Prometeo and IESCampus, Multimedia Learning Management Systems, towards Intelligent Agents

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Abstract: In this paper we present learning tools from a new perspective, characterized by the way they are scheduled and developed as well as their interactive nature. The interactive software applications described mean a device to improve the teaching-learning process and to make it more attractive. These tools are delivered using multimedia learning management systems whose implantation and use will be developed through different phases in the university and in various Secondary Schools in Las Palmas de Gran Canaria. In these new learning management systems different learning objects are implemented in order to make it possible to adapt the web platform to the new characteristics of the Web 3.0. These projects are called *Prometeo* and *IESCampus. IESCampus* has been developed for Secondary Schools as an extension of the project *Prometeo* developed in the university as an initiative promoted by the *Quality and Educative Innovation Vice-chancellorship* of the *University of Las Palmas de Gran Canaria*.

1. Introduction.

Internet can be defined as a great virtual data centre whose contents are continuously being updated and that allows an exchange of information amongst users. A large amount of the Internet users are able to access this information, which have caused important social and cultural changes (P. Brey, 2005) (M. Vlada, R. Jugureanu, 2007).

There exists a second web generation, called Web 2.0 (T. O'Reilly, 2005) which is based in a collection of services. Amongst them we find social networks, which promote the information exchange amongst users. This offers us the possibility of sharing and collecting a wide range of information and even more, the possibility of creating a common identity that is at the moment in a developing process.

Nowadays we find a third web generation, the so called Web 3.0 (P. Wainewright, 2005) or Semantic Web[1], which is considered by many authors as the one that means an approach of Internet to artificial intelligence[2] technologies (A. Yong-yeol, H. Seungyeop, K. Haewoon, M. Sue, J. Hawoong, 2007).

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1 Semantic web is a concept used by data warehouse whose information describes the content, meaning and relation of stored data; these are the metadata, used to evaluate the information automatically.
2 Artificial intelligence is the responsible for building processes executed to achieve the maximum of a particular yield measurement. These results obtained depend on the system's inputs, and the stored knowledge.

2. Educative contents

A learning object is an entity used in learning processes (J. L. Rodríguez Illera, A. Escofet, M. Azzato, 2005). Its modular design allows them to be reused in the processes and used in the planning of education routes[3].

Digital learning objects lead us to think of the same concept but making use of a new container: the whole hardware and software that supports digitalized information.

Multimedia contents and interactive software applications created have been developed following object oriented programming[4] and design principles.

Amongst their main characteristics we find:
- *Modularity*. Composed of independent pieces that interact with each other. The information inside these modules is strongly related, this is denominated *high cohesion*. And the degree to which each module relies on each other is low, which is called *minimum coupling*.
- *Portability*. Independent from the runtime environment used. This way, the possibility of broadcasting in different media is higher.
- *Scalability*. With the possibility to increase or decrease its size or even its configuration in order to adapt to new requirements.
- *Extensibility*. Its amplitude could be increased, allowing the easy incorporation of new elements such as, for example, resolution methods.

In the same way that software engineering was developed in order to apply proved techniques of exposition and software development at a reasonable cost, the creation of large-scale educative multimedia contents implies a structuring of the process. This is necessary due to the wide range of contents that can be found within a lesson module and to the different resources that will be needed. In the creation process it will be used a methodology through which the aims will be reached.

The contents will be developed by a multidisciplinary team which competences are defined by different profiles: project managers, analysts-programmers, recording managers, multimedia technicians, designers and the teacher staff of the subjects.

Different tasks of each professional profile will come together in order to create a production line to maximize results.

2.1. Multimedia contents.

With an audience increasingly demanding, used to the new technologies and, therefore, with a very different profile in comparison to those of past decades, universities should contemplate how to tackle the development of high quality educative content. Contents that make use of new technologies and that will be adapted to new learning methodologies.

The lecturers should be part of the multidisciplinary team that will work in the project in order to develop the material according with his/her needs. All the staff will develop the contents making use of a methodology. This formal method will define what to do, what resources to use, the estimated schedule and mistakes' correction and revisions.

