

Towards a Proactive Learning Management System Using Early Activity Detection

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Abstract: This report shows some findings of a study conducted on graduate level project management course using a simple Learning Management System (LMS) test-case interaction. Statistical analysis techniques were used to observe if students who had more interaction in the LMS online activities and content access, were more likely to succeed in the learning experience. Furthermore, this paper describes the concepts and the methodological approach designed to study how to early trigger the LMS user's interaction.

Introduction

E-Learning environments, or Learning Management Systems (LMS), are a set of methods, tools and techniques to deliver learning content through the Internet or similar networks. LMS are suitable systems to support distance learning and blended learning – used in conjunction with face-to-face teaching. Over the past ten years, LMS has been adopted by educational institutions, becoming almost omnipresent in many parts of the world. These systems have been designed adapting existing interactive web based technologies – relating to a program that responds to user activity – to deliver educational content.

This approach has limited the students and instructors learning experience to be mainly web users driving the learning process only in one direction, led by the user action only. Why this approach limits the user's learning experience? Because all depends on the user's actions. If the user does not know how to use specific function or does not receive feedback of his/her actions (e.g. submitting an assignment or participating in an online discussion) the learning process will be incomplete.

The need of a continuous effort has been recognized as important to the educational experience of students and the early they are engaged, the more stable the experience will be. The continuous effort is orchestrated by pedagogic approaches where step-by-step strategies for instruction are defined. In order to improve the user's (students and instructors) learning experience, this research proposes to analyze and design a new type of interaction from the LMS to the users: proactive interaction – working on behalf of, or pro, the user, and acting on its own initiative – as a mean of triggering continuous effort.

This paper reports the initial statistical analysis observations of triggering continuous effort in a simple proactivity test-case study developed in a blended learning environment for a second year bachelor class with 40 students during the winter semester 2006-2007. Furthermore, this paper describes the concepts and methodological approach designed to study how to early trigger LMS user's interaction.

The rest of this paper is organized as follows: first, we will introduce our vision of “proactive LMS”; then, we will explain the concept of “early proactive triggering”; next, we will demonstrate what our case study

was and how we conducted the experience; the main results of the empirical data and our conclusions of the experience will follow; finally, we propose some future work are proposed.

Proactive Learning Management Systems

Learning Management Systems are dedicated software tools intended to offer a virtual educational and/or training environment online. Although there are already a large number of functions covering a large number of users' needs for a variety of different users acting specific roles in these environments, current LMS are fundamentally limited tools.

Indeed, they are only reactive software developed like classical, user-action oriented software. These tools wait for an instruction, most probably given through a graphical user interface, and then react to the user request.

One could imagine and hope for more help and assistance tools, especially because users are often inexperienced online software users and expect some guidelines (what to do and how to do it) from the system instead of a static user interface. Also because certain users like e-tutors have to peruse lots of data in order to try to efficiently manage other users' needs and expect some clues (where to search and what to look for) from the system instead of a passive database.

There is a need for a new kind of LMS, designed to improve the users' online interactions by providing programmable, automatic and continuous analyses of users (inter-) actions augmented with appropriate actions initiated by the LMS itself. One could call it: Proactive Learning Management Systems.

Proactive systems, as defined by (Tennenhouse, 2000), adhere to two premises: working on behalf of, or pro, the user, and acting on their own initiative, without user's explicit command. Proactive behaviors are intended to cause changes, rather than just to react to changes. This is a major change from interactive computing, in which we lock a system into operating at exactly the same frequency as humans do.

A proactive LMS would, for example:

- automatically and continuously help and take care of e-users with respect to previously defined procedures rules (use of online forums, group work tools, etc.);
- flag other users, like e-tutors, if something "wrong" is detected in their behaviors (report not sent before the deadline, etc.);
- automatically verify that awaited behaviors of e-users have been carried out, and it can react if these actions did not happen (use of mandatory resources, etc.).

However, besides the efforts we are making to design and to implement such a Proactive LMS (Zampuniéris, 2006), we also need to know what kind of proactive scenarios are the best suited in order to augment the online learning success of students.

Early Proactive Triggering

Learning is a continuous step-by-step effort that requires conscientious undertakes in order to achieve predefined learning goals. This continuous effort is orchestrated by pedagogic approaches where step-by-step strategies for instruction are defined. Different pedagogical theories exist: constructivism, resource based learning, collaborative learning, problem based learning, narrative based teaching, situated learning, etc. One of the common denominators of these pedagogical theories is the need of a continuous effort.

