



Selection of an open source virtual learning environment for Universitat Jaume I

Centre d'Educació i Noves Tecnologies de la Universitat Jaume I
in collaboration with the Servei d'Informàtica and the Gabinet Tècnic del Rectorat

May 2004

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<mailto:cent@uji.es>
<http://cent.uji.es>

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Abstract

The Centre d'Educació i Noves Tecnologies (CENT), in collaboration with the Servei d'Informàtica and the Gabinet Tècnic del Rectorat, at the request of the governing bodies of Universitat Jaume I, has evaluated a number of open source virtual learning environments. The purpose of this evaluation is to select an IT application that will act as a tool to improve the training processes undertaken by the Universitat.

This report outlines the background to the process, the criteria and the methodology used in the evaluation and the conclusions reached, and recommends the use of Moodle as a virtual learning environment for the Universitat Jaume I.

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1. Background

The governing lines approved by the Universitat Jaume I Senate expressly mention the «development of a “Virtual UJI”, one of the objectives of which is to facilitate the undertaking of phases in the teaching/learning process that are not necessarily classroom-based». During the 2001/2002 academic year, under the auspices of the Governing Body, the CENT carried out a pilot project to evaluate virtual environments for classroom-based and distance education, in which 33 academic staff and around 900 students took part, and which used the WebCT and BSCW platforms. As a result of this project, in December 2001 the CENT presented a report to the UJI governing bodies on the pedagogical requirements and usability of the software. In April 2002, the Virtual UJI committee was created with a brief to promote the use of a virtual teaching and learning environment that would answer the needs of classroom-based and distance education, whether regulated or not, of the institution. At the beginning of the 2002/2003 academic year, the UJI provisionally selected WebCT, a well-known commercial product designed for distance learning, as the operative environment for the new Aula Virtual¹ (Virtual Classroom) service. Over the last two academic years, some 44 subjects, postgraduate courses and other educational activities have made use of this platform. In December 2003, in line with the UJI’s commitment to open formats and free software (see Statutes, additional order nº 7), the Commission decided to analyse the various alternatives available, and if the results were favourable, to introduce an open source environment. This evaluation and selection was to be jointly carried out by the CENT, the Servei d’Informàtica and the Gabinet Tècnic del Rectorat. The findings of this assignment are presented in this report.

¹ <http://aulavirtual.uji.es>

2. What is a virtual learning environment and what is it for?

A virtual learning environment (VLE) is an IT application designed to facilitate pedagogical communication amongst those participating in an educational process, whether it be distance learning, classroom-based or any combination of the two. The purpose of a VLE is to distribute educational material in digital format (texts, images, audio, simulations, games, etc.) and to provide access to online debates and discussions on aspects of the course study programme, to introduce relevant content from the Web or to enable external experts or professionals to participate in debates or talks.

Thus, a series of various tools are brought together in a VLE:

1. Synchronised (e.g., chats) and non-synchronised (e.g., mails, forums) communication tools.
2. Tools for the management of educational material.
3. Tools for the management of participants, including student follow-up and progress evaluation.

From a didactic perspective, a VLE offers technological support to teachers and students to optimise the various phases in the teaching/learning process: planning, implementation, development and evaluation of the curriculum.

Why use a VLE? The UJI aspires to being a dynamic and innovative university, committed to the introduction of new information and communication technologies in teaching, research, the conservation and spreading of culture and the management of its resources. For a variety of reasons, teaching and learning are perhaps the areas in which the possibilities offered by the new technologies have least appeared to date. Nonetheless, the effort involved in introducing a VLE in a higher education institution is amply justified by the advantages and potential it offers for the improvement to teaching and learning quality:

- It augments the quantity and quality of materials and resources for learning, both from internal and external sources, and facilitates student access to them;
- It increases the possibilities for communication between teachers and students, and between students themselves;
- It enhances the flexibility and variety of didactic activities that make up the core of the curriculum;
- It contributes to training students in instrumental and meta-cognitive skills («learning to learn», devising one's own learning plan, self-evaluation, etc.);
- It makes «study time» more flexible, in order to adapt to students' needs and possibilities; etc.

However, it must be clearly specified from the outset that the implementation of a VLE does not guarantee *per se* the improvement in teaching quality. A range of other provisions must also be added to availability of technological resources: professional training programmes for teachers in didactic strategies and information technologies, means of support for educational innovation and good practices, encouragement for the production and distribution of quality teaching materials programmes to encourage enhanced quality and quantity of communication between teachers and students in the tutorial setting etc. In sum, the innovative teacher who systematically strives to provide quality in his or her work must be helped and rewarded. In our opinion, providing teachers and students with a VLE is a necessary requirement, but on its own it is not sufficient to improve the quality of university teaching. This technological innovation must therefore be placed within the framework of a comprehensive, global project that embraces all organisational, personnel and material factors, and in which every body of the university community with responsibilities in these areas participates in a coordinated manner.

