# HYBRID SYSTEM FOR PERSONALISED TEACHING: MOODLE P

*Carlo De Medio, Università degli studi di Roma TRE*

## Abstract

In recent years, one of the most discussed topics in the field of education is the customization of courses and content. Many intelligent systems have been developed to solve this problem. This paper aims to present the hybrid system MoodleP, which starting from the re-engineering of the Moodle_LS system and the integration with a second system for retrieving learning materials Moodle_REC implements the functions of path customization within an e-learning environment. The material recommendation system functions dedicated to teachers allows them, through an innovative user model, to obtain materials more congenial to their teaching style optimizing the subsequent learning process for students. The approach with which the system was evaluated will be presented and future developments will be discussed.

## Introduction

In the growth path of adaptive and customization systems, one of the most important moments was the arrival of Web 2.0 or Dynamic Web (O'reilly 2009) where the way in which users approach content completely changes: the user goes from being a passive element, i.e. a simple reader of the web to an active one, i.e. he can interact by updating or producing material. From this point of view, there is no longer a distinction between 'author' who publishes documents and 'reader' who consults them: the central role is now the user. Moreover, in recent years, the web is changing again, leaving the floor to the Semantic Web: in this new paradigm, the focus is no longer on the user as content producer, but on the information contained in the documents or pages, making semantic links available.

Finally, it is a fact that the current web has relied on the new concept of social networking , which has been reported in various studies as a tool for sharing knowledge with e.g. in (Müller-Prothmann 2007) an in particular in (Limongelli et al. 2010, Micarelli et al. 2009, Deed and Edwards 2010, Benson et al. 2012, Nanni and Temperini 2012): this second paper presents the Moodle REC system, which uses an innovative user model that will be described in the following chapters, based on the decisions made by the community of teachers on the platform, who are able to search the most famous repositories of teaching materials and open educational resources for the materials most congenial to their teaching style, based on the idea that teachers with similar profiles will make similar decisions.

In a similar way but using a different user model the PLORS system defined in (Imran 2016) is able to recommend customized quizzes, self-assessment tests and discussion forums in addition to the learning materials. unlike Moodle REC the user model is not based on the use of materials within the course but on the navigation information on the course and manually defined levels of expertise.

Another system based on the idea of social networking is Wiki Course Builder (Limongelli 2015), a system for constructing online teaching paths by exploiting the materials and links in Wikipedia. In addition, a community graph generated by the choices made by all teachers and easily searchable by filtering by subject area or teaching level has also been introduced.

## Methodology

The tool developed from the Moodle_LS and Moodle_REC systems, i.e. MoodleP, aims to take care of the customization of pathways in both creation and use by modelling teachers and students. Starting from this central idea, the research questions are:

1. is it possible to recommend learning materials when creating courses using a collaborative user model based on community decisions?

2. is it possible to customize the learning path (different materials or sequence of modules) dynamically according to the students' interaction with the system?

To answer these questions, the MoodleP platform was implemented, based on the open source Learning Management System Moodle. To model the users within the platform, the Felder-Silverman Learning Style Model was used, a model with four dimensions associated with each student and each material: active/reflective, sensing/intuition, visual/verbal and sequential/global. Each learning style can take values from 11 to -11; this model is widely used as it is easy to use and update within online platforms. At platform registration we initialize the model by means of a questionnaire developed by the authors. Each time a user performs a test in the platform, based on the results, we label the material with the user's learning styles or calculate the ecuclidean distance between the vector of the 4 learning styles associated with the user and the material.

