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Teaching Innova Project: the Incorporation of Adaptable Outcomes in Order to Grade Training Adaptability

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Abstract: The education project presented in this paper endeavors to study the feasibility of incorporating adaptive systems into LMS systems, by using them both in training & learning process and at work. This case study is aimed at employability and job post improvement. For this purpose, we have created a process that is flexible both to the student pattern (and to the job pattern. The developed process is adaptable both to the student (via the incorporation of an adaptable system with an LMS system) and to the job model (via an adaptable system to the knowledge management). The evaluation was qualitative and measured the process (feasibility to apply adaptive systems) and the efficiency of the method (applicability and employability). The functionality of the specific developed tools allowed us to grade the degree of adaptability in the training process, to dynamically vary the training plan from the student's actions and to identify the resources that best met the job needs.

Keywords: LMS, Knowledge Management System, Repository, Adaptable Hypermedia System, Personalized Learning, Lifelong Learning
Categories: H.3.3, H.3.5, I.7.3, K.3, K.4.3, L.1.3, L.2.0, L.2.1, L.2.3, L.3.0, L.3.2, L.3.3, L.3.4, L.3.5, L.3.6, M.7

1 Introduction

Online training is currently introduced at all levels of education, either as a support to in-person training or as distance training. The most widely used systems are LMS (Learning Management System) and are based on the traditional idea of teaching where students must adapt to the course (contents and sequence). However, the best way to obtain efficient learning results is based on a system that adapts itself to students' characteristics [De Bra 99] [De Bra 02]. Therefore, every student will learn in a different way [Cabrera 12]. Nevertheless, professors (human resources) giving in-

person teaching cannot always adapt effectively to the different ways of learning and characteristics of each student. This is not feasible in the current training process due to the student/teacher ratio, since it means a high cost of effort and human resources. However, there were technological tools available, called *Adaptive systems*, that allowed us to reduce the effort to implement a customized training system.

This is the approach to our training project called "Teaching Innova" [AVANZA 10], which is within the R&D&i National plan funded by the Ministry of Industry, Energy and Tourism. Projects within the "Avanza-formación" program are online training courses addressed to employees from SMEs (Small and Medium-sized enterprises). The Ministry specifies, in each call, the priority topics for employability. This project, carried out from September 2010 to March 2012, was granted by a competitive examination. Its main innovation was the course's adaptability to different training contexts, even to the post-training one.

Despite the advantages of a customized training, already acknowledged at an institutional level, and the ability of technology to adapt to each type of student, at present, the adaptive systems are not completely implemented in training. This is mainly due to their high cost of implementation and maintenance, as well as their complexity and interoperability between applications [Berlanga, 08]. The implementation of an adaptive system into the training process means using specific products, many of them still under research and development or requiring specific customization for each course, thus implying a drastic change in the approach and resources used in the training processes.

Drastic changes are the most difficult to implant; an alternative is to make gradual changes counting on the online learning systems mostly used, that is to say, LMS systems, to provide them later with the conceptual, functional and technical principles of the adaptive systems named as *Adaptive Hypermedia System* (AHS).

The case study presented herein is exploratory, as far as the objective is concerned, [Yin 02] given that results may be used as a basis to outline research processes. In addition, the case study is based on a heuristic strategy. The theory on which this work is based is the *Adaptive Navigation* [Brusilovsky 96], setting different links to different users. Even though the system is applied within the educational context, some ideas are taken from other types of application in the adaptive hypermedia systems, such as the *Online Information Systems* (assistance to find information references that are useful for the user) and the *Information Retrieval Systems* aimed at searching information.

This project integrates functions and concepts from the Learning Adaptive Hypermedia Systems, Online Information Systems and Information Retrieval Systems [Brusilovsky 01], since adaptability is applied during the training process by itself, in post-training process, and is used in different contexts (educational and professional). From the point of view of taxonomies usage for the adaptation of man-engine systems [Feigh 12], this study is based on the modification of that interaction.

The initial approach was based on integrating adaptive methods with an LMS system in order to provide them with adaptability. LMS systems are mostly used by training organizations; therefore, the initial hypothesis was to check whether integration was possible and if adaptability to the different customization needs of the learning process could be gradually performed.

Furthermore, the possibility of transferring this adaptability to the work context was also considered. We worked with a population of students that were employees and may require training both to improve their work conditions and their employability options. Therefore, evaluation was made on the indicators that this case study was supported on (efficiency in the training process and employability). The context selected was the Avanza Formación programme of the R&D&i National Plan [AVANZA 10] of the Spanish Government – training for employees of small and medium-sized companies. This project was presented and approved in the 2011 call of the Avanza plan.

The following section describes the model and the techniques used to develop the two adaptive systems used in the project: one allows to establish a dynamic training plan (*Multiconditions*) and the other one allows the student to specify his/her own interests (Organizer 2.0). Section 3 describes the architecture and functionality of the different computer products in the project. The architecture was based on the Lego metaphor [Berlanga 05] and on the adaptive navigation systems acting on the resources [Koch 00], [Koch 01]. Section 4 determines the two sorts of evaluation tests carried out in the project: the learning audit, performed by an external agency, and the internal assessment, performed by the project team. Finally, the section specifies the improvements identified, the research lines generated and other projects where the tools mentioned in this paper, may be used.

2 Model and techniques used to develop the project's adaptive systems

The project used systems that may be adapted both to the training process and to the real work context. That is the reason why the selected case to validate the system was a training course for active workers; this way the users may apply the system, both during the training process itself and once it has been completed, in their own companies.

Two different adaptive systems were used, both based in the same model but with techniques, user interfaces and types of resources that were specific for each of them. An adaptive system interacted with the training program and another one allowed the student to individually examine the resources and use them in contexts that were even different from the training one.

In both cases, the adaptation model was the same. They are based on the creation, by the user, of adaptive rules [De Bra 12] and they are assigned to different resources. A set of requirements associated to each learning resource or content (that may be either true or false) and a logic statement relating them. When the result of the logic statement was true, the learning resource or content was shown to the user. In one case, the requirements were the student modeling and/or actions on the resources (read a resource, choose a particular option to reply to a questionnaire, take part in a forum, etc.) and, in the other case, they were attributes of the knowledge itself.