3. Current trends

The terminology, characteristics and functions of VLEs have evolved over time. Currently, various tendencies coexist in the research and development of these environments:

1. The integration of VLEs into teacher and student management systems, brought about by the institutionalisation of initiatives, to form what is known as an MLE (*Managed Learning Environment*).
2. The break down of previous monolithic systems into architectures of levels and inter-operable, standardised components (see the OKI initiative, for example).
3. The separate management of content and its creation, distribution and integration in didactic units, encouraged by the theory on standardised learning themes: reusability, aggregation, metadata, free distribution, inter-institutional collaboration, etc.
4. Concern for the pedagogical aspects of online learning and teaching, as can be seen in the development of modelling languages or learning design (EML and IMS Learning Design, for example), in contrast to the obvious triviality of the pedagogical assumptions underlying models such as SCORM that focus exclusively on materials.
5. The rapid expansion of open source environments, in part due to the pricing policies of the leading firms in the sector, and to the increased quality and didactic sophistication of these environments, and their greater flexibility and potential for integration.

If we had to opt for just one adjective to describe the current situation, *fluid* would be a good choice. On the one hand, theoretical developments are well ahead of the software available, but these developments must be carefully considered so as not to make the wrong decisions with a view to the future. On the other hand, the first generation of VLEs, based on the distribution of materials and evaluation by means

of «objective» trials, has given way to a second generation of environments inspired by new knowledge about how to learn with online resources. This second wave is oriented more towards didactic communication, the design and monitoring of collective work flow with the materials and, in general, towards the teaching activity or learning experience. In this context, the need for content standardisation must not be forgotten if our aim is to reuse and share these contents, thereby optimising the cost of their production.

4. Selection criteria

In order to select the most suitable VLE for the UJI, certain criteria had to be previously set down in line with the needs and type of use we are proposing.

4.1. Didactic flexibility

The UJI VLE must be a useful tool that is suitable for the diversity of teaching and learning methods and styles found in the university, for its wide range of subjects and courses, for its diverse content and formats and for its variety of levels and aims, and it must actively facilitate good teaching and learning practices. It must extend the opportunities for communication and collaboration in knowledge building between those participating in the educational process and expand a meaningful relationship with the learning materials.

Thus, we understand «didactic flexibility» to mean the capacity to offer added value to training processes that differ in several aspects:

- Undergraduate and postgraduate training.
- Classroom-based, semi-classroom-based or distance learning.
- Academic training aimed at students and professional development training activities for academic and administrative staff.
- Teaching styles focused on content or instructivist styles, on student activity or constructivist styles, or based on research activities.

- Conventional subjects taught on campus and practicums in companies and institutions, including practicums abroad, in which the UJI teacher acts as a tutor or coordinator.

Whether intentional or not, the philosophy behind the design of every VLE is pedagogical. In other words, it is based on a set of assumptions about how the individual learns, and consequently, how teaching can help to foster this learning process. More specifically, every VLE assumes an implicit theory about online learning. Certain environments prioritise the creation and distribution of training content, assuming that the students' contact with relevant, accurately designed materials is the key element in the learning process. Others, in contrast, highlight communication between participants, in the firm belief that learning is a product of social interaction and a shared construction of meanings in an atmosphere rich in information and opportunities to gain knowledge. In each case, the various modules, components or tools incorporated in the environment have different functions and are arranged in different ways. Furthermore, in a university like the UJI, the teaching staff approach their work with a wide range of different teaching styles, resulting from their own pedagogical convictions, the nature of their subject content or materials, the variety of learning styles manifested by their students, etc. An environment that is to satisfy the maximum number of needs must be extremely flexible: no one particular teaching style may be imposed; rather, the greatest possible range of styles must be allowed for so that both teachers and students appreciate an increase in the possibilities available to them, rather than a limitation, a disruptive element or an obstacle to their creativity and innovative capacity.

4.2 Usability

In broad terms, a system's usability can be defined as its efficiency combined with its ease of use. The VLE selected by the UJI must be easy to use both for teachers (in designing the courses, encouraging participation and didactic communication, and in their role as managers of academic information) and for students (as the main protagonists in their own training process). What generally makes a system complicated to use is not the wide range of functions it is able to perform, but rather, bad design. The ideal VLE will not require a «student's manual» or a series of user

training sessions: it must lend itself to hands-on learning, with minimum previous instruction. It must be a simple, intuitive, easy and user-friendly environment. Any student accustomed to surfing the Web and using normal web applications (e.g. webmail, forums) must be able to use the UJI VLE without major difficulties. A teacher with the same IT knowledge base must be able to create and manage a course on the VLE.

