

# Extendibility of Educational Systems to Include a Learner-Adaptive Motivational Module

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## Abstract

*Motivation is a key component of learning, no matter if it takes place in the classroom, via an online system or in a blended setting. Motivated learners feel more self-efficacious, they spend more effort and persist more on a task, they are more interested in the learning activities and they use more self-regulatory learning strategies. If in classroom teaching motivation is handled by teachers, in the case of online learning, motivation has been considered only in terms of content and ways of delivery. There is a need for considering motivation by educational systems in a more personalised way that would allow adequate interventional strategies to motivate learners. This paper explores the possibility of existing open-source educational systems to be extended with a motivational module.*

## 1. Introduction

The purpose of this paper is to analyze the extendibility of some open-source educational systems with a motivational module. A review of six systems is presented, focusing on certain characteristics that would allow assessment of motivation and complementation of interventions in order to increase or maintain the level of motivation. Thus, this review is different from the many reviews available (e.g., [1]), as most of them have been done from evaluation perspective.

There are two main approaches to assessment of motivation: 1) non-intrusive deduction of motivational level from learner's interactions with the system [2] and 2) "classical" assessment by asking the learner about his motivation, both to be included in the motivational module [3].

For intervention, two aspects are important: a) the possibility of the system "talking" to the learner, giving

feedback about his/her motivation related to the learning process; b) adapting the learning activities to the learner's level of motivation.

Thus, the following criteria are considered: 1) tracking the learners' activity, 2) possibility to "dialog" with the learner, 3) the system's possibility to keep learners' profiles (user models for motivation and knowledge) and to adapt to them, or to be extended with these possibilities.

The "dialog" refers to the possibility to communicate with the learner in order to assess his/her motivational characteristics. This dialog would "pop-up" when activity tracking shows disengagement.

Another criterion would also be relevant for this review: the pedagogy behind the system. The design of the envisaged learner-adaptive motivational module to be added to an educational system is based on Social Cognitive Theory [4] that represents a social constructivist view of learning. Thus, it would be important to work with a system that supports learning based on grounded learning principles.

## 2. Educational systems review

Only open source systems are included in this review due to the advantage of the open source code [5] and because of their presence in the academic arena, colleges and universities being directly involved in the development of open source e-Learning applications [6].

The following learning systems are considered: Moodle [7], ILIAS [8], AHA! [9], ATutor [10], Claroline [11] and .LRN [12].

Almost all the systems considered (except AHA!) are learning management systems and they all have some common characteristics such as: course elements (lessons, resources, assignments, quizzes etc.), communication tools (forums, chat etc.), group management etc.

However, the following review will focus on the differences between them with regard to the criteria mentioned above.

## 2.1. Moodle

Moodle (Modular Object Oriented Dynamic Learning Environment) is a course management system built on the social constructivism principles. It has a modular extensible architecture, the main focus being on activities.

Moodle's logs provide detailed *learner activity* of page and tools access; also of the activity in forums and individual performance in tests.

Moodle architecture is extensible, thus it is possible to integrate a “*dialog*”. Also, it has low coupling and high cohesion that makes the system easy accessible to developers.

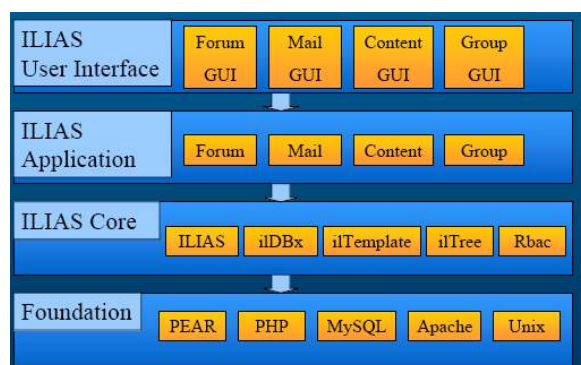
There is *no user model* in Moodle, as this system is not adaptive.