The adaptive presentation used in this project was based on one of the two characteristics typical of this model: the re-ordering of information according to the user model [De Bra 99]. Therefore, it was based on using the same set of resources both for learning (including contents, forums, questionnaires, etc.) and for the

contents. Moreover, this adaptive presentation was based on Koch's principles [Koch 00], [Koch 01]. The most relevant resources were presented via links starting from a particular situation. Adaptive navigation had a "Local guide" orientation, that is to say, the most relevant resources were presented (via links) starting from a particular situation.

The techniques used were different for each adaptive system of the project. In Multicondition, it was based on the hiding links technique and, in Organizer 2.0, it was based on the direct guidance technique (starting from the characteristics stated by the user, the system decides which are the best links). Both techniques were suggested in [Brusilovsky 96], [Brusilovsky 01], [Brusilovsky 12], [Koch 00], [Koch 01].

2.1 The Multicondition adaptive system

The e-learning platform used in this Project was Moodle (www.moodle.org), an Open Source system that has its own repository of resources and activities. Resources are organized in sections and each section may have an ordered list of these resources. Moodle 1.9 with Multiconditions was used in the project. New versions 2.x of Moodle offer the possibility to link to some external repositories but the 2.0 version was available from November 2010 and the project started in September 2010.

All the students could see the same set of sections in the same order and for the same periods of time. The purpose of the adaptive system included in Moodle for this project (Multicondition) was to get different students to see different blocks and different resources at different periods of time. This way, the learning process would adapt to the characteristics of each student.

The classification used by Wu [Wu 00] to determine the components of an AHS was used to describe the architecture of this adaptive system; that is to say, the Knowledge Domain, the Adaptation Model and the User Model.

2.1.1 The Knowledge Domain

The platform's own knowledge domain, Moodle, was used, organised in directories, given that the activities and resources are specific of the platform.

2.1.2 The Adaptation Model

This adaptation model may operate both right *from the beginning*; before starting the training process, and *gradually*; during the training process. Anyhow, this adaptation model was based on determining a set of interrelated requirements via logical connectors.

Requirements are conditions associated to a particular multimedia content or Moodle resource (files, directories, sites, task, questionnaires, forums, etc.). Conditions are logical expressions and conditions' results may be either true or false and they are called **conditional requirements**. For example, a conditional requirement might be that the student answers a specific option to a particular multiple-choice question in the questionnaire.

A set of conditional requirements was associated to each resource that, related by the logical operators "and", "or" and "not", made up a new logical expression that was called **Multicondition**. If the Multicondition result was true, the associated Moodle resource/activity would be displayed, only for the student meeting the

Multicondition associated to that resource. Students who do not meet the Multicondition, cannot access to this resource/activity.

Figure 1 displays an example of Multicondition. Therefore, access to the initial questionnaire in one of the course's blocks depended on having sent a minimum number of messages to three of the course's forums.

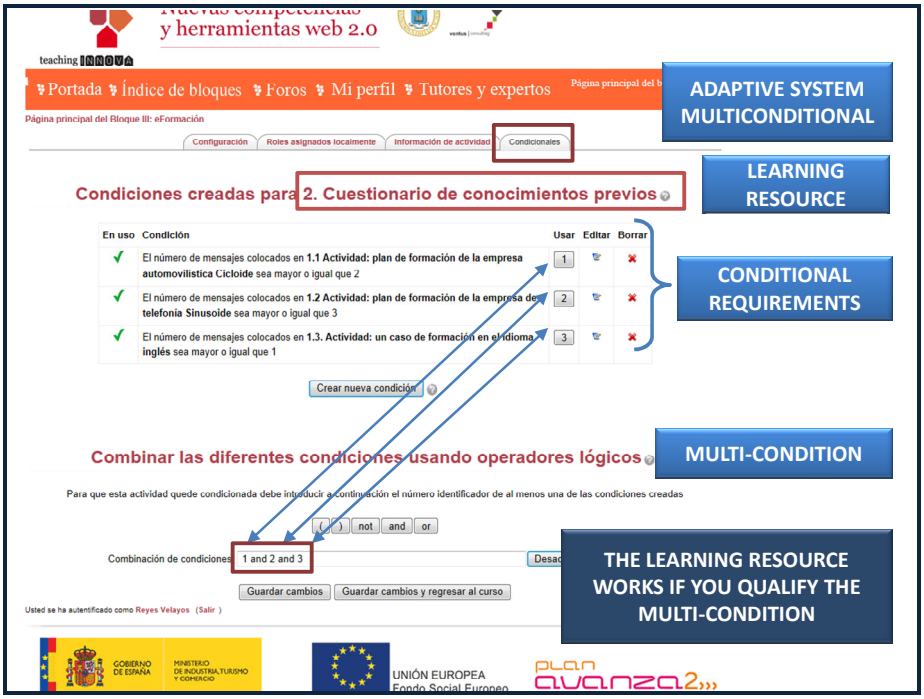

Figure 1: Multicondition associated to the display of a questionnaire

The system is very flexible and efficient, since you may interact with the student before starting the course, for instance via questionnaires, and, according to their results, customise the training plan for each student. Moreover, given that the conditional rules may also be applied on the interaction with the resources, the system may change the training plan according to the results of the learning process.

This system was developed by the CICEI (Information Centre for Information Society by its Spanish abbreviation) of the University of Las Palmas de Gran Canaria (participating in the project) in 1999 [Castello 10]. Nowadays, the basic idea of this system may be found in the 2.x versions of Moodle, but it is still not as complete as the system developed by the CICEI, since the operator "OR" cannot be included in Multiconditions, and no conditional requirements may be added to the responses in a questionnaire, thus remarkably restricting the possibilities of the adaptive system.

2.1.3 The User Model

It allows static and dynamic user models. Each user model is determined by a set of characteristics. They may be either previous information about the student (level, age, gender, interest in the course, experience, etc.) or a set of *Multiconditions*.

