

**CONTRIBUTIONS TO IMPROVE ONLINE LEARNING THROUGH  
ADAPTIVE HYPERMEDIA TECHNIQUES**

**Javier ABRAHAM-CURTO**

**ABSTRACT**

*The personalization of learning through the automatic adaptation of the educational process, especially for the contents, is regarded as an important and necessary step for the improvement of education in the future. It is believed that through individualization get improved efficiency, increased speed and quality of learning for students and by automating the process, improved efficiency, better resource utilization, scalability of the process learning. To achieve this goal we have developed different strategies. One of them are looking for Adaptive Hypermedia Systems adjust all contents in a automática to the characteristics of each user.*

**KEY WORDS**

*Adaptive Hypermedia System, user modelling, educational dataminig, learning analytics*

**INTRODUCTION**

In basics, the way of teaching has not changed. It continues to emphasize the figure of the teacher, who has some knowledge, together with a certain skills and teaching techniques, transmitting them to a group of students. Also, to consider that the student has acquired a certain knowledge there are some exercises and / or tests that must pass.

With the arrival of the Information Technology (IT) training and, more specifically, the eLearning was considered that it would produce a revolution in education. As time has verified these changes have not really affected the learning process rather has implicated a progress in the ability to access the educational resources regardless of the spatial and temporal. This is that students can access from anywhere, provided that availability of a device with an Internet connection. Similarly, these processes have allowed teachers to distribute their content to more students and track more or less detailed, which is the use of students perform on them.

Notably, thanks to technology, the inclusion of certain tools such as forums, chats, blogs, video, computer-assessment tests, etc. allow students to interact among themselves and with

the teachers, so that it is reproduce the process of interaction and feedback from classroom education, as necessary during the training process.

Basically, without addressing the complexity, quality and standard of materials and teachers, these formations are under the paradigm "the same education for all students" which is based on the assumption that students come to training with certain knowledge, similar, and must acquire a minimum knowledge through a predetermined classes and materials and pass some tests, which are the same for everyone.

However, it is possible to understand what are the limitations and disadvantages of this system, and it is equally possible to understand the enormous benefits that a system would adjust the training to the individual characteristics of each student, taking into account their prior knowledge, their way of learning and skills, adapting the different materials to each student and not forcing students to adapt materials. This would allow students to progress and learn more efficiently and students realize their full potential, which could mean a huge improvement in the development of knowledge, science and, ultimately, society.

Why still using this paradigm? We can find several answers: (1) education system has worked well for results obtained based on available resources (2) Not found another best possible apply to the real world. For over 20 years has been considered to have the potential IT to individualize the learning process in a more or less automated. With this premise began to develop a new area of research, Adaptive Hypermedia Systems (AHS). An AHS can be defined as the system that builds a model of the goals, preferences and knowledge of each user, and uses it to set the user interaction, in order to adapt the content to their needs (Brusilovsky 1996). Although there are dozens of developments of all types of educational SHA and the large number of researchers and resources have been devoted, not all of them have gone from being prototypes or experimental developments, used on a small scale, in terms of reduced courses content and / or students. Currently there is none with a real and complete application in the field of education.

To understand the full scope of the concept adaptive system, it is important to differentiate the adaptive adaptable concept, and the necessity of the existence of a user model. Is adaptable system that allows the user, through an appropriate interface, can manually set certain options or features of the system directly or indirectly, while an adaptive system that adaptation process performed automatically or semi-automatically, without intervention by the user. There is also the possibility that one system can have both characteristics, i.e.: be adaptable and adaptive simultaneously.

Another important concept is that of user modeling, which is based on user characteristics represented in a User Model and User Model (UM). From a general point of view one can differentiate the adaptation to user data, the usage data and environment data. The data point to the target user adaptation. Usage data is data on the user interaction can be used to influence the process of adaptation. Data environment includes all aspects that are not related to the behavior or characteristics of the user (Kobsa 2001).

We can consider several causes of these difficulties in the implementation of AHS in the field of education, such as: (1) the complexity and cost of adaptive content development, (2) difficulty in determining the user's current knowledge / student (3) lack of appropriate platforms, adaptive capacity, to distribute content.

In order to resolve some of these difficulties and / or limitations and to better understand the individual learning process, since the beginning of this century, we have been starting to use the analysis of information systems that generate web-based education, primarily the Learning Management Systems or Learning Management System (LMS). This information

can come from different sources: (1) provided by the user, (2) the results of the test, practice tests, (3) the activity logs (log files), with which it can be determined properly configured what resources you used, how many times you have used, how long it has been in every one of them and (4) even with the help of specialized tracking software, which has performed actions in each resource (mouse movements and clicks, if has rectified an answer, etc.). Obviously for each session of each user on each system can generate a huge amount of data and, by linking the data of all users, they become totally unmanageable for people to analyze directly. Therefore, they began to use different data mining techniques to find patterns that could help analyze and understand this data in order to improve the learning process in general, and, among other things, to model each much more user automatically, efficiently and effectively.