Proactivity is a mean of continuous effort and the early the students are engaged in it the more chances they have to succeed. Recent research (Kickul, 2006) demonstrates that students with high proactive behavior are more likely to succeed in a LMS environment.

Some LMS, like Blackboard [<http://www.blackboard.com>] or ANGEL Learning Management Suite [<http://www.angellearning.com>], have implemented early warning system approach, by applying rules on Grades, Due Dates, etc. with alerts to the instructor. These early warning system approaches of the proactivity, are triggered by the instructor when a particular event is getting close to happen. It is not necessary early in the sense that the student may not have enough time to correct or to perform an action.

The problem, then, is "how to trigger early proactivity?" One way is to early detect a particular behavior by tracking student activities in the LMS, and assess it with a known scenario. This approach is called,

in this research, Early Activity Detection. One example is the (early) monitoring of students participation or not in LMS activities like forums, content access, etc. In other words, by monitoring the amount of continuous step-by-step effort put into effect by the students.

Early activity detection is defined as the process of gathering LMS e-user interaction data and comparing it with known proactive scenarios to trigger a response from the LMS back to the e-user (students or instructors).

In order to achieve early activity detection, three elements (see Figure 1) are required:

1. Proactive Scenarios: define when proactivity is needed and how to activate it (triggering). A proactive scenario describes a situation where a student's behavior with a lack of interaction, reduces his/her continuous learning effort and limits the chances of successful learning.
2. Proactive Categories: are created by grouping similar proactive scenarios in order to predefine a set of responses (rules). A situation describes a set of conditions and attributes that might be similar for different proactive scenarios. The creation of a logical grouping, categories, of similar conditions and attributes will reduce the number of proactive action triggered by the LMS providing clear response guidance to the students and/or instructors.
3. Proactive Rules: are the set of computing rules, in a particular proactive category, to trigger an interaction from the LMS back to the e-users. A dynamic rules-based system, part of the LMS, will continuously evaluate the rules with respect to the e-users' actions, in order to enable the proactivity capabilities of the LMS [2].

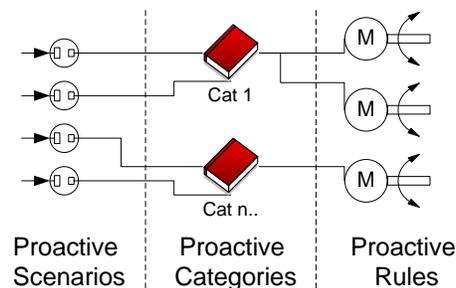


Figure 1: Proactive elements.

To create the proactive scenarios, categories and rules, a research approach is proposed which first step is the gathering of observable usage data on a real LMS, using a simple proactive case to study students' behavior and outcome. The result of this study will provide the necessary basis to understand if a simple proactivity case can show "that students with high proactive behavior are more likely to succeed in a LMS environment".

Observations on a Simple Proactive Case Study

The case study was implemented in a blended learning environment for a second year bachelor class with 40 students during the winter semester 2006-2007. The class itself follows the normal academic program, with the LMS as a supporting tool of the learning process. Different activities were programmed for the students to balance the learning and more precisely to provoke continuous step-by-step effort. Two types of activities, forums and homework, and learning content were available on the LMS for the students to participate and all the students' interactions were recorded.

A proactivity rule, in the context of Early Activity Detection, was triggered two times during the semester, one early in the semester and one in the middle. The rule was based on the students' total participation in the class activities and an email was sent to those students who had not enough participation.

The rule is defined as:

- **rule description:** After A possible number programme activities all students with less than LT participation were advised by email to increase their participation
- **data acquisition:**

```

es = get_user(S)
cc = get_course(C)
ac = get_activities(cc)

```
- **activation guards:**

```

ac = A
date = D

```
- **conditions:**

```

es.numberOfParticipation(ac) < LT

```
- **actions:**

```

sendLMSeMail(to = es.name, subject = "Reminder: Bachelor class and
online activities participation", data = "Please remember to participate
in the class and online activities of your ...")

```
- **cases:**
 - (1) $A = 5$, $LT = 2$ and $D = 05/11/06$
 - (2) $A = 12$, $LT = 4$ and $D = 12/12/06$

The LMS recorded the student's interaction by 8.729 events for 40 students and by 0.66 Cronbach's Alpha (Cronbach, 1951) for the participation to activities. The Figure 2 shows the integration of the students' LMS daily access and the class activities over the time.