Stages of the creation process:
1. Planning. This is made taking into account the subject and the lesson whose material will be created, as well as the availability of teachers and resources. According to these factors, a time schedule will be established.
2. Material collection. There will be made a search in order to collect all the material that could be useful for the scripts' production, texts' writing, graphs, exercises and assessments. The material collection could be found in notes, books, papers and other publications, as well as software applications and information found in web pages and other sources of interest.
3. Design. In this stage the content´s index, images' selection, texts, and software applications to be used will be established. Besides, exercises to make will be selected and classified as well as the education routes to be

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3 In the teaching field, education routes are defined as the routes scheduled by lecturers according to a calendar. In this way the student could follow their own learning process.
4 The object oriented programming is a technology that expresses a software application as a collection of objects that collaborate together in order to complete tasks. This allows creating, maintaining and reusing programs easily.

followed by students. If not all the material is defined from the beginning, the stage can start with a preliminary design that will present the selection range and a second one presenting the education routes.

4. Writing.- There are two types of essays to take into consideration:
   ▪ Scripts. The composition of scripts is made for the video recordings. Although some of them could seem more colloquial without the use of a script, there are others where it is more suitable to follow a previously written text.
   ▪ Lessons texts. Texts, show the complete and organized narration of the lesson's contents. Their main feature should be their accuracy, rigour and simplicity.
5. Revisions. Are necessary in order to correct mistakes and their aim is to include all the information that has been left behind in previous stages. It will be suitable that all these revisions will be made by other lecturers that have not participated in the writing.
6. Content's creation. Once the collected material and the content created in previous stages is checked, video recordings are made and the software applications needed are defined.
7. Postproduction. The raw material recorded is edited using the corresponding resources to each type of recording: texts, images, animations, audio and other videos.
8. Tests. Tests batch are designed, to check the correct work of the material produced and how they are delivered.
9. Releases. In this stage improvements needed to enhance the content are exposed. This is made according to polls, assessment of results and lecturers' own assessment.
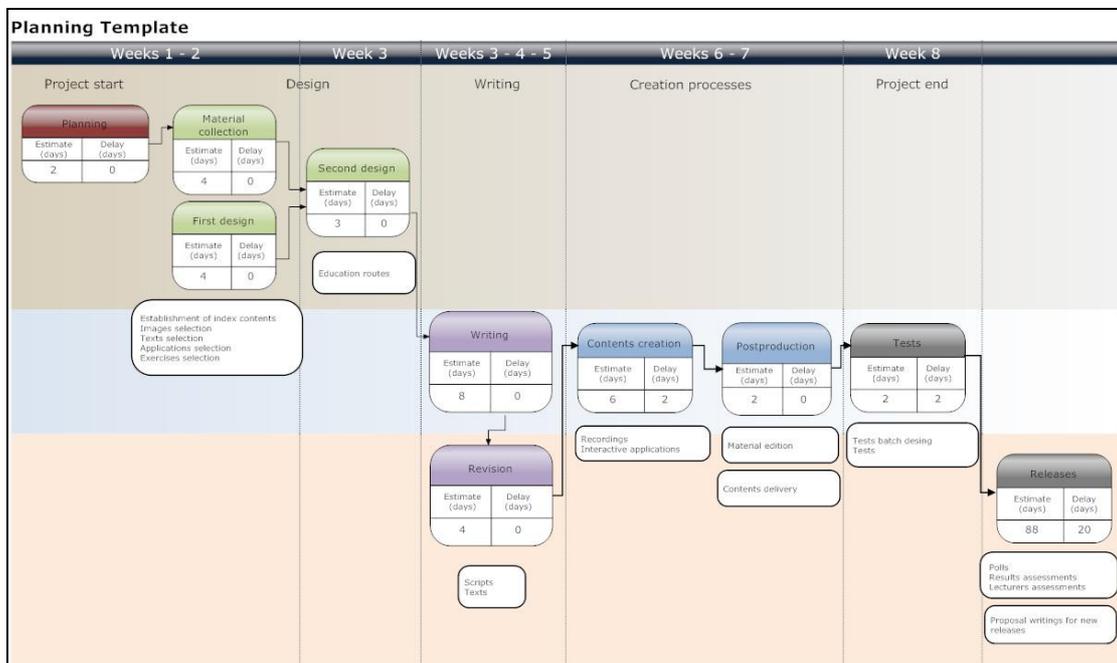
Figure 1: Planning template.