Ease of use must not be regarded as a secondary requirement. We believe that user experience is a crucial factor in the general acceptance of this type of environment, and one of the main problems presented by numerous systems on the market. If teachers and students consider that the environment is going to make their lives more complicated, and that it does not provide any added value to their teaching and studying activities, it will inevitably be rejected. For this reason, a modular system that allows a progressive, tailor-made configuration to be developed, according to the needs of the moment, and which conceals the tools or resources that are not used will be considerably more effective than a complex system complete with functions that are not used to their full advantage.

It should also be mentioned that, in our opinion, usability also includes, amongst other key elements, accessibility. Within the scope of the technological possibilities, the UJI VLE must meet the regulations and standards on accessibility so as not to present a new barrier to students with disabilities, whatever form they might take.

4.3 Technological flexibility

We are of the firm conviction that pedagogical and usability-related criteria should take preference when selecting a VLE. However, its technological base must also be taken into consideration, in that it should be suitable for the viability of the platform and for its consequences for functions and ease of use. With this in mind, we particularly took the following aspects into account:

a) The technical specifications of the VLE (database requirements, development environment, software interfaces) must allow for their integration with the UJI information systems, in such a way that direct communication can be established with registration data, teaching organisation plans, certificates, records, etc. This

integration must also be effective at user interface level. A user should not have to authenticate him or herself more than once to the various online services, or have to use more than one password. The user must be automatically recognised by the virtual environment of all the subjects on which he or she is registered.

b) Firstly, the UJI VLE must allow the huge amount of resources of educational interest found on the Web to be easily incorporated, and secondly, if the participant so wishes, it must provide free access to educational resources created in the UJI, thereby contributing, as a public university, to the general development of knowledge. The UJI –as is clearly stated in its statutes– is committed not only to open formats and free software, but also to the free dissemination of the knowledge created by the university community. The MIT OpenCourseWare project represents a line of work that the UJI must pursue in depth and the chosen VLE must be technically capable of allowing this to occur.

c) The UJI VLE must follow reference models with international standards for e-learning in an intelligent non-limiting way. Currently, the most widely used and stable standards related to the packaging of materials, such as the IMS Content Packaging, are of limited application in the area of higher education. Content compatibility through standardised formats is desirable, and even necessary, but it is not sufficient. A university VLE must be a platform for didactic communication, and not merely a manager or presenter of contents to individual learners. An environment based on SCORM, for example, would not be sufficiently flexible and would not be a good match for the most common educational practices in a university. On the other hand, the support of standards is in most cases partial, experimental or only in the project stage, particularly in the case of more advanced specifications, such as IMS Learning Design, which goes beyond packaging of materials and aims to cover any type of teaching/learning activity. Thus, the only factor we can practically demand at present is the commitment to standards by software developers.

d) We have already mentioned the UJI's commitment to free software, as set out in the Statutes. We believe that this mandate can be perfectly accomplished in virtual learning environments, considering that the development of free VLE is equal to and in most cases superior to user-owned systems. It is a tendency that is increasingly becoming generalised in universities all over the world. It makes more economic

sense and is more efficient for a university with the sufficient material infrastructure and trained staff to opt for open source products rather than pay the expensive annual licences for closed products with limited flexibility. Previous experience has shown the inherent risks involved in a commercial VLE:

- An increasingly burdensome and clearly abusive pricing and licensing policy.
- Closed programme cannot be modified to cover new or specific needs, and it presents difficulties of integration.
- An underlying philosophy, of for instance, an instructivist nature, that is not always appropriate for higher education and educational innovation.

As the fruit of a different working model, VLE created as free software projects are better adapted to the real needs of a user community that actively participates in its development. Therefore, one of the aspects that should most be taken into consideration when choosing a VLE for the UJI is the dynamism and degree of openness of the project, which must have a wide international user base whose contributions and participation must be accepted when decisions are taken. In contrast, a project with few users or programmers, with a restricted local base and an inflexible decision-making structure does not guarantee that new functions will appear, that problems will be solved, that new versions will be prepared or that creativity and innovation will be considered not only as desirable, but as imperative.

5. Methodology

Specialists from both pedagogical and IT fields participated in the evaluation process coordinated by the CENT. The stages outlined below were followed:

1. Firstly, the characteristics of a long list of open source VLE were analysed, on the basis of documentation available and previous experience in the CENT with this type of tool. The Edutools database, which includes summaries of over sixty products,¹ was particularly useful. In addition, demonstrations were explored and trial installations carried out. As a result, three well-defined trends in the current scene

were observed, from which the three most promising and representative systems were chosen:

- A. Environments that focus on content creation, management and distribution, with some additional communication tools although these are of secondary importance. The software selected was **ATutor**.
- B. Environments focussed on communication and teaching/learning activities that also include course management tools. The system chosen was **Moodle**.
- C. Workgroup environments for academic communities that incorporate functions that can be used in teaching, although these were not their prime or essential purpose. The system chosen was **.LRN**.