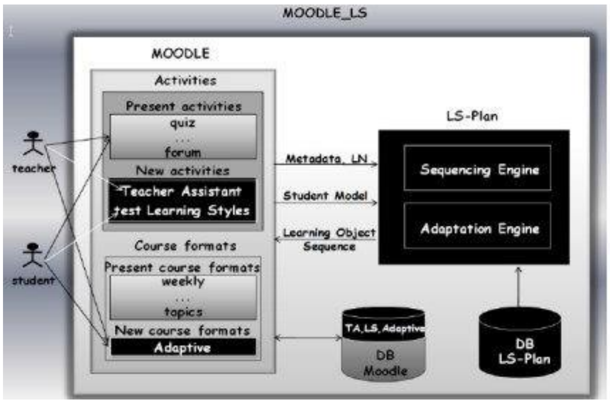


Figure 1. Moodle LS architecture

For each teaching module, there may be materials with the same learning content but with different styles. The system is able to present for each learner the material most congenial to his or her needs. In addition, we have provided a metadata module for topics that allow tagging operation on the concept defining teaching prerequisite and teaching successor in order to move from a simple linear online course to a concept map (Fig.3).

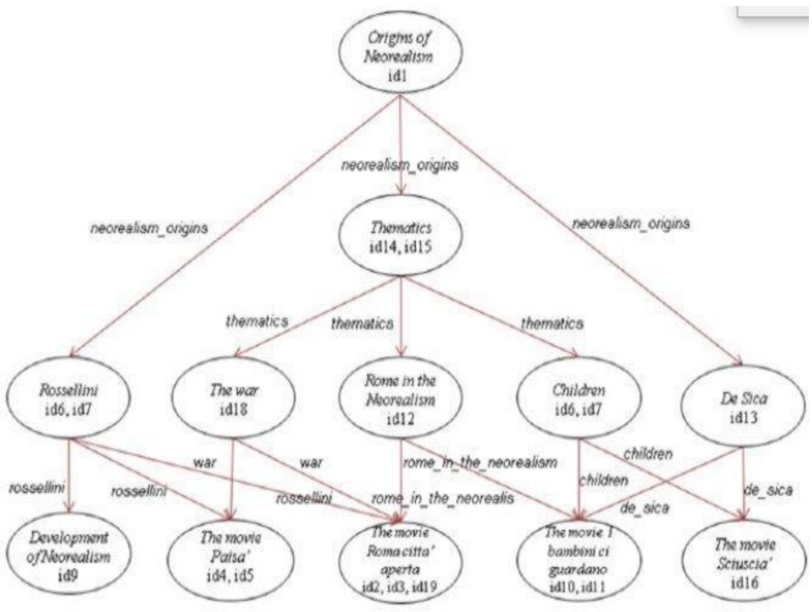


Figure 3. Course concept maps

The system via the LS_PLAN plainifier is able to reorder the course modules and in some cases eliminate some of them (recognized prior knowledge) or reintroduce some (missing prior knowledge) in order to optimize the learning process as is shown in Fig. 1. Finally, at the course creation stage, the model generated at runtime of the Moodle_REC (Fig. 2). platform was introduced: the model is represented by a vector of similarities with all the other lecturers. To generate this value each time it is used, the structures of the set of all courses created by the teacher are compared with the set of courses created by each teacher. The score is increased by one unit for each common material used; using the concept of prerequisite/successor, if a material is used in the same sequence within a course (e.g. M1 before M2 in both courses, Mi=material number i) the score will increase by 2 and so on for longer sequences (M1->M2->M3 score increases by 3)(Fig.4). This model is used to reorder the materials obtainable directly within the system via a query from the most important repositories of Learning Objects and Open Educational Resources.