These stages followed in each project are similar to those used in software engineering. The traditional model, similar to the waterfall model, is the one used. Each phase begins once the previous one is finished. Each project starts with a solid set of requirements and definitions, but it must be considered from the very beginning that changes are not only inevitable but also desirable.

Prometeo project has been developed in different phases:

In the first one, called *demo phase*, it was planned to develop contents for subjects of three different knowledge areas: the technical, social sciences and health sciences areas.

In the second one, *Prometeo I*, were produced contents for at least one subject of each colleague of the University of Las Palmas de Gran Canaria which is composed of 17 university colleges.

Nowadays we are working in the third phase, *Prometeo II*. The selection criteria of these subjects were published in the Official Bulletin of the University of Las Palmas de Gran Canaria, according to these conditions:

1. Conditions for the subjects: It is recommended that the content of these subjects be present in the new university curriculum defined within the frame of the Royal Decree number 1393 (October 29th, 2007), which establishes the plan for the official university education. The conditions to be preferential in the selection process are listed below:

- Subjects' contents of the first two years and first course as opposite to those of superior courses.
- Subjects' contents of core subjects as opposite to those compulsory and these as opposite to the elective ones.
- Those subjects' contents with a highest number of registered students.
- The proposal of cross curricular topics to a number of subjects from the same degree or even different degrees.
- Those contents with a highest variety in the typology of educational resources used in the contents.
- The necessity of special adaptations for challenged students will be adequately taken into account.

It is also considered as a global technical selection criterion a suitable distribution between subjects of different terms with the aim of presenting a well-balanced planning of the workload in the production process.

2. Conditions for lecturers: For the proper execution of the Project it is considered a basic value lecturers' motivation, because the participation demands dedication.

The stages proposed have been used in *Prometeo I* and *Prometeo II*. After a previous process, in the first phase, where some errors were detected in different stages. For example: the necessary revisions, or scripts, or even some changes in the tests batch.

2.2 Interactive Software Applications

Interactive applications are developed with the goal of making students interact and manage them. This way the student can create a mental model of its working (C. McHugo, T. Hall, 2006). The learning process, in this case, does not come simply from reading and understanding a concept, but from the understanding of its behavior.

In the creation process, it is essential the role of the lecturers for whose subject the interactive software applications will be developed. It is very important to take them into account to make the scheduling, to receive the material to use, and to participate in the contents' creation and documentation (C. Gráinne, 2007).

Stages of the process:

- Initial requirements definition. At this first stage the project manager gathers information about the subject making a research on its teaching project, and introducing the applications to develop and technologies to use. Later the project manager arranges the first meeting with the lecturers.
- Meetings with the lecturers. This is the first contact with the teachers. In these sessions a series of demos and applications already finished belonging to other subjects are shown to them. Teachers expose the objective of their subject, how they give the lessons, and the material used. On the part of the project's staff all the lecturers' questions are solved, they receive advice and one or various prototypes are proposed.
- Scheduling. A work agenda is established where the tasks of the whole development staff will be included.
- Analysis. Using the information obtained in the first meeting, the analysts-programmers work in the first analysis for the prototype. Software and user's requirements are documented. The recording manager prepares the material in those cases where multimedia elements are required. All these tasks will be supervised by the project manager.
- Recordings. Teachers' videoing. These could be made in the record studio, laboratories, classrooms, exterior locations or making use of screencasts.
- Prototype development. Using the documentation of the previous phase, the programming code is edited.
- Tests. The prototype is accessible through Internet to the teachers in order to allow them to check the application.
- Documentation. All the documents generated are stored. On one side, the documents related to the development and, on the other side, the documents about the recordings. The objective is to make easier the maintenance and new releases.
- Meetings with lecturers. The prototype should present all the features defined in the previous stages. New requirements considered by the teacher are documented. After these tasks the final version with the requirements of the application is documented.

