
Adaptive learning paths for improving lifelong learning experiences

Ana-Elena Guerrero-Roldán

Department of Computer Science,
Universitat Oberta de Catalunya,
Barcelona, Spain
E-mail: aguerreror@uoc.edu

Julià Minguillón Alfonso

Department of Computer Science,
Universitat Oberta de Catalunya,
Barcelona, Spain
E-mail: jminguillona@uoc.edu

Abstract: The Open University of Catalonia is a virtual university that offers some courses in the same virtual context to official degree students, as well as for students or professionals who want to improve their knowledge in a special area. The scenario where the lifelong learning courses are carried out is called Ateneu. A good example of this framework is a Data Mining course, which belongs to the Computer Science degree. In this paper we talk about the previous competences Ateneu students need to have and which of them have to reach when they finish the course. Given that student profiles are different; we bring up adaptive learning itineraries to attend these different formative needs. The main goal of this paper is to describe a proposal of an adaptive learning management system for improving the acquisition of competences on this lifelong learning scenario student.

Keywords: Lifelong learning, competences, virtual environments, adaptive learning paths, data mining.

1. Introduction

With the creation of the Bologna process, distance and open education is changing the followed approaches until now. As the UNESCO enunciated, “Universities are important stakeholders in lifelong learning. Their role could evolve, and the link between the learner and the university could become a lifelong link, both to constantly disseminate the knowledge and to develop the networks and communities. E-learning should be encouraged and trained to acquire and further develop their e-competences”. Lifelong learning becomes a clear objective for any university, using a learning competency-based approach.

It is well known that student formative needs are different for an official degree than for postgraduate students. In this case, some students need to improve their knowledge in order to apply it immediately at work, and also most of them want to learn about specific

Author

topic without obtaining an official degree. The Open University of Catalonia offers several courses in a lifelong scenario called Ateneu and one of them is Data mining. The particularity of these courses is that a great variety of students with different backgrounds are in the same virtual classroom, but in the case of Data mining this is highlighted. Different formative actions are needed and a learning proposal could be to design learning paths to attend the particularities of these learners in this course.

2. Virtual learning environment for lifelong learning

The Universitat Oberta de Catalunya (Open University of Catalonia) is an institution which has emerged from the knowledge society. The mission is to provide people with training throughout their lives. The university's principal aim is to ensure that each student satisfies his/her learning needs, gaining the maximum benefit from their own efforts. To this end, it offers intensive use of information and communications technologies (ICT), thereby enabling us to overcome the barriers imposed by time and space and to offer an educational model based on personalized attention for each individual student. At the UOC, students, professors and administrators interact and cooperate on our Virtual Campus, constituting a university community which uses the Internet to create, structure, share and disseminate knowledge. Within the UOC virtual campus, each subject has a virtual classroom for teaching and learning process and they are the virtual meeting point for the different learning activities.

Among many other courses, the university offers official degrees and also called the Ateneu courses. These courses selected from the subjects offered as part of the official degrees, are oriented to lifelong learning students who want to improve their knowledge and professional competences. The virtual campus and all the resources and services involved in the learning process are the same than the official degree learners. But the Ateneu learner profile is not the same, as we will see. Students can be enrolled without an university prerequisites access, with the aim of develop and reinforce their competences and knowledge. Therefore, students with different knowledge, competences and background are studying together in the same virtual classroom and with the same resources. When an Ateneu student passes a course, he/she obtains an extension university accreditation from the University. This accreditation allows to have this subject recognized when accessing a specific official degree where this subject is offered.

3. Adaptive learning paths for data mining

Since five years ago, UOC has offered a data mining course, which at present time has had a lot of demand from a great diversity of people with different origins, backgrounds, motivations and goals. In a certain sense, this course can be considered in itself as a paradigm of a large diversity of learner profiles combined into interdisciplinary work teams. The course aims to provide an introduction to the basic principles, methods, and applications of data mining. Students will gain knowledge on how data mining techniques work, how they can be applied across different domains by using these methods. This course combines the application of the previous knowledge that the students have learnt in other subject such as Statistics and Databases, with the presentation of new concepts and techniques. A set of methods coming from the Artificial

Title

Intelligence field, which constitute the main core of the data mining subject, are also presented. The statistical concepts are very useful to evaluate some of the techniques that will be studied. Therefore, although there are no formal pre-requisites, a basic knowledge of statistics, probability, databases and programming is expected.

The most common profile is an adult with a full time job, and with an average age between 30 and 40 years old, and mostly has got already a previous degree, but wants to be updated and improve his or her knowledge, either for personal or professional reasons. A study about the satisfaction of graduated students shows that they chose the UOC for the learning model as the main reason, because it is a fully distance online system that allows them to study from anywhere at anytime, and it is very flexible. Lifelong learning is also important, as 38% of graduated students have also chosen the university because they wanted to improve their knowledge, and 44% of graduated students have chosen a degree related with their job while 28% of students wanted to improve in the exercise of their professions.