Therefore, the system enables creating very flexible user models. The authors of this paper performed different researches in this sense, such as the way to design different resources and to display them to generate learning paths, within the same course, adapted to the specific characteristics as regards to their profile, level of knowledge or *learning style*. The diagnostic assessment of these characteristics allowed us to automatically adapt, via the *Multiconditions*, the way to access to the resources and activities in each case, all of that before beginning the course. Furthermore, it is very important to mention the work carried out concerning the use of *Multiconditions* in order to perform formative assessment, which enables associating different options to continue with the learning at key moments of the training; As a result, for example, the overall marking of a completed questionnaire, along with the answer given to a particular question in it determine the following step in the learning process, either via activities encouraging it or by including reinforcement activities in case of detecting learning difficulties [Lerís 11].

2.2 Organizer 2.0

The Organizer 2.0 is based on ontologies (categories y attributes) and manages, classifies and organizes the learning resources of the project. The usage of logical expressions of metadata to search the learning resource is the main innovation and it provides flexibility to the system. The metadata also models the learning resources and activities.

Students demand the possibility to examine by themselves the available material and learning resources and, then, decide the learning flow [Berlanga 08]. Free search systems allow users to determine their own criteria to obtain knowledge resources. An adaptive system that allows the user to obtain resources from particular criteria is implemented on this paper.

The main idea of this system was that the users were not aware of which resource they required, but they did know what they needed it for. When using this idea, two situations where this adaptive system improved the efficiency of the traditional LMS systems were defined.

One situation occurred during the training process at scenarios where the student was alone to face the learning task. For example, when performing a learning activity, and even the typical “study”. In these situations, Organizer 2.0 allowed advising the students on the most suitable and appropriate resources to perform that learning task.

The other situation took place when students tried to apply to reality the knowledge acquired during the training course or to carry out their profession. This was one of the main reasons to choose the environment where this system’s efficiency was to be tested. The selected course was given to active workers and most of them may have needed to apply the course’s knowledge.

As in the previous adaptive system, Wu’s classification [Wu 00] to describe the components of the adaptive system was used. The ontologies (represented by tags) are used in order to define the knowledge attributes because they let bigger flexibility for

the database to define the structure and the knowledge base [Burzagli 11]. In this research line there are some works based on ontologies and search such as [Knutov 10].

2.2.1 The Knowledge Domain

The *Lego metaphor* [Berlanga 05] was used; the resources were stored in a repository in such a way that they may be independent from one another. In addition, a set of attributes was designed to be associated to each resource in the repository.

The attributes were defined via labels; they were grouped into categories and the categories associated to contexts. Therefore, the same resource may have attributes from different contexts. Please refer to Figure 2 to see an example of this categorisation.

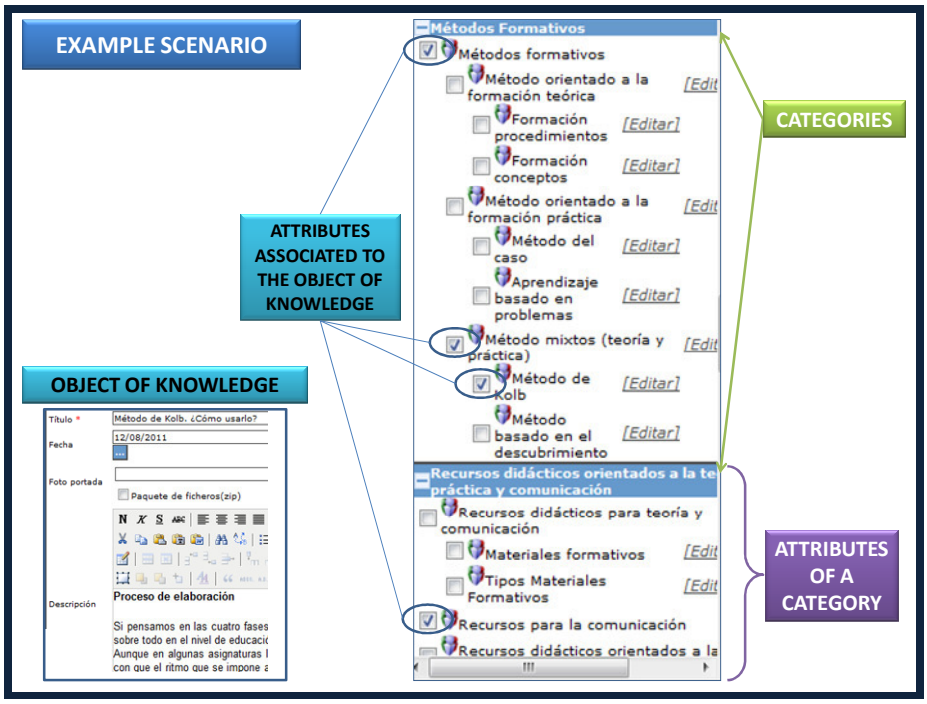

Figure 2: Categories and labels associated to resources

2.2.2 The Adaptation Model

A set of rules was established according to the attributes selected by the user. As a result, if several attributes in the same category were selected, an "or" condition was established between them, and, if the attributes were from different categories, an "and" was established.

Organizer 2.0 was based on enquiries. An enquiry, from the adaptation model point of view, is a logical expression obtained by means of attributes selection and the category they belong to.

Figure 3 displays an example where the logical expression corresponding to the selection made by the user is shown. It includes the selected categories and attributes, along with the logical connectors that relate them in the said selection.

Categories are normally used to get to know the user's interests so that, along with these categories, the adaptive system may also take search words into account. In this case, the word would be incorporated into the logical expression with an "and". Figure 3 displays the previous enquiry by adding a search word, which is reflected when the logical expression indicates and adds a search.

