Lámpsakos | Nº 10 | pp. 52-58 | julio-diciembre | 2013 | ISSN: 2145-4086 | Medellín - Colombia

A PROPOSAL OF T-LEARNING: USING ARTIFICIAL INTELLIGENCE PLANNING AND ONTOLOGICAL REASONING

UNA PROPUESTA DE T-LEARNING: USANDO PLANIFICACIÓN, INTELIGENCIA ARTIFICIAL Y RAZONAMIENTO ONTOLÓGICO

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(Recibido el 19-03-2013. Aprobado el 10-06-2013)

Abstract. This paper focuses on the proposition of how to use the techniques of Planning in Artificial Intelligence in conjunction with Ontological Reasoning in t-learning environments, in order to i) achieve automating processes such as, the presentation and adaption of the Learning Objects or the educational applications (composed of Learning Object); ii) address the differences of terms and meanings that can occur between multiple viewers, finally, iii) allow the reuse of learning objects in different contexts.

Keywords: T-learning, ai planning, ontological reasoning, differences of meanings, automated processes.

Resumen. Este artículo se centra en proponer cómo utilizar las técnicas de planificación de inteligencia artificial en conjunto con el razonamiento ontológico en entornos t-learning, con el fin de: i) lograr automatizar procesos tales como la presentación y la adaptación de objetos de aprendizaje o de las aplicaciones educacionales (compuestas de objetos de aprendizaje); ii) abordar las diferencias de términos y significados (heterogeneidad semántica) que se pueden producir entre los múltiples espectadores, y iii) permitir la reutilización de los objetos de aprendizaje, en diferentes contextos.

Palabras clave: T-learning, planificación, razonamiento ontológico, heterogeneidad semántica, automatización de procesos.

Citación de artículo, estilo IEEE:
I.D. Torres-Pardo, J.A. Guzmán-Luna, M.A. Becerra, "A Proposal of T-Learning: Using Artificial Intelligence Planning and Ontological Reasoning", Lámpsakos, N° 10, pp. 52-58, 2013.

1. INTRODUCTION

Major international efforts have been made in order to improve teaching-learning model [21]. A recent proposal is the use of the television as a teaching device (t-learning). In other words, it is possible to say that the transformation of an e-learning application on a t-learning is not necessarily trivial and sometimes needs several modifications to the system in order to be usable. In the e-learning context, Learning Objects (or LO as shorthand) have played an important role in the conceptualization of e-learning applications [17], because these LO are the main components of educational applications [16]. But how to use the LO of the e-learning in the t-learning? In this situation there are many factors that must be considerated, for example:

- LO in t-learning which, unlike those of e-learning, consist mainly of audio and video (traditional TV formats) trying to reduce the maximum text appearance, since it is difficult to read;
- the LO are developed by persons that use, most of the time, terms and meanings that are different to terms and meanings known by the viewers;
- It is necessary to present only the content of interest to viewers. But ¿what happens if, the viewers are a group of persons that have different preferences?. How can we to know which is the LO that representing more the interest to all viewers?.
- Other problem is the navigability. This occurs because all process of input of user´s data is made by the remote control, following in predefined navigation template.

This paper proposes to use the techniques of Planning in Artificial Intelligence (AI) in conjunction with Ontological Reasoning, in order to enable t-learning process automation. The main idea is to automate the presentation and adaptation of the LO, address the diversity of meanings and allow a consensus between a group of interests composed of several viewers.

To provide a more detailed vision of this paper, the article is organized as follows: section 2 defines the main concepts related to this proposal's framework. Section 3, presents some of the relevant works related. The Section 4, defines the proposal and finally, Section 5 compiles s and future work arising from the development proposed herein.

2. REFERENCE FRAMEWORK

In this section, we survey and present the background knowledge with emphasis on the following areas:

2.1 Learning object (LO)

The use of LO is supported by three basic ideas [13]:

- The LO are digital elements, that can be converted into small learning units.
- The LO are self-described elements. This allows each LO can be manipulated independently;
- The LO are reusable; this is the ability to find and assemble the LO in different contexts and by different users.