Logically, in this initial phase, many other environments not without their own merits, had to be eliminated. Some of these did not differ greatly from the systems mentioned above, and it was necessary to select the one that would prove the most reliable. Others presented particularly interesting or innovative features, but did not match the requirements of stability and scalability of an institution such as the UJI.

2. Secondly, a series of indicators was defined that would enable us to judge, with the greatest objectivity possible, how well each of the three systems would adapt to the above-mentioned criteria of pedagogical flexibility, usability and technical flexibility. However, indicator objectivity did not require them to be quantifiable; rather, it is vital to evaluate the functions and characteristics of the various environments by means of qualitative information.

3. Finally, the Computing Service installed the three VLE in its servers and immediately began to evaluate them, throughout March and April 2004, in real teaching/learning situations. During the whole process, our purpose was to test out the effectiveness of the environments' characteristics, as opposed to their specifications on paper or their simply theoretical possibilities. The CENT took on the evaluation of aspects related to pedagogical flexibility and usability, while the Computing Service examined strictly technical questions. The results of the process, summarised below as part of the conclusions, are set out in the tables of comparisons in Appendix I.

6. Conclusions

In the light of the trials carried out, we are able to conclude that the three VLE analysed are technically viable as far as their possibilities for integration are concerned, although .LRN presents certain particular features that increase its implementation and maintenance costs. On the other hand, all three offer the sufficient basic functions for their use as virtual learning environments in a university. However, to date, Moodle appears to show a clear advantage in practically all the aspects we compared:

1. It offers more didactic functions, and they are more sophisticated and have a wider range of options. At the same time, the modular design of the environment guarantees its flexibility: depending on the modules employed, it can lend support to any type of teaching style or educational mode.
2. A further asset resulting from its modular design and its greater attention to user interface is Moodle's superior rate of usability, compared with its competitors. In the case of this environment, the fact that it has a wider range of options does not make its use more complicated.
3. Its degree of openness and the dynamism of the project are also higher. Moodle's development is being led by a user community that is constantly becoming wider and more open to participation, which has given rise to a faster evolution of the product than expected, and the development of additional modules and characteristics in a very short period of time.

As for its weak points, at least two should be mentioned: the implementation of both e-learning and accessibility standards is still only partial ².

² Notwithstanding, Moodle did not come out any worse in these aspects than the other VLE analysed. It should be pointed out that in certain cases a considerable disparity was observed between what the documentation promised and what it actually provided.

Consequently, the following recommendations are made:

1. To select Moodle as the UJI virtual learning environment because of the combination it offers in flexibility and didactic sophistication, its technological flexibility, the dynamism of its development community and the ease with which it can be used by students and teachers, a factor that will undoubtedly contribute to its diffusion.
2. To follow the evolution of ATutor, .LRN and other similar environments (e.g., Ilias) with interesting features that may overcome their current deficiencies³.
3. Actively commit the UJI to the development of Moodle so as to influence its evolution along the lines detailed above: support for learning objects, modelling languages and learning design, accessibility, etc.

Finally, this report will be published, since its data and considerations may be of use to other universities or institutions.

Jordi Adell
Director del CENT

José Miguel Castellet José Pascual Gumbau
Cap del Servei d'Informàtica Cap del Gabinet Tècnic del
Rectorat

³ An incipient process of convergence has been observed: on reaching a more advanced phase of development, certain environments tend to incorporate characteristics that initially appeared to be secondary or removed from their philosophy and aims. For instance: .LRN and Ilias are greatly improving their teaching functions; ATutor and Moodle include collaboration and document management tools; Moodle is now compatible with packaging standards, etc.