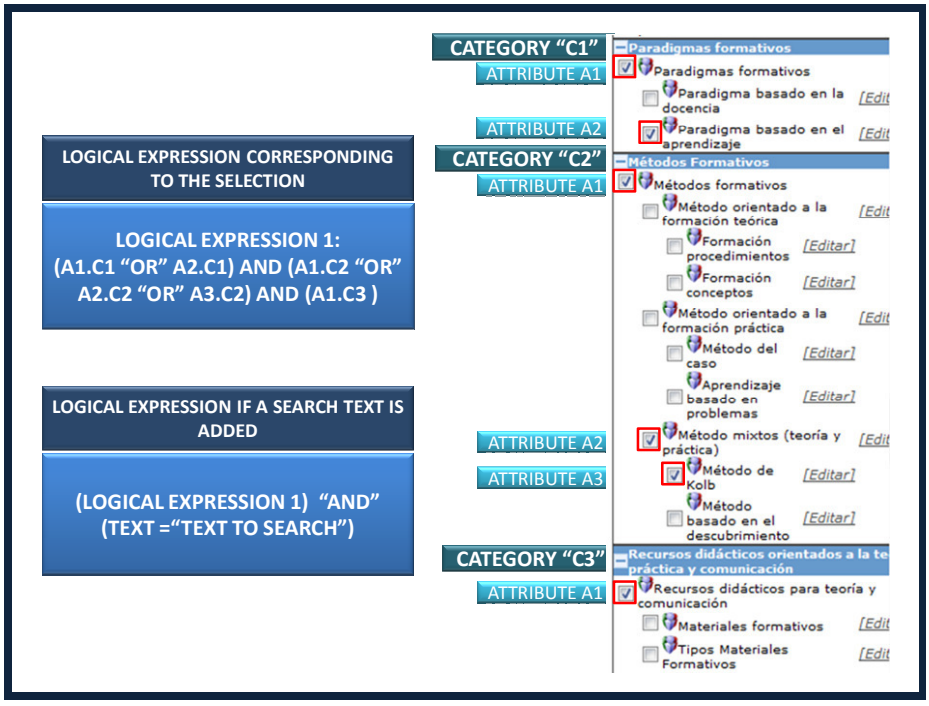

Figure 3: Example of enquiry

Therefore, the adaptation model selects the resources meeting this logical expression. Grouping the attributes into categories and these into contexts makes the search task easier for the user and allows having reliable criteria to organise the attributes. The adaptation model was more inspired by AHSs based upon Online Information and Information Retrieval Systems. In particular, it was based on search-oriented systems, where not only the words were taken into account but also the set of categories representing the student's interests. The system supplied a set of links replying to the queries made and these queries operated on the resource repositories.

Continuing with the *Lego metaphor,* the set of links obtained from the query were organised into different structures, the most common one being an ordered list of resources. But it may also be organised into more complex formats, such as a set of related lists or even websites. Moreover, the adaptive system can also produce

editable texts from the query's results. The user decides which resources to use in order to generate a customised text.

In the work described, links were categorized by interrelated lists. One list included the query result, classified by sub-lists, and, finally, a supplementary list according to the element being examined. This method was called *CSORA* (Classify, Search, Organise, Relate, Adapt) and showed advantages both in the query efficiency and in the organisation of the information obtained [Fidalgo 11].

2.2.3 The User Model

The user model is not known *a priori*. Therefore, it is the user who determines the model starting from his/her own interests. Interests are conditioned by various aspects such as what the information is required for (to carry out a training activity, to revise for an exam, to be applied, to reflect upon it, etc.), where it is to be used, characteristics of their own knowledge, etc. Consequently, selecting attributes, categories and contexts is a very important factor in the user model, since the user model may be determined from these definitions. Attribute + category + context are what determine the different models defined by the system's developers. Nevertheless, it is the user, when choosing attributes from the different categories and contexts, who determines the final model.

3 Work description. Architecture and functionality

3.1 System architecture

The project's architecture is both distributed and cooperative. Four computer tools are used: Moodle, Multiconditions, Organizer 2.0 and the Resource repository, as displayed in Figure 4.

With respect to the resource repository, the knowledge resources of the training activity, that is to say, didactic material and multimedia elements, may be found in this system. Contents are stored, classified and organized in the repository. The same resource may have diverse classifications and belong to different organizations. The repository is cooperative, which means that it may be remotely managed by several people with different roles assigned. The administrator establishes the group of people and the roles that will manage cooperatively the warehouse; even the students themselves may enter contents in the warehouse (for example, an essay) if the administrator allows it. The repository feeds the rest of tools. In this project, the organisation of the repository's contents is used to manually feed the Moodle's repository, whereas Organizer 2.0 incorporates them via the adaptation module.

Multiconditions must be integrated in Moodle. Currently, they cannot operate independently given that they use Moodle's own resources and, therefore, they have been incorporated as any other option in Moodle that professors may activate and deactivate at their discretion.

Organizer 2.0 is independent and directly operates on the resource repository. It is integrated into the repository via any object stored in it, either by the contents of the resources, by the attributes or by its organisation.

