Modeling Approach to a Learner Based on Ontology

Fayçal Messaoudi, Mimoun Moussaoui, Ahmed Bouchboua, Aziz Derouich

***Abstract*—A new generation of advanced systems of learning has to integrate new educational approach giving to the learner an active role to learn and build his knowledge and so allowing to integrate a vision more centered on the learner . The systems adaptive hypermedia in the field of distance education (e-learning) propose solutions of these problems. The objective of these systems is to adapt the presentation of the knowledge and to help the learner to navigate through the graph consisted by all the pages and the links.**

***Index Terms*—Modeling teaching, ontology, model of the domain, CEHL.**

I. INTRODUCTION

The modeling of the learner named also diagnosis (Dillenbourg et Self) [1], is a very active discipline of research in the field of the Computing Environments For the Human Learning (CEHL). The diagnosis is the process of modeling of the learner in the CEHL, and consist a set of treatments there allowing to elaborate and to update information on the learner (the state of his knowledge, of his preferences, his strategies of resolution of problems, his skills, his performances, his styles of learning, etc...) from the analysis of his behavior.

The analysis of the behavior of the learner consists most Often to observe the information on the interactions of the learner with the system during a session of learning and then analyze them and interpret them.

This work consists in setting up tools allowing to take into account the behavior of the learner using a CEHL, and then to adapt the activity of learning to his profile. The methods of this adaptation can be numerous and varied, each treats a certain modality of personalization. Interdependent and complementary, these tasks are interested in theoretical and practical objects ranging from interaction traces and educational scenario to the analysis of activities of learning and the elaboration of model of the learner.

II. THE COMPUTING ENVIRONMENT FOR HUMAN LEARNING (CEHL)

The Computing Environment for Human Learning (CEHL) are computing environments which have for objectives to favor and arouse learning, to accompany them and to validate them. A CEHL integrates human agents (in particular the learner and the teacher) and computing and their offer of the necessary conditions of interactions, locally or through the data networks, as well as the conditions of access to formative resources (human and\or mediatized) local or distributed (Tchouni-kine on 2002) [2]. The research on the CEHL is fundamentally multidisciplinary, by calling up to the cooperation of various computing sectors (engineering software, network, the modeling of the knowledge and the interactions, etc.), and human and social sciences (psychology, didactics, ergonomics, sciences of the languages, the sciences of the communication, etc.). Such environments were set up to model the knowledge of the learner and to help the teacher to follow him, to know his gaps, and at the end to estimate him.

III. MODEL OF THE LEARNER

The model of the learner is a model which contains information reflecting the cognitive state and the psychological features of the learner. It is the source of knowledge that contains acquisitions on all the aspects of the learner which can be useful for the behavior of the hypermedia. Several definitions were proposed in the literature of the hypermedia, among which we will retain that of (K.Höök et al) [3]:

"A user model is a knowledge about the user explicitly or implicitly coded, used by the system to improve its interaction".

It is possible to distinguish several categories of characteristics to describe the attitudes of a learner or a group of learners.

These attitudes are approximately divided on:

- Cognitive Capacities
- Current purposes
- Experiments and knowledge
- Styles and preferences of the users.

The preferences of the users cannot be deducted by the system, the user has to inform this one about his preferences (as for example the choice of a textual version of a concept or the other one by means of the animations and the simulations).

In the context of the education, the implemented fundamental principle consists in estimating the needs of the learner to adapt the educational contents (Fischer G) [4].

To facilitate their comparisons, we present the models of the learner according the following three criteria:

- The type of the model, we distinguish four types from: expertise partial (overlay), differential (primitive), disturbance and social (Piombo C.) [5];
- The data of the model, two categories of data are used: the level of knowledge of the learner and\or the preferences of the learner;
- The acquisition of the model which can be static, dynamic or mixed.

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A. *Type of the model*

We distinguish four types of models to represent the characteristics of a learner. Three models base themselves on the comparison of the learner with an expert of the domain studied (Expertise partial "Overlay", Differential and Disturbance). The fourth model, says social model, opts for a classification of the learners in stereotypes or in categories.

1) The expertise partial model: (figure 1)

The state of the knowledge of the learner is represented as a subset of the knowledge of the domain model (Derouich A. et al) [6].

We consider that the learner will have acquired the wished level of knowledge when there will be perfect overlay of the knowledge of the model domain by the knowledge of the learner.

2) The differential model:

It's a variant of the model expertise partial, it is then more flexible that the model type expertise partial because it allows to focus the inferences on the level of knowledge of the learner only for the aimed concepts. Thus, the educational sequence which would be proposed to it would take into account only the really necessary concepts for a certain objective of learning.

3) The disturbance model: (figure 2)

The disturbance model allows to represent evils rules observed most frequently at the learner, besides the correct rules which he possesses. The errors are considered as disturbances for the domain model. Thus, the system will be capable, thanks to the catalog of errors, to better reacting to fill the gaps.