Appendix I

Tables of comparisons

	ATutor 1.3.1	Moodle 1.2	.LRN 1
0. General aspects			
Philosophy and general characteristics of the environment			
<p>General Characteristics Philosophy architecture and aims of the environment. Is it a support environment for classroom-based courses, a distance teaching environment, a cooperative learning environment...? How is the environment organised? Around courses? Around the user?</p>	<p>ATutor is an environment for the creation and management of online courses. It places great emphasis on accessibility of learning materials.</p> <p>Its logical unit is the course, which might correspond to a subject, a postgraduate course, etc. The courses are structured in categories and subcategories.</p> <p>ATutor has recently announced plans to integrate ACollab, a workgroup tool.</p>	<p>Moodle is an environment for the creation and management of online courses.</p> <p>Its logical unit is the course, which might correspond to a subject, a postgraduate course, etc. The courses are structured in categories and subcategories.</p> <p>Moodle starts from a social constructionist pedagogical model that inspires the main features of the environment and all its functionalities. It places emphasis on activities and participation.</p>	<p>.LRN is a group support environment to which e-learning features have been added. This latter aspect is expected to be strengthened.</p> <p>Its logical unit is the user, who has a personal workspace at his or her disposal. This space also provides access to shared spaces that may be work or learning spaces (classes).</p>
<p>Support Who is responsible for the development of the software? Are there active user and development communities that guarantee the support, the future and the evolution of the product?</p>	<p>ATutor is an open source project from the Adaptive Technology Resource Centre (ATRC) at the University of Toronto. It currently collaborates with other Canadian institutions. The 1.0 version came out in December 2002.</p> <p>The ATutor web site includes a support forum, a forum on bugs and another for the proposal of new features.</p>	<p>Moodle is an open source project promoted by Martin Dougiamas, on the technical staff of Curtin University of Technology (Australia) with experience in WebCT and in academic training in the fields of IT and education. Version 1.0 came out in August 2002.</p> <p>The Moodle user and developer community is now very active and dynamic. It is organised around moodle.org. Its translations, some modules and much of its documentation are the work of this community. Its diverse debate forums constitute an efficient support tool.</p> <p>moodle.com provides some services for which it charges (support, consulting, tailor-made development etc.)</p>	<p>.LRN is an open source project promoted by the Sloan School of Management of the MIT and the University of Heidelberg. Version 1.0 came out in April 2003, followed by version 2.0 on 26 February, 2004.</p> <p>The .LRN environment is based on OpenACS, which has a considerable user and developer community.</p> <p>.LRN is not yet widely used, and is still in its initial development stage.</p>

	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
1. Didactic functions			CENT
Tools for the design and development of curriculum and for evaluation.			
<p>Curriculum design Access to courses. Possibilities for course design and organisation: organisation by time, by subject, etc.</p>	<p>Courses may be completely public, "protected" (requiring an opened account with the environment) or "private" (requiring authorisation).</p> <p>Each course is organised around a subject in electronic book format created by the teacher. This "book" is made up of "pages" and "subpages" of text/HTML. The text may include links to materials in other formats posted by the teacher and links to exercises the teacher might also create.</p> <p>Besides this, the course has a separate section of external links and a "discussions" section that includes forums and chats.</p>	<p>All courses require an opened account with the environment. A special "guest" user category allows occasional use. Guest login may or may not be authorised for each course.</p> <p>Teachers can choose between three course formats: by weeks, by subjects or by social format. The first two consist of a sequence of nuclei, each one of which can contain a variety of learning activities: teaching materials in any format, debate forums, exercises, assignments, etc. The social format is organised around a forum.</p> <p>It is a modular flexible environment: the teacher may choose what type of activity to use on each course. A course may be made up solely of materials or it may for instance include a series of forums for debate. Individual activities or complete nuclei may be temporarily activated and disabled.</p>	<p>The course ("class") is made up of a number of "portlets" that provide various functions: an area of materials, an area of forums, a news area, FAQ, etc.</p>
Learning tools			

	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
Forums Discussion forums.	<p>Forums are added to a "discussions" section which may also include chats. All course members may intervene and initiate debates.</p> <p>Messages are formulated by using a special code language (BBCode) and an embedded visual editor.</p> <p>Word searches cannot be made within the forum.</p> <p>Users can register in each debate in order to receive messages by email.</p>	<p>The teacher may use a forum at any point during the course. In each forum s/he creates, the teacher can decide whether students may initiate debates, whether they can only respond to debates started by the teacher or whether they are limited to the reading of postings (course news forum). These options can be changed later, e.g., to prevent new interventions beyond a deadline. The teacher may also allow students to assess each other's postings.</p> <p>Messages may be written in text format (with various self-format options) or HTML (with an embedded visual editor). Files may be attached. The teacher can limit the file size for each forum and may set a maximum size for all the course forums. The administrator can set the maximum possible size for all forums.</p> <p>Word searches can be made within all the forums on a course.</p> <p>Users may register in to each forum and receive messages by email. The teacher can require all participants to be registered in a forum for emails (e.g., to the course news).</p>	<p>Forums are added to the forum portlet. In each forum, the teacher can decide whether s/he wants students to be able to initiate debates or not, and whether or not they can send replies. These options can be changed later on.</p> <p>Messages can be written in text or HTML format by means of a standard web formula.</p> <p>Word searches can be made within each forum.</p> <p>Forum messages can be received by email. Users can register in by email to each forum and individual debate.</p>