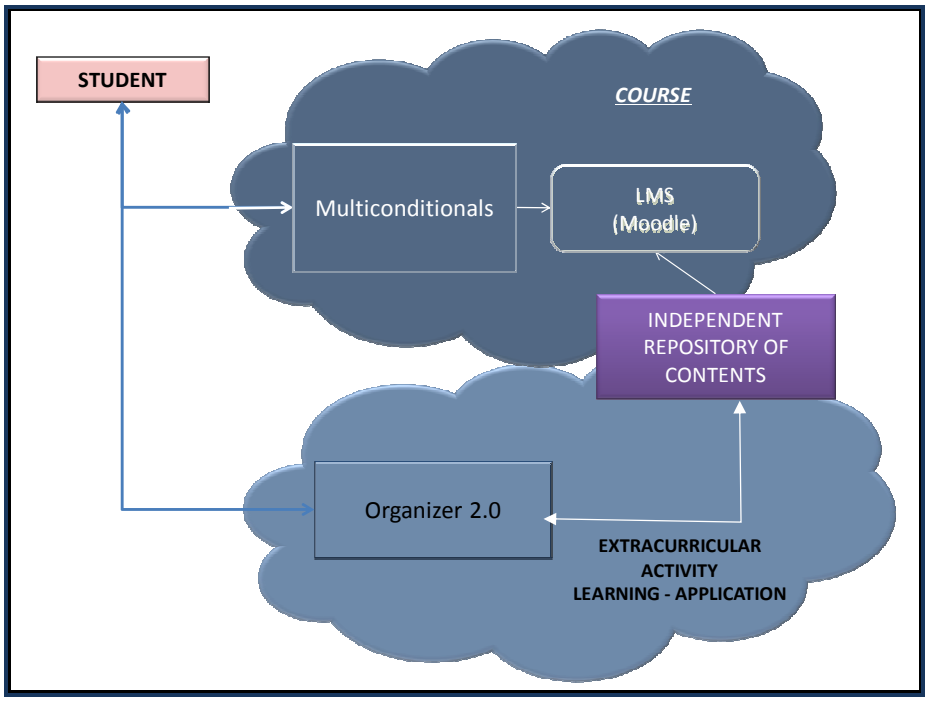

Figure 4: System architecture

3.2 System functionality

This paper describes the functionality of the system from the user's point of view (student's role) to compare his/her performance to the accomplishment of traditional LMS systems. Functionality is described from the different contexts with which a student interacts during the training process and when applying the knowledge acquired in work.

Some examples of this functionality may be found below:

3.2.1. Beginning of the course. Collect student's information to customize the learning process.

3.2.2. Dynamic adaptation of the training plan.

3.2.3. Customize resources to carry out learning activities.

3.2.4. Customize resources to be applied into real work contexts.

3.2.1 Beginning of the course. Collect student's information to customize the learning process

The adaptive system called *Multiconditions* is operating with Moodle in this case. The user does not make any decision, the adaptive system decides on the training plan according to the initial data. The initial data may be taken from questionnaires done by the student including the student's previous information that is available. This

characteristic is related to the *diagnostic assessment*; the objective is to establish a customized training plan both in contents and in training and learning activities [Lerís 11].

3.2.2. Dynamic adaptation of the training plan

As in the previous item, in this case, both the *Multicondition* adaptive system and Moodle operate jointly. The user does not make any decision at all; adaptation is carried through according to the user's interaction with the system's learning resources. The adaptive system may execute decisions to adapt the learning resources to the student according to the results of the different learning activities (option selected in response to a questionnaire, test result, participation in forums, work notes, etc.). This characteristic is related to *formative assessment*; its objective is to take corrective actions during the training process in order to suggest the most suitable resources to obtain optimal learning results [Lerís 11].

3.2.3. Customize resources to carry out learning activities

In this case, the adaptive system called *Organizer 2.0* operates. It is the student who makes the decisions by identifying a series of requirements that the learning resources must comply with. The user may either freely select the requirements that the resources to be obtained must comply with, or focus on a specific predetermined context. The predetermined contexts are: *Carry out activities and Study action and customised notes*.

Activity completion: The different activities to be carried out by a student are defined in this context; just specify the attributes "topic" and "activity" for the system to display the different resources related to this topic. The system informs of all the learning resources relating and useful to carry out the activity, even though they belong to other topics.

Study action and customized notes: In this context, a student may set requirements to categories relating to the different course topics (training paradigms, training methods, practice-oriented didactic resources) and to the types of contents available in the system (summaries, conclusions, presentations, group work). The user has a great deal of freedom to specify his/her interests by using this context. The adaptive system operates in a similar way to the previous case; all the recommended resources are displayed for the user to carry out the study. The student may interact on the obtained list of links by viewing the contents of each of them (each link corresponds to a resource), and he/she may also select what he/she wants in order to generate "customized notes". The adaptive system takes the resources selected by the user and produces a document with them, usually in a pdf format, where a customized text has been produced. Basically, it builds knowledge from already existing parts of knowledge.

3.2.4. Customize resources to be applied into real work contexts

In this case, the adaptive system *Organizer 2.0* operates and it is the user who makes the decisions. In a classical training system the acquired knowledge is commonly applied once the course has been completed, not while being carried out. However, if that is the case, the course's human and learning resources are no longer available,

only the course notes. This project offers the possibility to provide service to participants even once the course has been completed. Students have three categories available for this context (objective, technology and methodology).

In the "Objective" category you may select what the resources are to be used for, from the procedure's point of view. For example, the user may need resources in order to apply them to a real situation, to reflect on them, to research, to create new processes, to know, to change paradigms, to improve processes, etc. In the "Technologies" category, you may find the attributes: LMS/CMS, teleconference, Wikis, Blogs and Social Networks. These attributes correspond to the different technologies worked in the course. In the "Methodologies" category, you may find attributes related to the activity to be carried out, such as: master lesson/explanation of concepts, planning, formative assessment, proactive tutorial, group work, etc.

These attributes correspond to the different methodologies studied in the course. Figure 5 displays an example where the user wants to apply LMS technologies into aspects of evaluation.

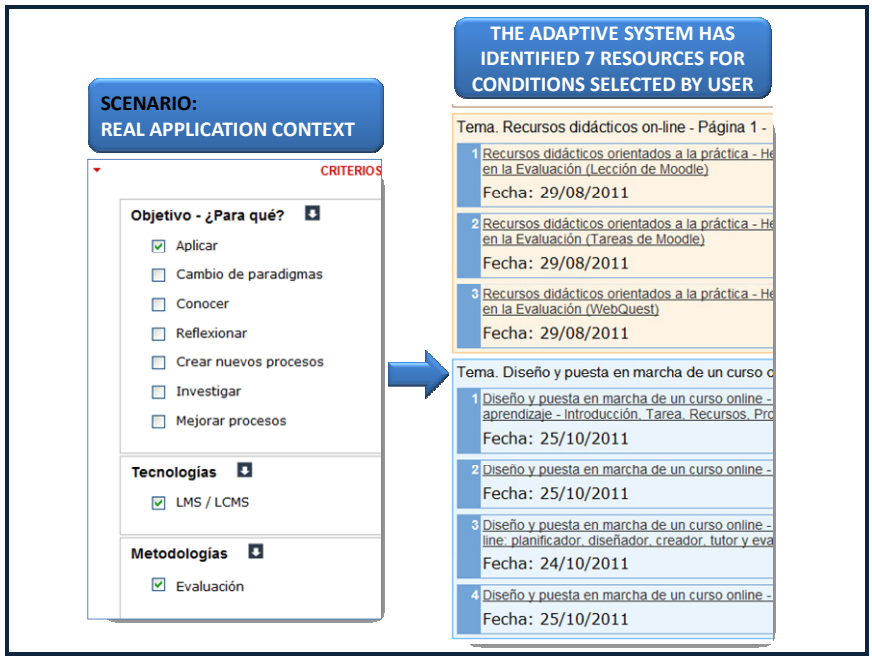

Figure 5: Resource generation. Organizer 2.0

The process is identical to the one expounded for the rest of free navigation cases, but, in this case, two aspects are highlighted: *The generation of related lists* and the *editable customized report***.**