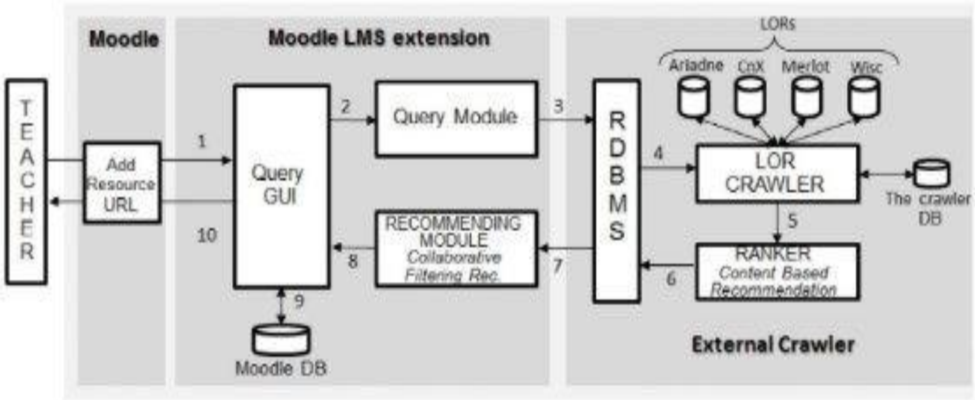


Figure 2 Moodle_REC architecture

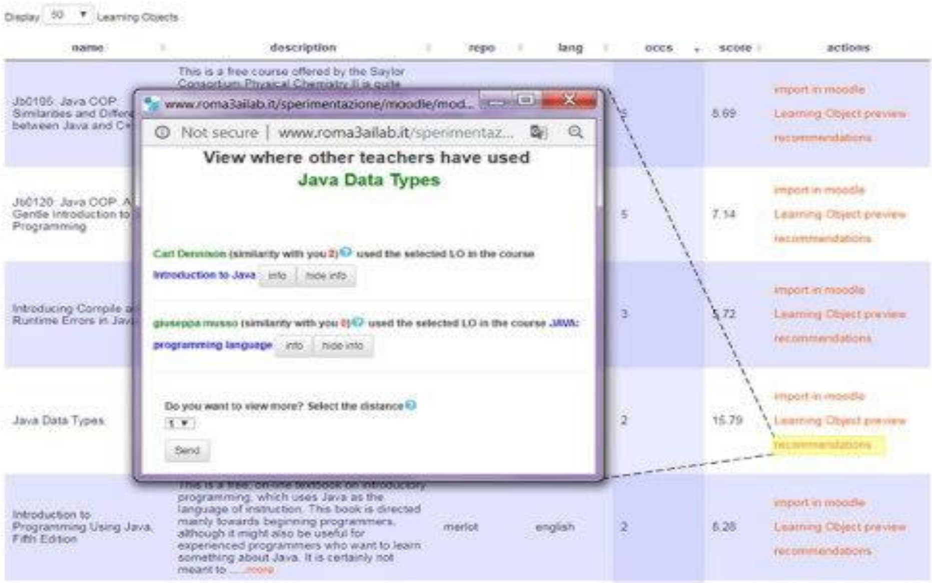


Figure 4 Moodle_REC User Interface

## Results

To evaluate the system, the MoodleP system was tested with 28 university-level lecturers via a call on MIUR's SOFIA platform. The recruited lecturers were asked to create a course using the integrated material retrieval system on one of the following four macro-areas: mathematics, religion, programming or biology. Using the Moodle platform logs, the following data were collected:

- the number of new courses .
- the number of system recommendations followed/not followed,
- the number of LOs retrieved from the system,
- the distribution of LOs retrieved.

There are several methods for evaluating recommendation systems in the literature divided into two macro areas of measurement; statistical accuracy metrics (Mean Square Error (RSME), Mean Absolute Error root mean square error (RSME), Mean absolute error (MAE) and correlation) and Decision support accuracy metrics (Precision, Recall, F.Measure).

The sperimentation suffered from the well-known cold start problem in fact as shown by the curve in fig. 3 as the number of courses on the platform increased, so did the recommendations followed. The expected results were not satisfactory in this case as shown in Tab. 1; this was partly expected as to have a sufficiently large community of teachers it would be necessary to connect different instances of this platform and start a large-scale experiment, the next step in the project.