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
Materials Possibilities for management of files, external links, etc.	<p>The teacher has a private area of files on each course that s/he can organise by means of folders and subfolders. Files that are uploaded in this area can later be placed at the students' disposition on any page of the course. Groups of files in ZIP format can be uploaded and unzipped at the server.</p> <p>The administrator can determine the type of files (extensions) that cannot be uploaded (by default, executable programmes cannot be uploaded).</p> <p>A section of external links ("Links Database") is also connected to the course, which can be organised by categories and accepts student contributions (controlled by the teacher).</p>	<p>The teacher has a private area of files on each course that s/he can organise by means of folders and subfolders. Files that are uploaded in this area can later be placed at the students' disposition on any page of the course. Groups of files in ZIP format can be uploaded and unzipped at the server.</p> <p>The type of files (extensions) that may or may not be uploaded cannot be defined.</p> <p>External links can also be included on a course, one by one, with various options for viewing: on the course window, on a new window, etc.</p>	<p>Some of the portlets ("Lecture Notes", "Handouts") comprise archives and/or external links provided by the teacher.</p>
Messenger Is there an internal messenger system?	<p>Users have a private mailbox for exchanging messages.</p>	<p>There is no internal messenger. Users must have an external email address. The teacher can register students in a forum in such a way that they receive messages by email.</p>	<p>There is no internal messenger. Users must have an external email address. The environment allows email messages to be sent to a group or to all the members of a course.</p>
Chat Is there a chat system?	<p>Each course has an active chat room. The teacher can activate and disable the chat transcriptions. Transcriptions are archived and are available to the students.</p>	<p>The teacher can programme chat sessions in different chat rooms within each course. Transcriptions are automatically archived and can be made accessible or not.</p>	<p>There is no chat option.</p>

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
Exercises Can tests, questionnaires or self-correction exercises be created?	<p>The teacher can create questionnaires with true/false questions, multiple-choice answers and open answers. The test is activated for a determined length of time.</p> <p>The teacher must check the answers in order to give a mark.</p>	<p>The teacher can create questionnaires with true/false questions, multiple-choice answers, open answers, matching exercises amongst others. Questions are kept in a database and can be reused in other questionnaires and courses. In addition, questions can be brought in from external files (WebCT, IMS QTI and other formats).</p> <p>Many parameters can be configured: questions can be reordered randomly each time a student does an exercise, the correct answers can be shown once the student has completed the exercise, etc.</p> <p>The system can automatically calculate and display marks.</p>	<p>Surveys can be created with various types of questions (they are not exercises: they cannot be given marks).</p>
Homework Can students be given online/offline tasks to do?	<p>This possibility does not exist.</p>	<p>The teacher can set students assignments. These may consist of uploading an archive or doing an offline activity. The task has a deadline. It can be assessed by the teacher.</p>	<p>There is a "Homework Dropbox" where students can post their assignments (files). The teacher cannot evaluate them, but s/he can attach comments.</p>
Others Other relevant teaching/learning tools.	<p>Glossary: the teacher can create a glossary of terms used throughout the subjects of the course. Automatic links to terms in the glossary cannot be created.</p>	<p>Glossary: the teacher can create different glossaries (they can be imported/exported in XML format). An option is available to activate automatic links to the glossary that appear each time a glossary term is served e.g., in a forum message.</p> <p>Journals: the teacher can activate personal learning journals where the student can write on a studied subject. The teacher can read, comment and evaluate these entries.</p> <p>There are also a growing number of additional activity modules in various stages of development (Lesson, Workshop, etc.).</p>	<p>Version 2 allows all users to create their own weblogs (personal and/or in groups).</p>

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
Extendibility Can additional learning tools be incorporated?	This possibility does not exist.	Moodle's modular architecture enables additional tools programmed in PHP to be created easily. There is a template and documentation.	OpenACS's modular architecture enables new functions to be integrated using tcl.
Multimedia Is there a special facility for the distribution of audio or video content?	There are no special facilities.	Moodle 1.2 incorporates an audio reproduction system (streaming) in MP3 format based on Flash. It may be useful, for example, in language teaching, interviews, etc.	There are no special facilities.
Groups Can groups of students be managed within a course?	Groups cannot be created within a course.	Groups can be created in which members can either "see" each other or not. Each individual activity (e.g., a forum) can be configured for all the class or for one group only (although this does not yet operate in all modules).	Groups of students can be created with their own forums, calendars and news.
Copies Can teachers create backup copies for their courses?	The teacher can create complete course backups in ZIP format (only the structure is included, not forum messages). This backup acts as a safety copy and also can be imported to other ATutor courses.	The teacher can create complete course backups in ZIP format. S/he can decide what type of activities to include (forums, resources, exercises, etc.), whether to include user contributions or not (e.g. forum postings), list of users, the logs and files uploaded on the course. This backup acts as a safety copy and also can be imported to other Moodle courses.	The teacher cannot create course backups. Only file backups ("Lecture Notes") can be downloaded in .tgz format.

