Systems and we have compared learning activity between two years (the current one and previous one respectively). Each of two courses has covered the same topics but in the previous one the activity has been done by following traditional learning approach whereas in the next year it has been introduced a novel paradigm based on Agile learning and obtained with an example of (simulated) Scrum Flow Process.

The time scheduling obtained by applying the process shown in Figure 3 to the course is described in Figure 4. The scheduling is organized as a sequence of Sprint cycles each corresponding to a topic and with the duration of 2 weeks. The list of the arguments shown in Figure 4 is listed above the timeline and in the lower part has been detailed the task assignment by partitioning loop cycle arrow in three part each labelled with corresponding learning activity introduced in the Learning Scrum-Flow of Figure 3 (Introduction, Project and Demo).

Topics	Summary of Contents
1: Introduction	Web Information Systems Introduction
2: Web Modeling	Web Information Systems Modeling
3: UWE Description	UML Diagramm Metamodel and Process
4: UWE Examples	Examples UML Description
5: Frameworks	WIS Application Frameworks
6: Rails Introduction	Ruby on Rails Introduction and IDE
7: Rails Applications	Ruby on Rails Applications
8: WIS Scenario	UML Based WIS Scenario
9: Mobile WIS	Applications to mobile WIS

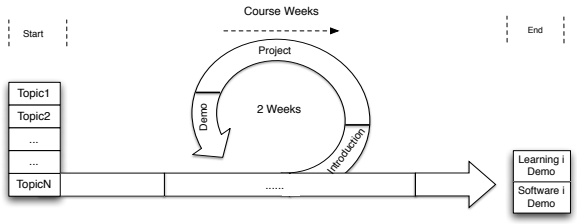

Figure 4: Scrum-Flow Process Timetable and Topics list for the Web Information Systems Course

In the Introduction lecture sessions, the teacher presented the contents of the topic in order to allow the students to acquire the basis they needed to prepare the learning project activities and demonstrations. Task assignment is given on a dynamic basis after a discussion and it could be updated at each scrum meeting. During the first week, each student of the assigned group had to study the contents of the topic, prepare a learning demonstration in cooperation with her/his peers and organize the corresponding presentation (Demo). During all this process, the teacher emphasized the importance of the active learning approach by encouraging reviewing tasks and other typical learning tasks. In this way the evaluation phase could be easily inserted by expanding the task line. Moreover a global view of how active learning is processing could be shown as result of this methodology.

4.2 Learning Evaluation Analysis

To evaluate the impact of Agile learning we have applied the Learning Scrum Flow Process to an example of six-month Master Degree course held in our University. The Course Program is on Web Information Systems and we have compared learning activity between two years (the current one and previous one respectively). All of two courses have covered the same topics but in the previous one the activity has been done by following traditional learning approach whereas in the next year it has been introduced a novel paradigm based on Agile learning and obtained with an example of Scrum Flow Process.

To this purpose Figure 5 shows a plot of the learning activities collected in the Educational Example by comparing traditional passive learning methodology with active learning through Agile paradigm.

We assume that Learning activity is defined in terms of total number of hours spent in the leraning process development in the following way. On the x-axis the process iteration time values in terms of week number and on the y-axis the process work to be completed in terms of time estimated in hours. The total week number is given by $N = 24$ and the total expected work is given by $H = 240$ hours. Each burndown chart starts with 240 hours of work (to be done) and is composed of a sequence of sprint meeting (iteration) that are plotted as a function of

the pair week number (starting from the first pair of weeks to the 12th pair of weeks) denoted by $t_1, \ldots, t_{12}$.

The ideal burndown chart is plotted as a dotted straight line starting from the start point (0,240) to the end point (24,0). Each burndown chart gives the actual work done (effort) and when is above the ideal work line it means that there is more work left than original predicted and the learning process is behind schedule. On the contrary if the actual work line is below the ideal work line it means that there is less work left than original predicted and learning process is ahead of schedule. The blue work line plots data taken from Agile learning Process obtained for each sprint meeting $(t_1, \ldots, t_{12})$ whereas the red one plots data taken from Traditional Process obtained for week 12 (mid term evaluation) and the last week 24 (final examination). In addition the work line must be necessarily extended after the end of the Course in order to include other weeks for developing and evaluating final learning product. Each completed task is evidenced as additional histogram in which task $(T_1, T_2, T_3 and T_4)$ executed in current year following agile learning and Task executed in the past year without agile learning paradigm, are plotted as vertical rectangles

- Agile learning workline is close to the ideal one whereas traditional is too much higher than ideal one. Hence agile learning keep remaining tasks at minimum level and the total effort will be spent during the course by avoiding the need of extra time effort after the end of the course.

- since the Agile learning workline has more iteration points than traditional one we hold that students are more active and could be monitored by teacher in a better way.

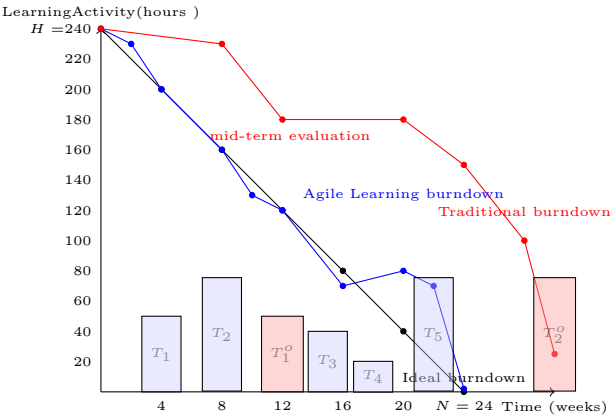

Figure 5: Comparison Analysis

We decide to use it in new Agile Learning process because of the students needs to have a continuous log for their learning activity. In particular in our Educational Example we have used:

- A Moodle Site devoted to the Course and assigned to the Classroom.

- A set of scrum worksheet defined by using Acunote, an agile project management web tool (http://www.acunote.com/) to manage burndown charts and time scheduling with backlogs.

The overall management has been done through mail exchange and/or mes- sages via Moodle. At the moment this solution is semi-automatic but we are developing a web-based application composed by a Moodle extension interfaced to Scrum engine and communicating through a Service based Architecture in a way similar to paper [12](see Figure 6).

5 Technological Agile Learning Platform

A Moodle Platform as a e-learning collaborative platform and a Scrum work-sheet tool were used to support Active Learning Process. In fact Paper [10] shows as main thing the use a web platform like Moodle, to support learning also in a distance way.

6 Conclusions

An Agile and Collaborative Learning Methodology has been presented. It is based on a 3-phases learning Scrum-Flow process in which general Scrum is tailored to the Active Learning paradigm. The students' feedbacks are successfully encouraged and consequently knowledge transfer will be increased as soon as possible. From the results that are ob-

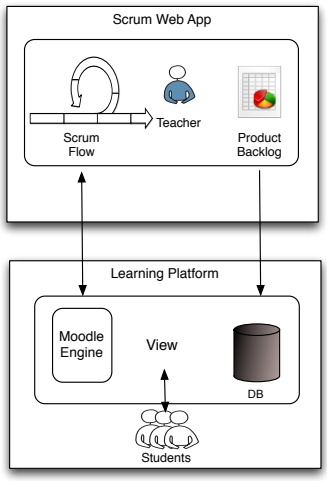

Figure 6: ALE Web Platform Architecture used to support Agile Learning

tained by this methodology we argue that other scientific courses with predominant technological contents could benefit as well.

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