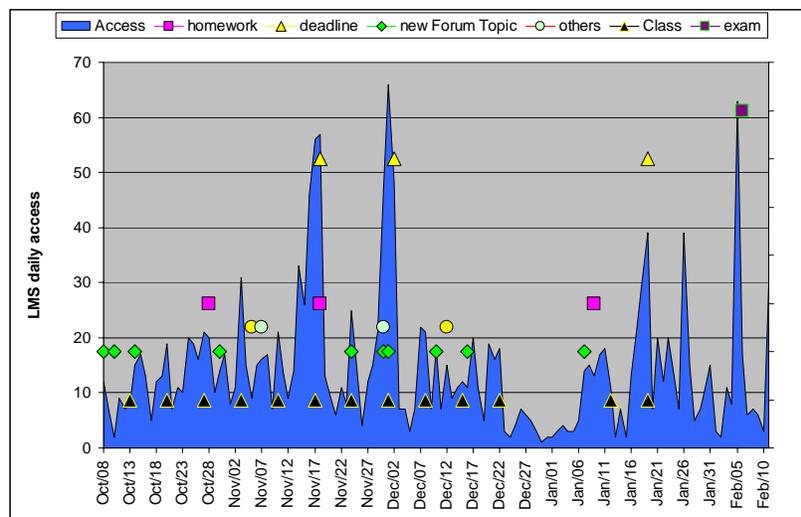


Figure 2: Interactions on the LMS.

The data were analyzed by comparing the student's final exam results with the degree of participation in the LMS. The correlation coefficient analysis show a 54% correlation level between the forum and homework activates and the final exam results and a 40% correlation level for online content access, for the entire class (see Table 1).

Results were validated by computing the P-Value using the Spearman's rank correlation (Spearman, 1904): all results were below 0.3% meaning that they are not the result of a coincidence (see Table 2).

Correlation	Coefficient	Result
Activities vs. Final Grade	0.541	Large +
→ Forum Participation vs. Final Grade	0.403	Medium +
→ Homework vs. Final Grade	0.665	Large +
# Online Connects vs. Final Grade	0.405	Medium +

Table 1: Entire Class Correlation Analysis.

Correlation	Coefficient	P-value
Activities vs. Final Grade	0.541	0.31%
→ Forum Participation vs. Final Grade	0.403	0.02%
→ Homework vs. Final Grade	0.665	0.02%
# Online Connects vs. Final Grade	0.405	0.15%

Table 2: P-values.

To answer the question if a simple proactivity test-case can show that “students with high proactive behavior are more likely to succeed in a LMS environment”, the correlation analysis was computed only for the students for whom proactivity was triggered. The results show an 82% correlation level between the forum and homework activities and the exam results, and a 73% correlation level for online content access (see Table 3). These results also show by 28% and 33% respectively, that proactively triggered students were more successful than the not triggered ones.

Correlation	Coefficient
Activities vs. Final Grade	0.824
→ Forum Participation vs. Final Grade	0.506
→ Homework vs. Final Grade	0.742
# Online Connects vs. Final Grade	0.729

Table 3: Proactive Triggered Student’s Correlation Analysis.

These results also show that in this particular scenario of Early Activity Detection, the use of some proactivity triggering leads to more chances for a student to be successful.

Next step towards a proactive LMS

The next step is the gathering of observable and empirical data in a predefined LMS scenario using two groups; one control group without early triggering proactivity and a second group with early proactivity triggering. We will apply statistical analysis to this new case study and we will compare it with the case study reported in this paper, in order to produce the first model for early activity detection within a predefined scenario, and to design its general proactive response actions.

Conclusions

This paper reports the initial statistical findings to the question if a simple proactivity test-case can show that “students with high proactive behavior are more likely to succeed in a LMS environment”, where correlation analysis shows a 82% correlation level between the forum and homework activities and the exam results, and a 73% correlation level for online content access wrt. the students for whom proactivity was triggered. These initial results also show by 28% and 33% respectively, that proactively triggered students were

more successful than the not triggered ones. However, these results are to be considered as initial findings and are not general conclusion as they were developed in only one scenario, and more repetitions are required.

The paper also describes the concept of Early Activity Detection, in the context of proactive LMS, as a mean to trigger early proactivity by detecting student's particular behaviors in the LMS and assess it within a previously known scenario.

Future work include the run of a new case study using two groups; one control group without early triggering proactivity and a second group with early proactivity triggering.

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