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
<p>Content compatibility Can courses or parts of courses be shared/imported? Can content from other environments be introduced? Specifically: can contents from WebCT be imported? Is it compatible with the IMS/SCORM/other standards?</p>	<p>Backups enable courses to be shared with other ATutor installations.</p> <p>Content Packaging enables course materials (all or part) to be exported/imported in IMS Content Packaging format. Only materials are included: forums, exercises etc. are excluded.</p> <p>Compatibility with the SCORM Run Time Environment is planned for mid-2004.</p> <p>Exercises cannot be imported or exported.</p>	<p>Backups enable courses to be shared with other Moodle installations.</p> <p>Course materials can be imported/exported in ZIP format archives. Compatibility with SCORM (Content Packaging + Run Time Environment) is planned for mid-2004 (at the moment the module is available in beta version).</p> <p>Exercises in various formats can be imported: WebCT, Blackboard, IMS QTI amongst others.</p>	<p>The support of IMS, SCORM and OKI standards is planned for Version 3 ("early 2004", although version 2 appeared in February of this year).</p>
<p>Follow-up and assessment of learning Can the teacher monitor student activity within the course? Can s/he assess and give marks to students within the environment?</p>	<p>The environment registers the user's navigation of the course material, visits to external links and interventions in forums and chats. The teacher can consult these registers.</p> <p>The teacher can only give marks to the exercises.</p>	<p>The environment registers every action made by course members. The teacher can obtain activity reports on each member that detail the days they logged on, how many actions they made, the activities they carried out and those they did not, how many postings they made in each forum, how many times they looked at a resource, etc.</p> <p>The teacher can assess and mark most activities. Marks can be downloaded onto a text or Excel format file.</p>	<p>There are no plans to include this possibility.</p>

	ATutor 1.3.1	Moodle 1.2	.LRN 1
2. Usability			CENT
Conditions and measurements of usability and accessibility			
Ease of use Ease of use as perceived by users ⁴ .	Low. Perception of the environment: confusing, muddled. It has its own logic, which is difficult to fathom at first.	Medium-high. Perception of the environment: simple, friendly, quite intuitive. Basic operations are carried out without difficulty.	Medium. Perception of the environment: simple, clear. Few options, easy to find.
Technical knowledge What level of knowledge does the user (teachers and students) need to have?	Familiarity with web working environments: editing formula, sending files, forums, etc. The teaching staff need to learn how to create course materials by using the ATutor creation environment.	Familiarity with web working environments: editing formula, sending files, forums, etc. The modular conception of the environment enables the teacher to use it to a greater or lesser degree of complexity: to begin, for example, it is sufficient to learn how to upload files and create a forum	Familiarity with web working environments: editing formula, sending files, forums, etc. The environment is modular. For the moment, there are few modules and they are relatively simple to operate.
Assistance Is there an online assistance system?	A contextual system of assistance is available to the user.	A contextual system of assistance is available to the user.	An assistance section is available.
Offline work Can the environment be used when the user is not connected to the web?	The student can download course material (all or part) into a ZIP file to his or her computer.	The user can download to his or her computer, files that the teacher has uploaded on the course.	The user can download to his or her computer, files that the teacher has uploaded on the course.

⁴ The CENT designed an experimental usability trial in which a limited number of UJI teachers participated. These teachers had some previous experience with another virtual teaching/learning environment (WebCT). After a brief period (10-15 minutes) in which they familiarised themselves with the environments under study, they were asked to carry out three basic activities: a) upload a PDF file onto the course, b) create a forum of debate and c) place an announcement. The perception of these participants on the environment's ease of use was revealed through individual interviews with CENT technicians.

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
<p>Accessibility Does the environment meet the standards of usability?</p>	<p>ATutor reveals an explicit commitment to content accessibility, although it does not pass the strictest accessibility tests.</p> <p>IT includes documentation and assistance for teachers on the creation of accessible content.</p> <p>It plans to integrate with the ATalker text-to-speech server, with the ATRC accessibility checker and with the TILE accessible e-learning object repository.</p>	<p>Moodle plans to improve accessibility to conform to standards in the 2.0 version. At present it does not pass the strictest accessibility tests.</p>	<p>.LRN does not pass the strictest accessibility tests.</p>
<p>Languages Can the interface language be changed? What languages are available?</p>	<p>13 language packs for the latest version (1.3.3): including Spanish, Portuguese, French, Italian and German as well as English. The packs are downloaded and installed separately, one by one. Translation into Catalan is planned, but at the moment it is 0 %.</p> <p>Translation can be done by means of web formula.</p> <p>The language packs are different for each new version of the software. Packs corresponding to previous versions appear to continue working, but the new chains that have still not been translated are substituted by a variable name.</p> <p>The administrator establishes a default language for the whole environment. Each user can select the language of his or her choice for the interface.</p>	<p>39 language packs including Catalan, Spanish, Portuguese, French, Italian, German and other European languages as well as English (British and North American versions) and many others (Arabic, Chinese, etc.). All are included in the official distribution of Moodle.</p> <p>Translation can be done by means of web formula. The CENT is coordinating the official Catalan translation.</p> <p>These language packs continue operating when the software version changes. The new chains that have still not been translated appear in English.</p> <p>The administrator establishes a default language for the whole environment. Each user can select the language of his or her choice for the interface (but the teacher can predetermine the language for the course: e.g., an English course in English.)</p>	<p>Version 2 of .LRN includes support for the «internationalisation» of the environment. Innova (UNED) is collaborating in this aspect in the translation into Spanish.</p>