4) The social model: (figure 3)

The social model consists in classifying a learner among a set of predefined stereotypes. The principle is to use these stereotypes as guide for the choice of an educational sequence. Stereotypes are defined thanks to an analysis of the answers of the learners to a questionnaire.

B. *Data of the model*

The model of the learner allows the system to choose the concepts of courses adapted to the learner and to conceive dynamically the presentation and the organization of the educational contents during a sequence of education. It is possible to split the model of the learner into knowledge model and preferences (attitude) as became famous on the (figure 4) below.

Fig 1: The expertise partial model

Fig 2: The disturbance model

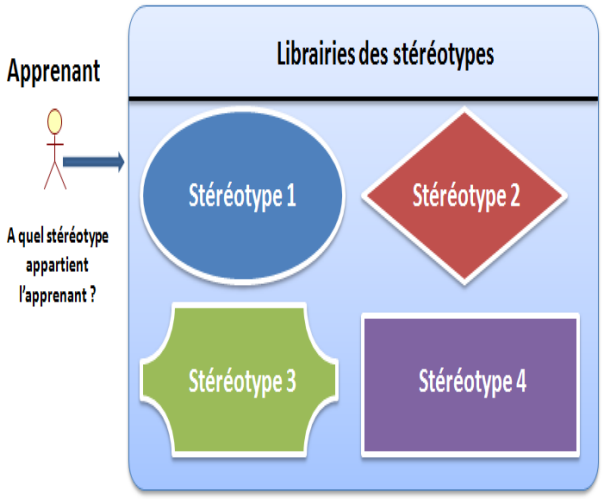

Fig 3: The social model

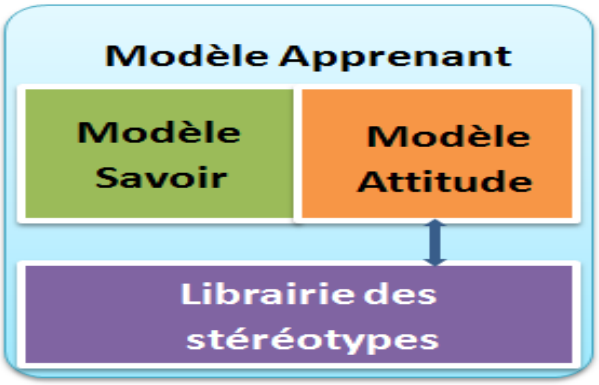

Fig 4: The various components of a learning model

1) The namely model

The knowledge model or namely models of the learner contains information on the level of knowledge of the learner towards every concept considered in the model of the domain. Trella M. et al [7], use a model in two layers): the layer "verified" contains the level of knowledge of the concepts which were estimated by a summative way, while the layer "estimated" contains an estimation of the level of knowledge by the collection and the treatment of diverse information reflecting the behavior of the learner during the session of learning (example: visited pages, access time on pages). The approach of the authors is to consider that the concepts, pages of which were not visited, cannot be known.

2) The attitude model

This model, also called model of preferences, is primarily responsible for the choice of the course: its organization, the media used, the context of learning, the subject of study etc..., it is also responsible for the choice of the presentation model of courses and for the definition of the appearance order of the various media in the course (M. Laroussi) [8]. Secondly, this model defines the educational objectives of the current session. Indeed the behavior of the system will change according to the nature of the consultation of the course (revision for an exam, a deepening of a theory, a complement to a course, etc…).

C. *The acquisition of the model*

The relevant acquisition of information on the learners can be made by automatic methods (G.Webb et al) [9] or by a direct questioning of the learner which it is possible to classify in three families following the acquisition mode: statics acquisition, dynamic acquisition and mixed acquisition.

IV. MODELING APPROACH OF THE LEARNER

There are several modeling approaches of the learner in the CEHL. (Sison et Shimura) [10] classified these approaches in two categories:

- The synthetic approaches which are guided by the data, i.e. by the behavior observed by the learner. These approaches use as techniques of diagnosis, those of the datamining to deduce the individual characteristics of the learner.
- The analytical approaches which the model of the learner is a structure of data, in the sense, which characterizes for the system of education, the state of a subset of the knowledge of this learner. This last one, is going to define himself by the distance between the own knowledge of the learner and the target knowledge, the stake in the learning, such as they are represented in the system. In this sense, the analytical approaches, besides the data, are guided by the models (model Of the learner, the domain model of application, the model of the expert). These approaches use generally systems with knowledge to deduce knowledge of the learner.

The most known analytical approaches are the approach of expertise partial (OVER-LAY) in which the knowledge of the learner is only a subset of the knowledge target (concept of the model of domain, the knowledge of the expert); and the differential approach (OVERLAY expanded) who incorporates erroneous knowledge of the learner.