Generation of related lists operates once one of the links generated by the adaptive system according to the selected criteria has been selected. In this case, the adaptive system takes particular attributes of the resources that the student is examining and, starting from them, it generates a list pertaining to each resource that

has been accessed. Figure 6 depicts this situation; in this case, the student decided to examine the "case method" resource, took the attributes "Collaboration" and "Case Method" from it and generated a list of related resources for each of those attributes.

Figure 6: Generation of related resources

*Editable customized report***.** It works identically to customized notes, the difference being that, in this case, the text generated is a work tool, instead of a study tool. Therefore, the user may modify the text to add comments, information about the company, incidences, etc. That is the reason why, in this case, the text generated is usually in a format that may be modified by the user. The customized report has a high value since this is work information to carry out a particular activity, but, if the user includes the additional information as well, the value of such knowledge increases for similar professional situations. This new knowledge may be stored in the repository so that other users may benefit from it, or what is even more important, it may be used in the training process (at other course calls). Figure 7 displays an example of generation of an editable customized report.

4 Evaluation

The model described in this case study was tested and validated both in informal academic education (modules at the Technical University of Madrid and at the University of Zaragoza) and in qualification courses for the labour market. This section compiles the evaluation of the project "Teaching Innova" [AVANZA 10],

object of this paper. The course was taught in 2011-2012 to SMEs' employees and two evaluations were presented: an external audit and an internal evaluation. The first aspect useful to validate the evaluation was that the study case was approved and funded by the Ministry of Industry, Energy and Tourism of the Spanish Government.

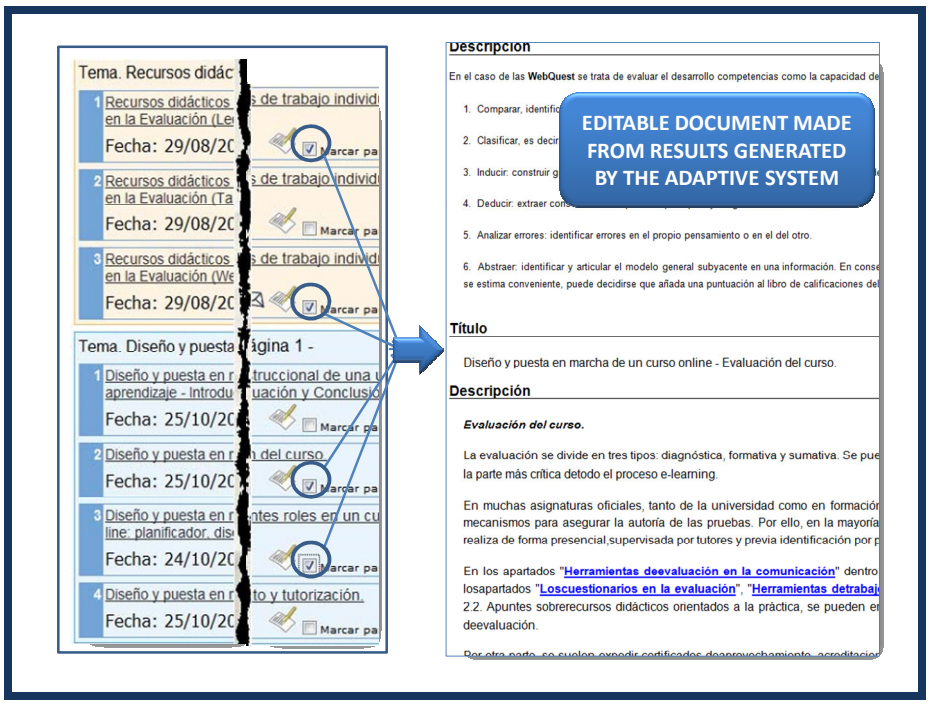

Figure 7: Generation of the editable customized report

4.1 External audit

The audit performed on the project was based on the UNE 66181:2008 standard [AENOR, 08], which is considered to be the first standard on virtual education quality. This standard was an initiative of the 66 AENOR's standardisation technical committee and defines the characteristics of quality in virtual education with regard to their potential customers.

Quality criteria (see Table 1) are established with regard to the project's potential customers (in this case, students and market). The international auditing body (Bureau Veritas) certified that the project complies with the UNE 66181:2008 standard.

The proposal presented this project's approaches on innovation in training for employability and on improvement of the job post. The auditing company knew the web address and had an access code. They accessed the platform online and checked that it complied with the standards. Furthermore, during an in-person session, the auditors accessed the platform and asked questions to the people in charge of it. The questions referred to the requirements of the above-mentioned standard.

Factor Satisfaction	Key attributes	Objetive
Employability	Market Demand Acknowledgement of the training	Measure the increase in the student's ability to integrate into the labor market or to improve his/her job post.
Ease of assimilation	Interactivity Tutoring	Measure the ability of the training project to encourage the users, understand the concepts and favour learning.
Accesibility	To the hardware To the software To the contens	Measure whether the online training is easy to understand, useful and may be effectively and efficiently practicable by any type of enrolled student.

Table 1: External audit's quality criteria

4.2 Self-evaluation

The course topic was training for e-commerce trainers, and the learning resources were organised into three blocks: e-competences, e-business and e-training. The three blocks are required to qualify a person in e-commerce training. Nevertheless, since this is an adaptable system, each student might take a module independently from the rest, they might not even take some of the modules where they had already been trained or had competences. An opinion poll was performed that aimed at measuring aspects concerning the training strategy and the use of such knowledge at work. That is the reason why the evaluation is based on two aspects: employability and learning.