In the case of the Computer Science degree, the data mining subject is available as an optional course, but it is also a free choice election for the students coming from others degrees offered at the university. Therefore, students taking the data mining course come from different degrees, such as Economy or Research in Market Techniques. Furthermore, this particular subject is also available to students from other universities, as part of an intercampus programme. It has also students of Ateneu program enrolled in a lifelong learning process. Intercampus and Ateneu students are between 15 and 20% of the total students enrolled into the data mining course. Most of them chose this subject because of the real possibilities of immediately applying the acquired competences into their jobs. In fact, Data Mining has been chosen for creating learning paths because of all these particularities. It really has a strong professional approach, so contents, activities, resources and learning outcomes are organised in order to improve the acquisition of a set of competences. The last activity of data mining is oriented towards a special area of application that students have chosen and they have to analyse and retrieve information working collaboratively, adopting each of them one particular role as if they were working for an enterprise. Students finish this subject acquiring some competences and the subject main goal. The initial diversity (both student profiles and knowledge) must be observed in order to ensure a correct integration of student backgrounds, particularities and goals. It is a lifelong learning course and the previous teaching experience shows that new learning approaches can be offered to improve the learning scenario according to these profiles. Previously, it is necessary to know which kind of student is enrolled in the Ateneu courses and the differences between them.

In this sense, between Ateneu learner profiles and degree learner ones we have seen some remarkable differences: previous knowledge is not required but in fact is needed, as well as additional activities and resources too. The teachers involved in the learning process of the data mining course, had to design new activities and learning materials to reinforce Ateneu student knowledge and competences during the training course. When they define the competences a learner should possess, they state the objectives to be reached regarding the knowledge process (Paquette, 2004). In general, there are different levels of competences, abilities and knowledge among students in the degree. That is why the learning scenario described is the most appropriate for designing adaptive learning paths and improving the subject.

An analysis carried out during the last three semesters shows that new training actions have to be designed to improve the learning process for this particular learner profile. The

Author

learning process should be consequently better and more adjusted to the learners' knowledge and profile. In this case, the most appropriate learning approach tends to create learning paths according to the pre-requisites to the data mining course for, and also according to student previous knowledge related with some topics and with the idea of reinforcing their learning process. If we create adaptive learning paths, lifelong learning experiences like the data mining subject can be designed in our virtual environment and the student learning process can be improved.

The Data Mining course students have to study several didactic materials and they have to perform some learning activities with the main goal of acquiring the principals competences related with the subject. The aim of the course is to provide students with the experience of working with methods for analyzing new, complex data, and arriving at reliable and detailed summaries of such data. Students learn to identify a problem underlying through selected data examples, and to address this problem with a complete analysis stage and extracting the appropriate conclusions.

Students will be able to do a data mining process after the course, but the Ateneu students need more learning support and resources to acquire these goals. Adaptive learning support paths have to be recommended in these cases as shown in Figure 1:

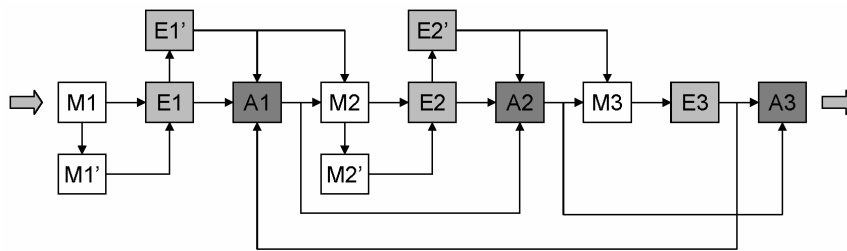


Figure 1: An example of adaptive learning itineraries.

In this example, three theory materials (M1, M2 and M3), exercises (E1, E2 and E3) and evaluation activities (A1, A2 and A3) have to be performed during the data mining course. Nevertheless, teachers could offer two reinforced theoretic materials and exercises to Ateneu students for improving their learning process. In order to promote each learning process according to student's profile, several adaptive learning paths could be chosen:

- Basic learning path: M1 E1 A1 M2 E2 A2 M3 E3 A3. This itinerary is supposed to be the most appropriated for any student with previous competences related to the course.
- Theory reinforced learning path: M1 M1' E1 A1 M2 M2' E2 M3 E3 A3. Students with basic knowledge on a theme will use the additional material for reinforcing their theoretic competences. A reinforced activity will be equally done by the student if we design it.
- Practical reinforced learning path: M1 E1 E1' M2 E2 E2' M3 E3 A1 A2 A3. In this case it would be possible that the student decided to divide up the educational theory materials and to join all the evaluation activities at the end. In the same way, this itinerary could be extended with the extensions described in the previous itinerary, in the event of the student needing it.