The *pedagogical theory* behind Moodle is social-constructivism that promotes especially learner’s involvement, group collaboration and learning by doing.

## 2.2. ILIAS

ILIAS is a web-based learning content management system and collaboration platform. The architecture is complex (see Figure 1.) and the tight coupling makes it hard to work with.

Figure 1. Layers in the ILIAS 3 System (from [13])



ILIAS doesn’t provide student *activity tracking*: no track of pages accessed, but activity on individual forum and performance on tests is indicated.

Although the architecture is extendable and a *dialog* could be included, the complexity and tight coupling makes it difficult to use.

*No adaptivity/ user model* is included in ILIAS.

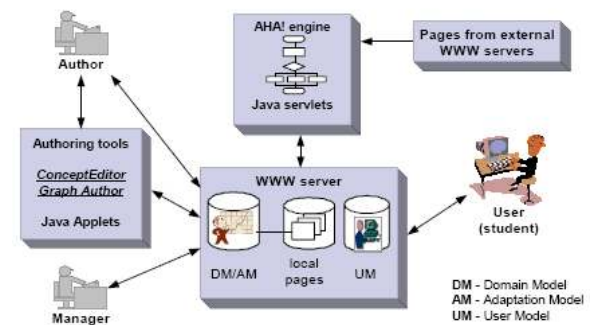
The *pedagogy* behind ILIAS is social constructivism (with the key elements already presented for Moodle) and social leaning (sharing knowledge).

## 2.3. AHA!

AHA! (Adaptive Hypermedia Architecture) is an adaptive hypermedia platform. The architecture is presented in Figure 2.

Unlike the other systems reviewed here, AHA! focuses on adaptation. It supports adaptive link hiding and adaptive annotation, and also conditional inclusion of fragments.

Figure 2. Architecture of AHA! [14]



The architecture of AHA! consists of Java servlets that interact with a combined domain/adaptation model DM/AM and with a user model UM. An authoring tool is available for defining concepts and relations between them, and also rules for adaptation.

The user model in AHA! is based on concepts and it is updated with every visited page. It is an overlay UM, each concept being also in the domain model.

An extension of the system should be possible to include a *dialog* and also, to add new concepts related to motivation in the *user model*.

There is no *pedagogy* behind the system.

## 2.4. ATutor

ATutor is an Open Source Web-based Learning Content Management System.

Activity tracking for student is supported in ATutor only for course usage and tests; there is no track of forum activity; tests performance is indicated.

The ATutor architecture is monolithic and all functionality resides in the core of application. Because the architecture is not modular, it is difficult to extend it with other functionalities, as extensions must be made part of the application, and are tightly coupled.

ATutor was designed with adaptability in mind. It provides adaptive navigation according to preferred navigational patterns: users can choose global, hierarchical or sequential navigation tools.

No pedagogy is included in the system's principles of design.

## 2.6. Claroline

Claroline is a learning course management system build on sound pedagogical principles.

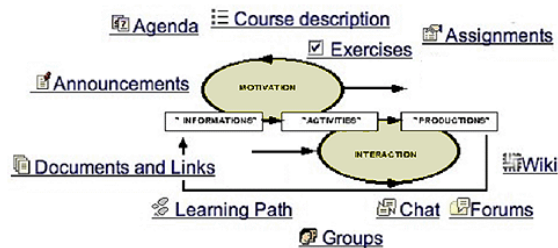
Learner's activity tracking includes detailed statistics for course pages and tools and also for individual activity in forums; performance in tests is also indicated.

The software architecture of Claroline seems modular, but this is not so well documented. Thus, extendibility may be possible, but difficult due to documentation problems.

Claroline had no user model/ adaptation features.

Figure 3 illustrates the pedagogical design, including the tools related to the learning model.