- Scheduling. Necessaries modifications are made in the agenda.
- Development application. Using the new documentation or its modifications, a new prototype is developed. Besides, multimedia modules created are included in the final version.

These two last stages could make the process cyclical.

The phases followed in the development stage are similar to those used in software engineering. The model implemented in the stages expounded is prototyping. This is an evolutionary model that begins with the exposition of global objectives whose definition becomes more specific after the release of the first prototype. The applications developed for these projects are small enough to be finished with just one prototype, i.e. the execution of one cycle.
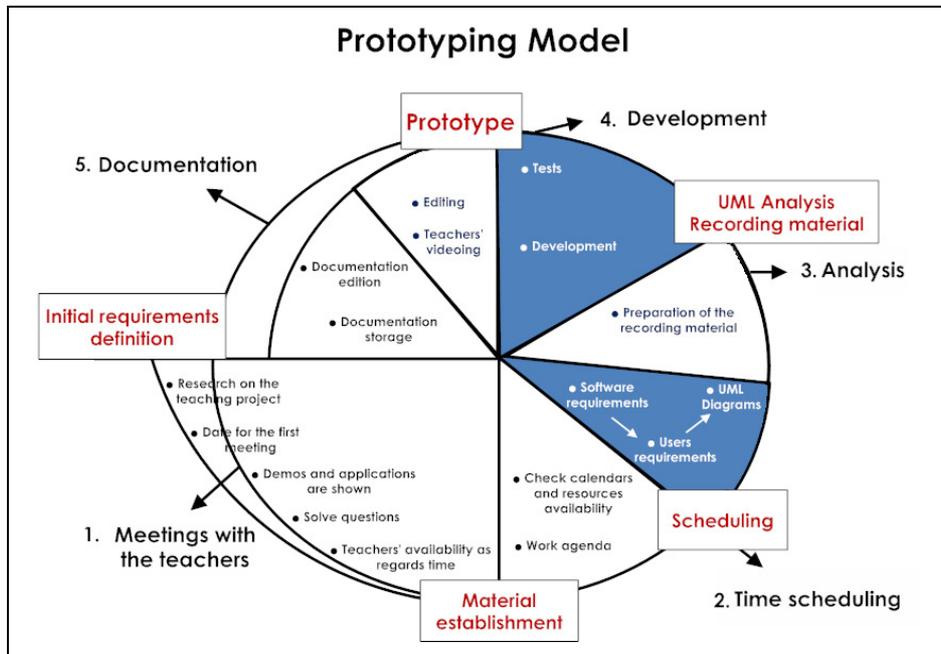
Figure 4: Prototyping model.

3. Learning Management Systems.

An LMS (Learning Management System) is a software application accessed through a web server that, making use of web technology, manages and broadcasts educative content to support the training that takes place in the classroom and the distance learning activities.

An LCMS (Learning Content Management System) is a management system used to teach, like the LMS. Its web technology allows users to create and manage the contents of a learning program (L. F. Ortiz, 2007).

The most appropriate form of making use of this kind of systems is to create content modular pieces which could be personalized, managed and reused.

Both web platforms introduced in this work are designed to offer the student a variety of tools which give them an important independence (N. A. Newbutt, 2007). (M. D. Afonso, C. Guerra, Y Rodríguez, A. Villalba, 2008)

3.1. MLMS Prometeo. Delivering educative contents at the University.

MLMS (Multimedia Learning Management System) *Prometeo* is a multimedia and interactive web platform. Its functionality is focused on users' management and the administration of the system's resources. The main feature that makes the platform different is the streaming media[5] (T. Hartsell, S. Chi-Yin Yuen, 2006) to

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5 Multimedia content broadcasting, on demand, through Internet. It is a delivery method that allows the visualization of this kind of content directly on the web page, with no need of a previous download.

deliver lessons videoed in multimedia format (H. Samaras, T. Giouvanakis, D Bousiou, K. Tarabanis, 2004) (K. Fraser 2006) and the use of interactive software applications (R. Rheeder, R. Diseko, G. Lautenbach, 2007).