| Precision | Recall | F1-measure |
|---|---|---|
| 0.22 | 0.39 | 0.28 |

Table 1: The Evaluation measures of Precision, Recall and F1.measure

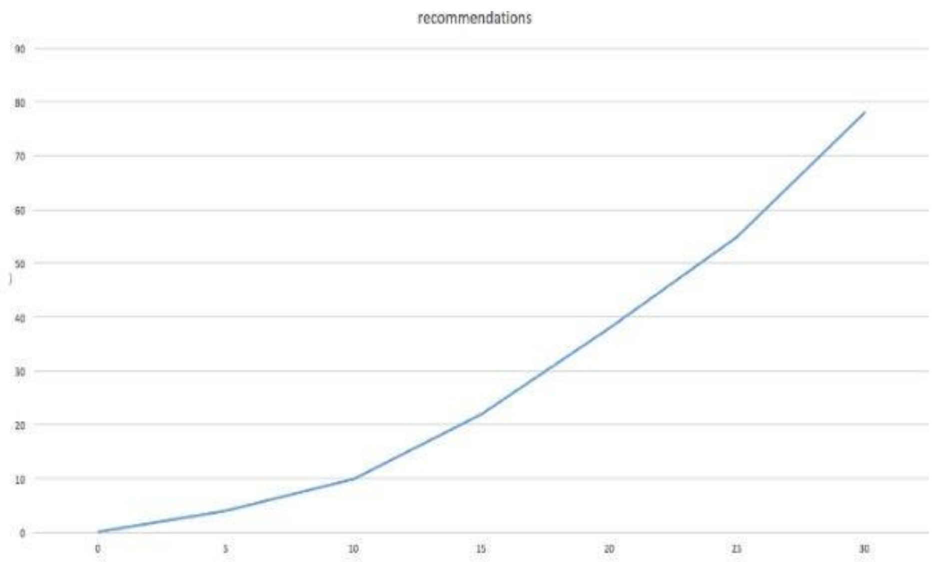


Figure 3 Results of MoodleRec use: the x-axis represents the number of courses in the system; the y-axis represents the number of recommendations followed by the teachers.

A System Usability Scale (SUS) questionnaire (K. Orfanou 2015) was used to assess usability Structured in 10-item satisfaction questionnaire was submitted:

- How much did the system help you find teaching materials?
- Were you helped by the teaching community?
- Did you use all the web archives?
- Did you use the recommendations produced by the system?
- Did you use the community functions?
- How many courses did you create?
- How long have you used the system?
- Are you satisfied with the overall use of the system?
- How satisfied are you with the courses created with the system?
- Do you think that the course creation mechanism is a good method,

The values for the answers to questions 1,3,5,7, and 9 were recorded by subtracting 1 from the value while for the missing items the value was calculated by subtracting 5 from the recorded value. Finally, the value was multiplied by 2.5 to obtain the SUS value for the evaluation. As expected in the literature a value below 50 indicates a failure while above 80 A evaluation. Moodle REC scored 70 points in the test showing promise. Finally, in order to check the consistency of the SUS questionnaire, we calculated the Cronbach's alpha, obtaining $\alpha = 0.85$.

## Discussion

This work presented a hybrid platform capable of following teachers and students in the complex process of creating/using teaching materials. The system allows the users to find Learning Objects and Ores from internet and organize them in topics and courses. It also provides a graphical interface to simplify the material selection process. The course graph (concept map) allows teachers to compare, easy reuse of the materials within the courses; also, students will be able to consult the course map and receive guidance on which modules to follow next and which materials to choose in order to optimize the learning process. In order not to introduce noise into the data (technology gap), the first trial was started with only teachers recruited via the SOFIA digital platform, so as to have teachers who had no problems with online platforms. The system, designed to optimize the teaching and learning processes within the digital teaching environment, was positively evaluated through the SUS questionnaire tool () scoring 70 points in the proposed experimentation; furthermore, the analysis of the recommendations made by the system showed a curve that grows exponentially with the number of courses (increasing population on the platform). Furthermore, the figures for accuracy P=0.22, recall R=0.39 and measurement F=0.28, although low when put in relation to the curve in Fig. 3, predict that as the number of active users on the system increases, these values increase, indicating more accurate recommendations.

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