V. DESCRIPTION OF OUR ONTOLOGY DEDICATES TO THE LEARNER

Our approach consists in defining a general ontology based on several works and researches which proposed solutions with ontologies to describe the profiles of the learners (A.Behaz et al) [11]. Our ontology allowing to describe the profile of the learner thus the representation of the preferences of learning. The cognitive level is necessary to describe the actions or the interactions of the learner with the environment. This ontology will allow collecting the information and the features of the learner, with classes, subclasses and relations between the various classifying. This ontology consists of three limitations of roles (Rr):

The first one is called user, this component is in charge of representing the information concerning a user. It consists of predefined, compulsory and common properties to all the users: identifier, name, first name, email, language, type media, etc…this one is modeled as a set of attribute-value pairs. example, consider U1 a learner Described: <U1, <Name, "Messaoudi">, <First name, "Fayçal">,
<Email, "fayca.messaoudi@usmba.ac.ma">, <Id, "XG121 f.messaoudi">, <language, {"Arabic", "French", "english"}>,
<media, {"Texte", "Audio", "Vidéo"}>>.

The second is mentioned knowledge, which allows to deduct the state of the declarative knowledge and the information on the procedures (procedural knowledge) adopted by the learner for the resolution of problems. This component is in charge of representing and of giving a level of knowledge of a learner for a concept. This knowledge is modeled by a stereotype which can be obtained by means of a level test (MCQ). The stereotype model allows the modeling of the knowledge in a group. The learner is classified under a stereotype, inherits from its properties and arranges adaptations elaborated by the stereotype in question. The possible values are: 1 expert, 2 excellent, 3 means, 4 weak, 5 bottoms.

This limitation will be evolve in an automatic and dynamic way as the learner is going to acquire new knowledge.

The third is called attitudes or (predilection). Allows to define the behavior of the learner, and also to know these needs, these preferences and these choices according to the environment, to his psychological state, and to his knowledge. This component is based on the psychology of the learner.

According to the studies and psychological theories established by (Carl Gustav Jung) [12], every individual possesses a natural preference, with various manners of learning:

Some are very fast in the assimilation of the learning: (A); some need to know the plan and the global vision about the subject before beginning the process of learning: (B); some people prefer to receive complete and precise instructions before beginning a new task: (C); some need to end the current subject before passing to the following one: (D); some people immediately prefer to take action and to learn on the job: (E); some need potential flexibility, for exploitation: (F); some need time and space: (G).

The modeling of this component will be in the form of an abstract vector Vi = (Have, Bi, This, Di, Ei, Fi, Gi), he allows to specify the psychological style of the learner and to inform about these preferences of learning. There are questionnaires allowing to determine the psychological type(chap) of a person. For example the types(chaps) psychological of a learner A1 is described as follows: < A1, < Ak, " 35 % " >, < Bk, " 10 % " >, < Ck, " 25 % " >, < Dk, " 55 % " >, < Ek, " 15 % " >, < Fk, " 10 % " >, < Gk, " 40 % " >>.

A. *Methods of ontological engineering*

The process of construction of an ontology is rather complex according to (Mendes et al.) [13], implying several participants in the various phases of the process. The management of this complexity requires the implementation of process of management, to control the costs and the risk and to insure the quality throughout the process of construction.

To do it, it is very useful to use(methods of development to assist the process of construction.

B. *Representation of the ontology Learning*

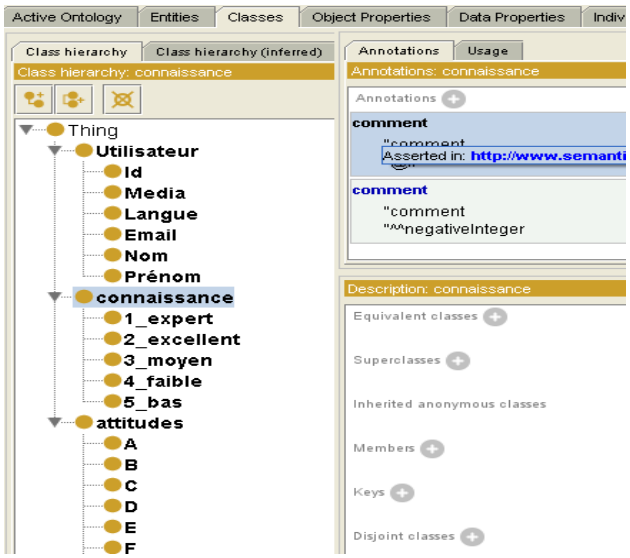

Fig 5: Ontology learning in protégé

We chose the software of edition of ontologies (Protégé [14]) to represent our ontologies, Protégé presents the taxonomies of classes under the shape of tree of composites (Figure 5).

VI. CONCLUSION

The modeling of the learner with ontology requires a repository structure, classic statics and an adaptive part which has to evolve by taking into account progress of the learner according to his knowledge, attitudes, and his preferences of learning.

We presented an approach of modeling of the learner in a system CEHL. A learning ontology based on results of the works of the cognitive theories for the description of the profiles learners more exactly for the representation of the preferences of learning. It seems useful to have available a number of predefined attributes, among which some people can be optional, and to give a frame to facilitate the creation of non-predefined attributes. It is difficult to supply.

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