Title

These examples are only three possibilities that the learning management system offers to students according to their profile, which is based on the competences they need to develop. These learning paths will be described through a educational modelling standard like IMS-LD with the aim of integrating them in the virtual campus of the Open University of Catalonia.

4. Modeling with IMS-LD

The IMS-LD standard (ADL, 2002), which is based on EML (Hermans et al., 2004), tries to describe the aspects more related to the learning process in itself, such as sequencing or role playing. The first step in preparing the design of the data mining subject as a unit of learning (or a sequence of them) according to the IMS-LD recommendations is to specify all the roles in the scenario defined by learning process. There are two main roles: learners and staff. In a first stage, all learners will share the same role (i.e., no sub-roles are defined yet), while staff is partitioned in three sub-roles: tutors, teachers and managers, following the UOC pedagogical model. With the introduction of collaborative work, though, it will be necessary to define sub-roles for the student role. As Williams (2003) stated in his study, there are some skills related to different roles, thus different roles and competences can be established according to such skills. The second step is defining the activities performed by all the roles and sub-roles defined in the previous step. Currently now, the teaching plan is the document in the UOC pedagogical model where most of this information can be found, but there are also a lot of hidden interactions between all the sub-roles (specially the staff ones) that must also be thoughtfully described in order to simplify the learning process and ensure its complete tracking. The next step is defining the environment (or the structure of environments) where the learning process occurs, that is, the virtual classroom within the virtual campus framework, which includes other resources such as the digital library or the agenda, among others. All the available learning resources are defined in this section. It is important to define here the variables which will be used for categorizing students, especially those which measure the navigational patterns followed by the students along the academic semester (Mor, 2004). Finally, all the relationships between roles, activities and the environments are defined as methods, which include activity structures, play roles and conditions (for personalization purposes).

In order to ensure a competency based approach, it is necessary to establish the complete taxonomy of required and desired competences related to the data mining subject. These competences will determine the activities and, therefore, play roles and conditions. On the other hand, in IMS-LD competences are formally described in the "Learning-objectives" within an "Activity", but using a more textual approach. Each learning objective is described using, at least, two basic fields, a text based description and a type, which can be one (and only one) of the following: skill, knowledge, insight, attitude, competency and other. This might not be enough to fully describe all the competences and their implications in the learning process (as triggers of activities or dependences for personalization), so an appropriate extension must be devised to overcome this possible limitation (Guerrero, 2006).

In this proposal we have tried to standardize the data mining subject according to the IMS-LD standard, and concluding that this standard is an appropriate choice for describing such a complex scenario. Using the IMS-LD standard, the aspects more

Author

related to the learning process in itself, such as sequencing or role playing in terms of competences can be described. IMS-LD opens new research lines for creating a formal definition of competences, studying also how to generate these adaptive learning itineraries for personalizing both content and activities in any formative action. Briefly the main found problems, are that it is very difficult to describe highly adaptive itineraries and there is a lack of parametrization and a weak support of courses in multiple languages which is the case of the Open University of Catalonia.

Anyway, this standard can be used for describing the learning process in a virtual environment including the proposed adaptive learning paths bearing in mind student profile (Koper, 2005) and it is the first step towards a complete formal description of the learning process in virtual environments including collaborative work and personalization issues.

4. Conclusion

It is important to promote the formal acknowledgement of skills, knowledge and competences gained through work experience, informal training and life experience, for prior learning recognition purposes. From the Bologna Declaration (Ade et al., 1999), “A Europe of Knowledge is now widely recognized as an irreplaceable factor for social and human growth and as an indispensable component to consolidate and enrich the European citizenship, capable of giving its citizens the necessary competences to face the challenges of the new millennium, together with an awareness of shared values and belonging to a common social and cultural space”.

Lifelong learning means that students with very different backgrounds will have the same learning goals so their particular needs must be adapted in order to provide the appropriate learning path to each learner, according to his or her competences, both already acquired and in development. Data mining is a highly professionalized area where learners have different needs and approaches (statisticians, computer scientists, project managers, and so) and the use of adaptive learning paths is a very good tool for providing them with a smooth learning path taking into account all their particular needs, requirements and even preferences.

We are currently analysing the general and specific competences, roles and resources for modelling them using the IMS-LD standard attending the possibilities mentioned before in this paper. IMS-LD seems to be the best standard for designing adaptive learning paths in a lifelong learning scenario because of its flexibility and possibilities, but a pilot test and gathering real experiences needs to be done in order to validate this proposal in a real learning scenario such as the UOC virtual campus.

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