The educative content videos should be attractive for the students. They are developed with a high quality, making use of the adequate techniques for each subject. The student profile has been considered in the writing of the scripts, in the presentation of the contents and the length of the videos, amongst other features.

Interactive software applications allow students to manage the simulator learning tools. They are developed with the goal of making students interact and manage them. This way the student can create a mental model of its working (C. McHugo, T. Hall, 2006). The learning process, in this case, does not come simply from reading and understanding a concept, but from the understanding of its behavior.

The information with the time video slots viewed by students and data about the use of interactive software applications are stored for information about its use.

The web platform allows users not only the possibility of contents' configuration but the possibility of following up students' work in order to guide them in the teaching-learning process.

With *Prometeo*, lecturers will work in the creation and configuration of their educational projects. They will devise and organize the different resources of the web platform, such as: notes, images, videos, interactive software applications, questions, exercises or tasks. From their user menu they could observe students' participation. This way they can assess, not only how students work with the material but also their progress (J. Clearly, 2006).

Besides, tools like the administration of doubts, offer the lecturer very important information. Making use of this resource, the student makes questions to the teacher. The most consulted questions can give information about the parts of the lesson where the teacher might emphasize or expose more practical examples.

On the other hand, students can follow up a complete course: making use of the digital material delivered in text documents as well as in video files; making questions about the lessons; making use of the interactive software applications to make practical exercises with results closer to reality; and assessing these results using questions and tests. Other tools like calendars, notes, tasks management, calculators, or diaries will allow them to personalize their work desktop.

3.2. MLMS IES Campus. Delivering educative contents at Secondary Schools.

MLMS *IESCampus* is a web platform similar to the one developed in *Prometeo* project. Its functionality is focused in the following up of the work made by the students. In this web platform the player shows the video slots viewed by the students. Here, a time slot is considered viewed when the student has been paying attention to the content of the lesson. In order to obtain this information the video player displays a short question that the student must answer. The time in which these random questions are displayed is called *control point*. If the answer is correct the video player stores the time video slot viewed from the last *control point*. Otherwise the video player considers *not viewed* the time video slot from the current *control point* to the last one, where the answer to a random question was right. This activity of the player is called *visualization control* and it is equivalent to the questions, generally simple ones, that the teacher makes in a classroom to check if the students are paying attention.

Interactive software applications allow students to manage the simulator learning tools and to give answer to different exercises. In this case information about the results, number of attempts, dates of attempts, and how many of them have been correct and incorrect, even the order of use, is stored.

With *IESCampus*, teachers will work in the guide and assess of their students only having a look at all the information stored and analyzed. They do not have the possibility to contribute to the educative contents. They can use them as well as the web platform, as an additional material.

The use of the teaching contents allows teachers to ask students to follow these contents before assisting to the classes, so, they will have a preview about the lessons they will attend at the classroom. After the lessons the students have got a lot of resources to complete the material of the classes: text documents, video files, question resolutions, and interactive software applications. This material means an important source of reinforcement elements. As in *Prometeo*, other tools like calendars, notes, tasks management, calculators, or diaries will allow them to personalize their work desktop.

3.3. Prometeo vs IES Campus.

Prometeo has been developed within the frame of a project, an initiative promoted by the *Quality and Educative Innovation Vice-chancellorship* of *the University of Las Palmas de Gran Canaria*. *Prometeo* project offers up lecturers a professional team to create multimedia e-learning content and to develop interactive software

applications. Later these contents will be managed making use of a multimedia learning management system. Therefore *Prometeo* is an integral service of production and broadcasting of teaching contents.

IESCampus has been developed as an extension of the project *Prometeo*. From a spinoff, which objective is to develop and distribute educative contents for secondary schools that can make use of a web platform as the one described above.