4.2.1 Evaluation on employability

All the students in this course were active workers; therefore, they could apply the knowledge acquired during the course to work. The objective of the training was employability (both present and future); as a result, what was measured was the impact of the training process on work.

Population: All the students that took the three blocks in the course. A total of 63 students completed the three blocks. Sample: 44 students that did the survey (69.8 % of the population) Method: The survey was sent by e-mail to the students that completed the three blocks (regardless of the mark obtained). The survey was designed to measure application into work, improvement of personal performance enabling access to an improvement of work conditions and the student's perception on whether his/her company values the effort made in the training of each module. Figures 8, 9 and 10 include the results of the questions on resource employability for each of the course modules and are graded in a 5-level Likert scale, 1 (little) to 5 (a lot). The first column (blue) corresponds to the question "Have you incorporated the contents of the course into your daily work?". The second column (red) corresponds to the question: "Do you think that your performance has improved?". The third column (green) corresponds to the question: "Does your company value your training effort in this field?".

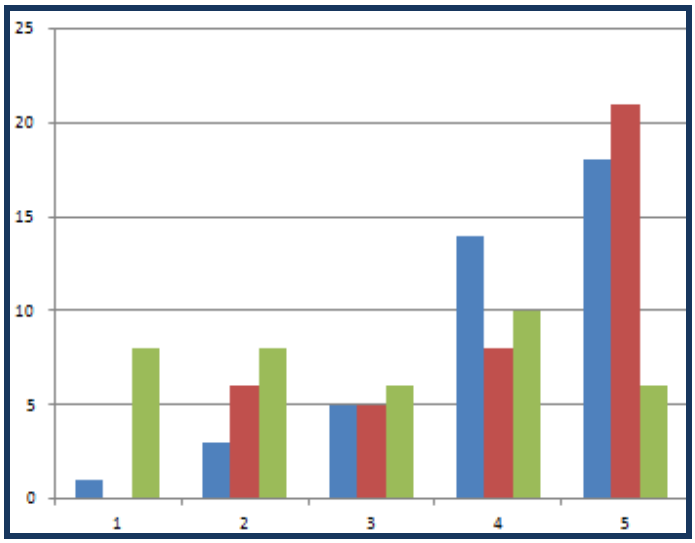

Figure 8: Employability. e-Competences module. 44 participants.

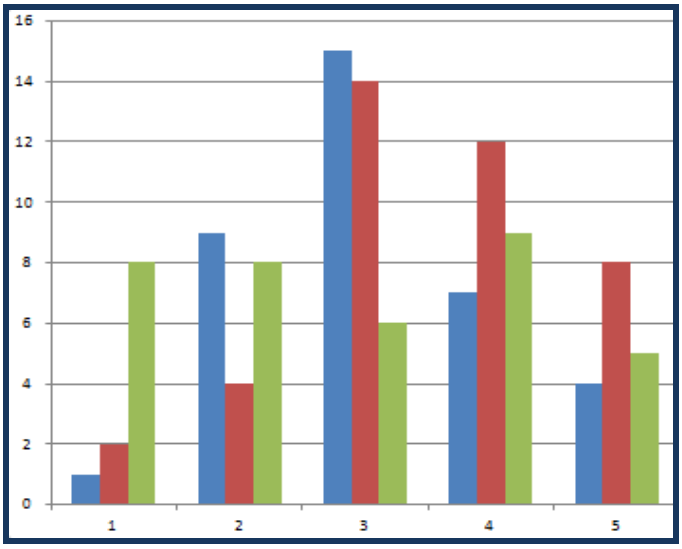

Figure 9: Employability. e-Business module. 44 participants

The impact of this module on work was high, since 78% stated to have incorporated the content into work between quite a lot and a lot (4 or 5); the percentage was 73% when asked about the improvement of their performance at work.

The impact of the e-business module was more modest than the previous one, since only 30% stated to have incorporated the course knowledge into work (4 and 5). A minority of 3% did not incorporate it and 25% only in few occasions. As far as performance improvement is concerned, results were better, since 50% of the survey respondents improved their performance either quite a lot or a lot (4 and 5), and 30% slightly improved.

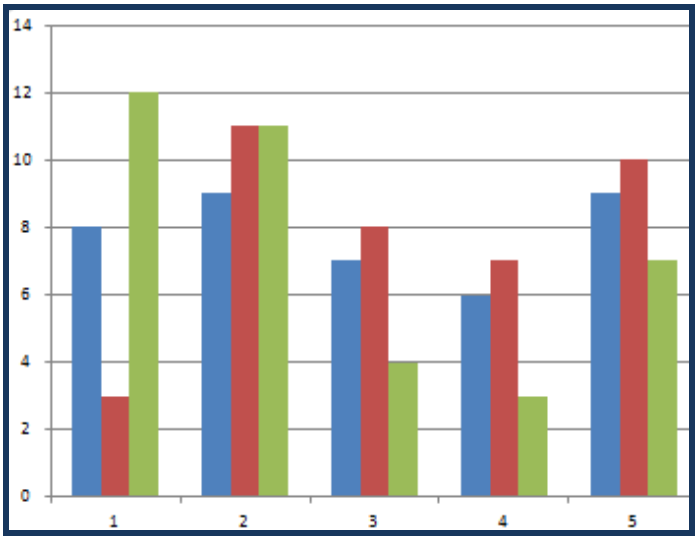

Figure 10: Employability. e-Training module. 44 participants

As a conclusion of the case study, impact on employability is high; however, it varies between the different modules (90% incorporated the e-competences module in comparison to the 56% of e-training). This coincides with the fact that e-competences are more easily applicable to habitual tasks than the trainer's competences, which require a very specific context. Out of the three modules on which any e-commerce training process is based, the company valued e-training less (only 38% of the companies valued e-training, in comparison to the 58% that valued e-competences); which proves that digital competences are generally valued and considered by the companies as necessary requirements to improve their employees' quality in general and, when training others, in particular. Training competences, perhaps due to their educational components that are seen as something far from the business context, are considered less necessary when training others in a topic entailing the use of information and communication technologies.