	ATutor 1.3.1	Moodle 1.2	.LRN 1
3. Technical flexibility			Servei d'Informàtica
Server requirements and scalability. Possibilities for integration, etc.			
Requirements Hardware / operating system / database server / other requirements.	<ul style="list-style-type: none"> • Apache (or other web server) • MySQL • PHP 	<ul style="list-style-type: none"> • Apache (or other web server) • MySQL or PostgreSQL (it can operate with Oracle) • PHP 	<ul style="list-style-type: none"> • AOLServer (it can operate with Apache, but it is not documented) • Oracle or PostgreSQL • OpenACS
Scalability Can the server cope with the anticipated number of courses / students / teachers in the years to come?	HA (high availability) architecture can be implemented based on CSS (Cluster Support Services) and on the load balancing software for MySQL.	HA (high availability) architecture can be implemented based on CSS (Cluster Support Services) and on the load balancing software for MySQL.	HA (high availability) is available on Oracle.
Integration Possibilities for integration with the UJI information systems. Can a course automatically be created based on an existing subject, including the students registered on the course? Can students' personal data be incorporated? Can the environment's evaluation and qualification data be connected with the provisional results?	There are no exchange interfaces. To incorporate personal data, create courses and automatically register students, inverse engineering must be undertaken on the data model and/or the source code. Disadvantage: loss of compatibility in future versions.	Lists of users can be imported and they can be registered on the corresponding courses. Moodle's authentication architecture allows data on users from an external source (database, LDAP, etc.), to be incorporated, but there are no other exchange interfaces. Automatic course creation and student registration requires inverse engineering to be undertaken on the data model and/or the source code. Disadvantage: loss of compatibility in future versions. Registration and course access management from and external source in the same way that authentication of personal data is dealt with now is planned for version 2.0.	There are no exchange interfaces. To incorporate personal data, create courses and automatically register students, inverse engineering must be undertaken on the data model and/or the source code. Disadvantage: loss of compatibility in future versions.

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	<i>ATutor 1.3.1</i>	<i>Moodle 1.2</i>	<i>.LRN 1</i>
Authentication User authentication mechanisms.	Passwords are stored in the database.	The authentication system is modular. Internal authentication modules are provided which are stored in the Moodle database, and others that communicate with external sources: external databases, IMAP, LDAP, servers, etc. A tailor made authentication module can easily be developed in PHP.	Passwords are stored in the database.
Image Can the environment's image be adapted to the UJI's visual identity requirements?	The environment's image (and that of every course) can be adapted through CSS.	The environment's image can be adapted through CSS and PHP templates.	Possibilities for adapting the image are scant.
Implementation costs Valuation of the cost of implementing the service.	Software installation and service set up costs are insignificant. Integration may take an estimated six months.	Software installation and service set up costs are insignificant. Integration may take an estimated six months.	Software installation is complicated due to deficiencies in documentation.
Maintenance costs Valuation of service administration and maintenance costs.	Maintenance of the software is limited to updating of versions. A person is needed to take responsibility for managing the service: course creation, configuration, problem solving, etc.	Maintenance of the software is limited to updating of versions. A person is needed to take responsibility for managing the service: course creation, configuration, problem solving, etc.	Maintenance of the software is limited to updating of versions. A person is needed to take responsibility for managing the service: course creation, configuration, problem solving, etc.

Appendix II

References

Virtual learning environments

Moodle

<http://moodle.org>

Atutor

<http://www.atutor.ca>

.LRN

<http://dotlrn.org>

WebCT

<http://www.webct.com>

Ilias

<http://www.ilias.uni-koeln.de/ios/index-e.html>

BSCW

<http://bscw.gmd.de>

Fle3

<http://fle3.uiah.fi/>

Standards and related projects

IMS Global Learning Consortium

<http://www.imsglobal.org>

ADL (SCORM)

<http://www.adlnet.org/>

EML

<http://eml.ou.nl>

OKI

<http://web.mit.edu/oki>

OpenCourseWare

<http://ocw.mit.edu/>

Studies

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