Figure 3. Claroline e-Learning model [11]



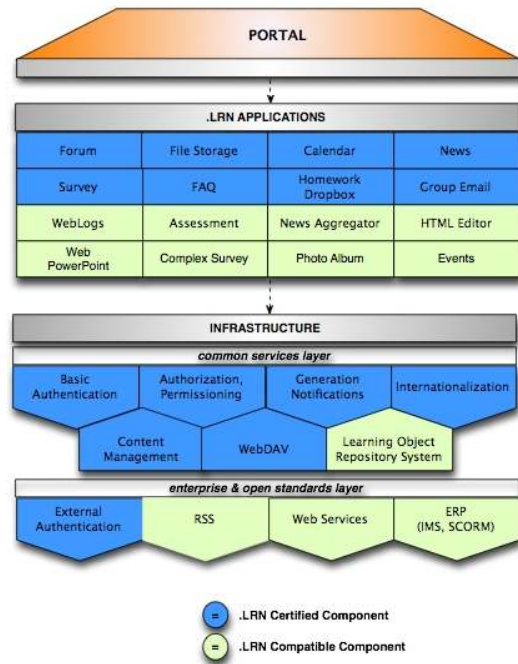
## 2.7. .LRN

.LRN is an open source application suite for learning and research communities. .LRN includes course management, online communities, learning management, and content management applications.

Tracking learner's activity is limited to forum activity, no track of pages accessed; individual performance in tests is provided.

Architecture is very complex, as it can be seen in Figure 4. Although it is extendable, the complexity and the documentation only for the core system make it difficult.

Figure 4. .LRN Architecture [12]



No adaptivity/ user model is included.

.LRN was design for collaborative learning and to be used by learning communities.

## 3. Discussion

A summary of the reviewed features for each of the considered systems is provided in Table 1.

Table 1. System's review

Features	Moodle	ILIAS	AHA!	ATutor	Caroline	.LNR
Activity tracking	+	-	+	L**	+	L**
Extendibility	+	D*	+	+	D*	D*
Adaptation/UM	-	-	+	L**	-	-
Pedagogy principles	+	+	-	-	+	+

\*Difficult

\*\*Limited

As Table 1 shows, there are two systems equally “recommendable”: Moodle and AHA!. While Moodle is a course management system, AHA! is an adaptive system (/ framework) for hypermedia.

ILIAS has the disadvantage of no activity tracking that is necessary for detecting disengaged learners.

The same problem applies to ATutor which has limited activity tracking. Also, even if designed with adaptivity in mind, the only adaptivity feature considered is adapting to navigational patterns which is not yet automatic.

Claroline claims to have a solid pedagogical background, but it has the disadvantage of an unclear architecture and little documentation about it.

.LRN is very complex and it has documentation only for the core system, which makes extendibility difficult. It also has limited tracking of the user’s activity.

Compared to the other considered systems, both Moodle and AHA! have the advantage of a clear structured architecture, which make them easier to extend with new functionalities. Also, they have rich activity tracking although very different: Moodle logs offer a view of pages/ tools accessed and other actions performed, while AHA! stores the learner’s actions in the user model.

At the same time, from the point of view of the selected criteria, both Moodle and AHA! each have a disadvantage: Moodle has no user model and implicitly no adaptivity, while AHA! has no pedagogy principles.

For a motivational module both elements are important. A user model with motivational characteristics is necessary in order to adapt to the motivational level of the learner, thus adaptivity/ user modelling is a very important aspect for effective interventions on learner’s motivation. No adaptation means a limited range of intervention that would basically be reduced to different kinds of feedback.

However, pedagogy is also important, as the motivational theory used, Social Cognitive Theory, refers to social constructivism principles of learning and thus, the learning systems should provide a framework for active construction of meaning (learning activities) in a social environment (communication tools).

#### 4. Conclusion

This review showed that two of the six analysed systems satisfy the majority of the selected criteria: Moodle and AHA!. The two systems focus on different aspects of learning: Moodle focuses on learning/

content management and AHA! focuses on adapting the content to the learner. Both aspects are important from the motivational point of view and the ideal would be to have a system that combines each aspect.

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