4.2.2 Evaluation on learning

Population – Sample. E-competence block 102-37 (36.3%). E-business block 100-47 (47%). E-training block 93-31 (33.3%)

Method: 9-question survey via the LMS platform used in the course. As is typical in case studies, the efficiency of the adaptable training process, with regard to the

indicators that may be measured by the students, is assessed. 2 questions are graded on a 5-level Likert scale: pace of the course (question 6) and assessment of different learning aspects (question 7). Open questions: moment in which the students were most involved (question 1), moment in which they were least involved (question 2), most useful actions (question 3), most complex activities (question 4), most surprising event (question 5), modifications to be made on the course (question 8).
The second part of the internal evaluation aims at assessing the learning strategy for the different modules. The results of question 7 are included in Table 2, since they show an overview.

Rate the following sections from 1 to 5 (poor 1, improvable 2, average 3, good 4, very good 5). Average range.	e-competences	e-business	e-learning
The activities were...	4,1	3,8	3,8
The contents taught in the course are...	4,2	4,0	3,9
The development of the topics is...	3,8	3,9	3,9
The tutors' performance during the course was...	4,2	4,1	4,1
The efficiency of your learning in relation to the time spent is...	4,1	3,8	3,7
The environment's user-friendliness is...	4,0	3,9	4,0
Your general assessment of the course is...	4.1	3,9	4,1

Table 2: Results of the assessment on different learning aspects. 37 participants

Each module had very different learning resources, given that, although the course is unique, the training and assessment activities are different according to the adaptability result (module studied). For example, an e-competence may be easily checked, but the design of the online course requires physical and human resources that are out of the scope of the course. However, in spite of those differences, the results of the evaluation (see Table 2) were very similar. This is due to the fact that the system used the same adaptable components and the same adaptive criteria were followed for all of them.

5 Conclusions

The case study herein presented incorporated methods and techniques based on multimedia systems that may be adapted to the education field and information search. The purpose is to provide the most widely used systems (LMS systems) with an adaptability layer and apply this adaptability, in a first stage, to habitual situations among any types of students, such as: the preparation of a customised training plan, dynamic change in the training plan, support to the students' self-learning activities (study, carry out activities…).

In addition, an adaptable product was created to be used once the training course had been completed in order to update and go into its contents in depth and apply the knowledge acquired both in their work and social environments. The architecture of the two products incorporated is modular; therefore, the teaching staff may use them

independently. It provides great flexibility to use them in different situations and making drastic or costly changes, in the previously used systems, are not required.

This way, a first approach to adaptability is obtained without having to make structural or resource changes, as detailed below:

- The organisations may use the herein presented products as a support to in-person training and online courses, without changing the current model. The model is based on the use of LMS systems as a support to teaching (in the cases of in-person training) and to teaching planning (in distance courses). Most of these courses are not adaptable. The system allows using one of the products (the *Organizer 2.0*) in such a way that the training plan is maintained but the students are provided with an adaptable tool to be freely used, both in learning activities and in the application of the contents once the course has been completed.
- These products allow changing a course, already available in an LMS system, into an adaptable course. The *Multicondition* adaptive system may be associated to any course in Moodle. Versions 2.x of the Moodle platform already have a *Condition* tool incorporated and, even though it has important restrictions in comparison to the CICEI's *Multiconditions* regarding the definition of certain conditional requirements, the development described in this project (and in previous work) can be used to obtain the adaptability of a traditional online course. Anyhow, only the students' characteristics are to be modelled and the conditional requirements are to be added without modifying the course's planning.

In this sense, *Multiconditions* allow specifying the degree of adaptability; that is to say, total adaptability may be defined, where the system makes the decisions during the entire course (according to the student's characteristics and progress) and little intervention from the teaching staff is required during the course. However, a certain degree of adaptability may be defined that allows the tutor's intervention, at particular moments of the process, who may determine the following steps in the process, for example, by just marking a non-automatic activity.

Taking all the above into account, the flexibility of *Multiconditions*, their compatibility with Moodle and the different degrees of adaptability they allow, make the results of this work be applicable to a wide range of institutions (universities, schools, continuous training centres, training companies, etc.) and to any type of training (in-person, on-line with or without tutor and b-learning). In addition, they permit the progressive implementation of this adaptability once the administrator has determined the effort and complexity of the changes.

Organizer 2.0 also allows establishing a model applicable to work (instead of to the model of student) via related contexts answering to the questions that the user makes to himself/herself, such as: what type of contents do I need? What do I want the contents for? Where do I want to apply them? With which activity or role at my work, either present or future, are the contents that I am looking for related to? Etc. This model opens a line of research for modelling, where the applicability of the contents along with the student's initial and learning characteristics are taken into account.

The products included in this work allowed us to incorporate, to our line of research on adaptable educational multimedia systems, aspects concerning knowledge

management and educational innovation, and were applied, also independently, to other contexts. On the one hand, the adaptable system *Organizer 2.0*, was used to develop a "Repository of good practices on teaching innovation" within the project EA2011-0035 of the Spanish Ministry of Education, Culture and Sports [MECD 11]. In particular, *Organizer 2.0* was used as a search engine for good practices in teaching innovation. The same knowledge domain is maintained and the adaptive model was used in this project. The attributes are the indicators modelling a great deal of the good practice in teaching innovation. On the other hand, *Multiconditions* were used in official subjects of the universities in the work team, as well as in Spanish and foreign collaborating universities, in order to customise learning according to the different characteristics of each student, such as their study profile, knowledge on the matter, learning styles, progress during learning, etc.

The team of this project continues working on the application of these products to different training contexts and the future technological possibilities are based on two aspects:

- Establish an automatic system of communication between the *Organizer 2.0*'s repository with the Moodle's one, so that the resources may be transferred between both systems.
- Incorporate the conditional requirements and logical connectors ("or") only appearing on the CICEI's *Multiconditions* to the basic installation of the latest Moodle versions and in the form of open code modules.

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