To answer this need to analyze these data, we developed two different research communities: Educational Data Mining (EDM) and Learning Analytics and Knowledge (LAK). Both reflect the emergence of the approaches based on the analysis of educational data to understand and improve the learning process. An analysis of the similarities and key differences between these areas can be found in the work "Learning Analytics and Educational Data Mining: Towards Communication and Collaboration" (Siemens 2010), which includes the following definitions: According to the International Educational Data Mining Society (IEDMS) "EDM is a discipline that seeks to develop methods to explore educational data, and use these methods to better understand students and the way in which they learn." According to the Society for Learning Analytics Research "is a measurement LAK, capture, analysis and reporting of data on students and their context, for understanding and optimizing learning and the environments in which this happens." The similarities between EDM and LAK overlapping suggest numerous research areas there between, besides the fact that practically required for development of the same data sets. However, having different roots and some important differences. Most importantly, this proposed thesis is the fact that mainly focuses LAK inform and empower instructors and students, while EDM is focused more towards adapting automated or semi-automated.

Another characteristic of these research communities is that they are composed of researchers from different disciplines such as computer science, teaching scientists, specialists in psychometrics, etc. Due to the short time they have developed, we can consider that the analysis of educational data through data mining technology is an emerging field that is still in an early stage of development and immature. However, the boom of its application in sectors other than education, such as finance, marketing, health. That is why it is considered to investigate the application of data mining techniques in educational environments presents significant opportunities for innovation and implementation in educational systems of the future.

Specifically, for the development of the thesis, we propose the implementation of the main AI techniques and data mining to propose a dynamic user model that can be implemented in an educational AHS. This is intended to analyze the various data sources currently used for user modeling and whether educational environments may include other data sources that have not been used to date in order to optimize the modeling. Once established the user model is intended to make a proposal of architecture of a generic educational AHS can be used simply and fully operational in a real educational environment.

## Knowledge Background

For a system to be considered adaptive hypermedia should meet three criteria: (1) be a hypertext or hypermedia system, (2) having a user model and (3) being able to adapt the hypermedia using this model (Brusilovsky 1996). To perform an adaptation the system must be able to respond to the six main issues:

What can we adapt? (What?)

What do we adapt? (Why?)

Why do we need to adapt? (Why?)

Where can we apply adaptation? (Where?)

When can we apply adaptation? (When?)

How can we adapt? (How?)

Despite all the research and developed systems, there is still no consensus on what is the ideal architecture for adaptive systems. Each new development introduces new components, new interfaces, new techniques for adaptation, etc. In search of a generalization of the AHS has tried to develop a model that could serve as reference standard. Among the most notable include: Tower Model, AHAM, "Munich" Model, Gahm and LAOS. (Knutov, De Bra et al. 2009)

The UM is a feature of the AHS. In an educational AHS has been doing modeling based on certain characteristics of the user, such as:

1. Knowledge
2. Interests
3. Objectives and tasks
4. Background
5. Personal Characteristics
6. Workbench.

The development of User Modeling can be done in two ways: (1) based on the characteristics of the user and (2) based on stereotypes. The first is based on making a UM for each user based on their own individual characteristics, is most often used in most AHS. The second is based on a set of user groups that meet certain characteristics and include each user in one of these groups called stereotypes, so many UM only exist as clusters are taken into the system. This is the oldest form of user modeling. To model the user's knowledge and developments in educational AHS is normally used an approach called overlay or overlay, which requires the establishment of a prior domain model or domain model (DM) and the UM builds from the back the DM, adding the values that reflect the user's knowledge level of each of the concepts (Brusilovsky, Millán 2007) Regarding the application of data mining in education or Educational Data Mining (EDM), we can highlight the work "Educational Data Mining: a Survey form 1995 to 2005" (Romero, Ventura 2007) and "Educational Data Mining : A Review of the State of the Art "(Romero 2010) as the most comprehensive survey to date. In the latter paper argues that there are many possible applications of data mining in educational environments. Among the investigated and we find:

1. Data analysis and visualization
2. Provide feedback to support instructors
3. Recommended for students
4. Predicting the performance of students
5. Student Modeling
6. Detection of undesirable behaviors of students

7. Grouping students
8. Analysis of social networks
9. Develop concept maps
10. Construction courses
11. Planning and organization

It also suggests several lines of future research:

1. Development of data mining tools easier to use by educators
2. Integration with eLearning systems
3. Standardization of data and models
4. Adjust the data mining algorithms traditional take into account the educational context.

### **Knowledge Contribution**

While the application of data mining techniques in user modeling AHS is not new, if it is to provide new solutions more efficient and effective in the face of their inclusion in real environments.

The definition and design of a dynamic user model using such techniques as well as the definition and design of a fully functional educational AHS can help lay the foundation for a new generation of educational AHS, focusing on its applicability and usability, rather than experimentation and research.

It is estimated that, overall, the progress they have been developing different data mining techniques, it is possible to achieve the proposed objectives, or at least, to establish a clear and concrete are the specific reasons that have prevented achieve those objectives, face to allow the development of new lines of research. From an educational perspective, being able to implement a fully functional educational AHS that is able to adapt content based on a dynamic user model simply, can make a revolution that will allow students to develop their potential so many more effective and efficient.

Finally, from an economic standpoint, can make the change in the business model of online training, because since the contents are quickly outdated and easily replicable and have lost a very significant amount of its value, so people are less likely ever to pay for some content. However, being able to use a system that adapts content to each user can add value in terms of learning more in less time (efficiency), it would be very difficult to replicate by individual user and by other organizations, what people would be willing to pay for use and could be a competitive advantage for the company or organization that achieved satisfactorily implement.

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