According to the description of both web platform the one used at the university level, MLMS Prometeo, gives more independence to the students an allow lecturer guide them in the learning process. The one developed for secondary schools, MLMS IESCampus, provides to teachers academic results shown with activity indexes, and grade point averages. These academic results will compose the statistics, calculated according to the information stored in the data base, making use of datamining[6] techniques.

In MLMS Prometeo, we find different users' profiles: the administrator, teachers and students (G. Lautenbach, 2007) (H.L. Grob, C. Buddendick, N. Albrecht, A. Widera, 2007). But in MLMS IESCampus there is one more: the parents, who now can participate in the education of their children been informed about their work and academic results in real time. This way the communication between parents and teachers could be more enriched.

The main difference between these two projects is that at the University, the lecturers participate in the creation of the educative contents they will use in their subjects. At secondary schools, a team of teachers will develop the educative contents that will be proposed to high schools and later used by other teachers.

Regarding the use of both web platforms, just a few of lecturers use the *visualization control* or the information of the results of the interactive applications' use. They use to require, above all, information about the use. For the teachers of secondary schools it is very important the *visualization control* and the academic results about the use of the applications.

But in both of them the information stored about the work of the users allow obtaining more information to follow the progress. For example: in a traditional LMS we obtain information about the view on the part of the students of a file or their participation in the subject forum. In these LMS, we obtain information about the view on the part of the students of a video, but this mean that the student has been paying attention to the video cause the time slot is considered viewed if he or she has given the correct answer to the questions of the different *control point*s. And it is possible to obtain information analyzing the number and frequency of attempts made by the student to resolve a problem.
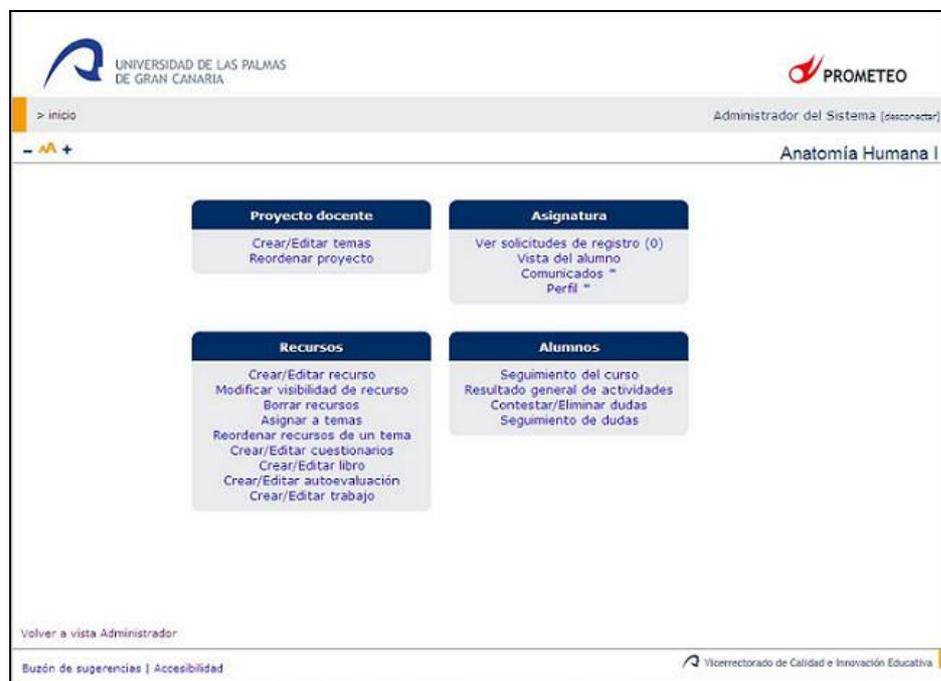
Figure 7: *Prometeo* main screen.

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6 The process of extracting hidden patterns from data.

Figure 8: *IESCampus* main screen.

4. Contributions and future lines

In this paper we expound the different phases proposed to create educative multimedia content and software interactive applications. To follow a formal method leads to the attainment of each project's aims, as well as to use the resources properly.

Amongst its advantages we find:

▪ This approach makes lecturers think about the configuration of the course, presenting the aims of each lesson and a proper and attractive exposition of the contents.

▪ It gives a general vision of the course. A planning that follows a formal notation will facilitate this vision, allowing this way the prompt detection and reduction of mistakes.

▪ It improves the planning and process of the material's revisions.

▪ It allows, making use of a suitable modular design, the reuse of educative material.

Nowadays the work is focused on a deeper research on datamining tools that will be necessary to design use patterns, and on a methodology for the labeling of both the learning objects and the data obtained from the monitoring of the teaching-learning process. Using this information, users' profiles will be defined. For these profiles new education routes will be scheduled. An analysis in order to include intelligent tutors in the project will be made. Finally we are working with the lecturers of the subjects to establish a new model of representation which will be used to define formally the education routes.

The main aim of scheduling routes is that students can follow the lessons together with a time planning adapted to their needs. This way it will be easier to adapt the learning process for those lecturers with students that attend their courses and who belong to different levels and present different learning needs.

The education routes could be implemented according to a collection of rules whose data input are: the time planning, the different tools used and the activities proposed. The decision-making process in this module is developed taking these data input and the information stored in the database obtained through data mining techniques (J.M. Domenech, J. Lorenzo, 2007) (R. Cooley, B. Mobasher, J.S., 1999).

This is the way these projects make us to give a step forward to the Web 3.0. The information stored will allow that computers could understand and use the content in the web. Therefore the e-learning could use the service and functionalities of this Web 3.0 technology.
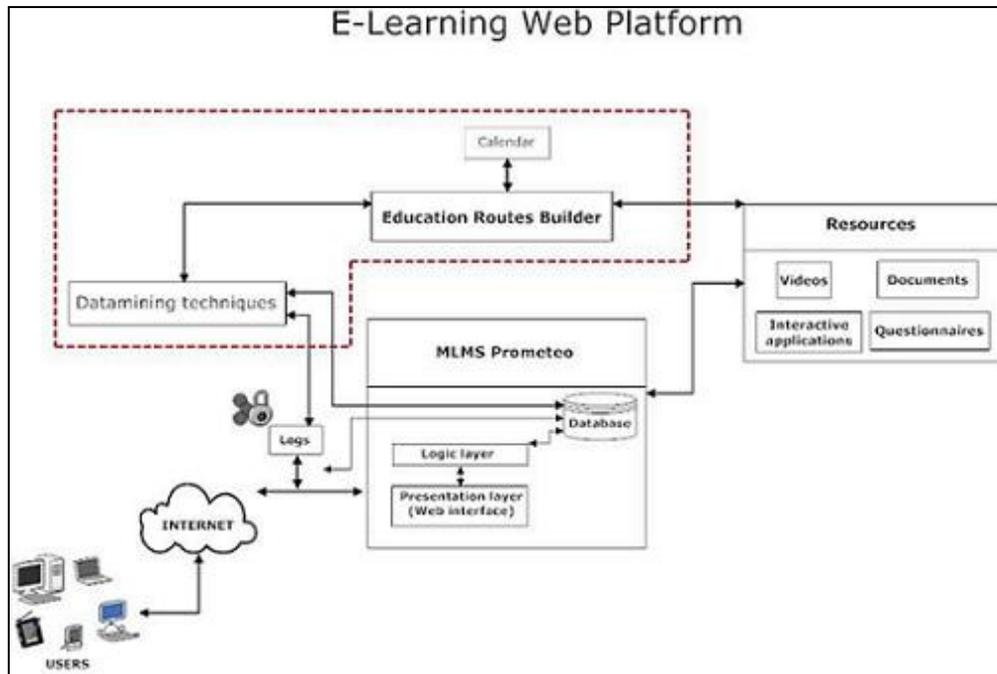
Figure 9: Education routes.

Projects like the exposed help the whole educational community in the implantation of the methodological use of new technologies to achieve the initial aims.

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