The use of these independent small pieces that are independent and the ability to find and assemble them at will, to build them up structural models added style LEGO blocks [10] is what makes the LO one of the most attractive elements of use that has increased the interest generated by e-learning. Formally, there is a unique one definition of the concept of an LO. Nonetheless, it is convenient to consider, as an attempt to unify; the following definition: An LO will be understood as all the material structured in a significant way, and it must be related to a learning objective which must correspond to a digital resource that can be distributed and consulted online. An LO must also have a registration form or metadata that includes a list of attributes which not only describes the possible attributes of an LO, but also allows to catalogue and exchange it. In this setting, standardization is a notably recurrent topic since when one handles various types of resources for different applications and with different technologies, it becomes a key topic to continue operating current applications and even to make them grow. Among these initiatives it is highlighting the an LOM (Learning Object Metadata [13]); It is a standard that specifies the syntax of a minimum set of metadata required to complete and to adequately identify, administrate, locate and evaluate an LO. Its purpose is to facilitate the task of searching, sharing and exchanging LOs for authors, students and automatic systems.

2.2 AI Planning

AI Planning is a process of explicit and abstract deliberation which selects and organizes actions anticipating expected results [15]. This deliberation aims to fulfill some pre-established objectives the best way possible for it; is a problem of searching which requires finding an efficient sequence of actions leading to a system from its initial state to an objective state [10].

In essence, in a learning problem the main elements are [6]: i) the students' background/preferences, ii) the learning goals to be attained, iii) the profile-adapted LOs with their prerequisites and learning outcomes, iv) the ordering relations, and v) the tailored learning route. In order to compare to elements of learning problem with the planning, respectively we can say that is possible to represent each of the above elements, respectively to: i) initial state, ii) top level goals, iii) actions with preconditions and effects, iv) causal link relations, and v) the solution plan. Planning also deals with multi-criteria optimization, a very appealing feature for e-learning: students (and teachers) prefer the best learning route, in terms of time, competence, resources or cost, and not simply yet another route [11]. All the processes described above, are always bearing in mind that an action represents the state of knowledge that have the viewer in an instant of time specified. So is possible to model all the learning process (for this case t-learning) such as a state transition system (i.e.,

2.3 Ontological Reasoning

Ontologies are formal models that support web semantics [5], provide more knowledge for contents (images, videos, audio), enabling the automation of many tasks currently performed by humans. In particular, semantics seeks to produce a world where ontologies [12] allow greater task automation by structuring resources available on the web, so that software agents may analyze and execute processes such as searching, retrieving, invocation, interoperability, and automatic execution [8]. To fulfill these tasks, such ontologies must be sufficiently expressive and must be able to describe the properties of related Domains.

An ontological reasoning is a key component for working with ontologies [14]. With an ontological reasoning is possible to make inferences. The inference makes a much more valuable data because it could have an effect on the creation of new information and lead to positive or negative effects. Each piece of information has the ability to add a lot of new information via inference. So from this way is possible to represent a knowledge base of a particular domain using an ontology, that addresses the diversity of meanings, while new knowledge is produced from the processing of the preferences and tastes of a group of users to convert it in one only specification valid for everybody, i.e. inference implementation.

3. RELATED WORK

This section is a brief compilation of major works of literature related to the domain of t-learning and defines how the authors have used the semantic web technologies. Specifically the review has focused on implementing solutions to: (i) payment contributions and (ii) the definition of the stage of learning process focusing. For space limits only a few works are presented in the Table 1.

An important aspect is that all authors have been working focused in the user, in recommendation system or in adaptive system. LO are considered as documents and search engines apply information retrieval methods, to retrieve the LOs that satisfy the user query. However, such work requires the viewer to scroll manually (with remote control) complete learning units.

Our proposal (see last row of Table 1) is to automate the search according to the exact requirement of the viewer (who represent users) customizing the presentation (adapting learning content to profile-viewer), the conceptual differences, own to culture and language. Finally, the approach described in the paper is inspired in several works that employ LO on digital TV to address classical problems from the personalization (T-maestro and Notube). Our proposal is related with the use of semantic models for the representation of all domain of LO and the knowledge world. The using the semantic allow, besides of personalization of the LO, we can to use too the LO of other repositories and specially, we can re-use that LO in other contexts of T-learning, defined previously by ontologies available on the web. While the AI planning technique is possible to build (in real time) a learning route (plan into IA Planning) that best suits the user profile, not force it to go through the learning content of a course.

LEARNING PROCESS	USER	LO	INPUT DEVICE
E-learning (Manual, Semiautomatic, Automatic)			
T-Learning (Manual)			

Figure 1. Elements e-learning Vs t-learning

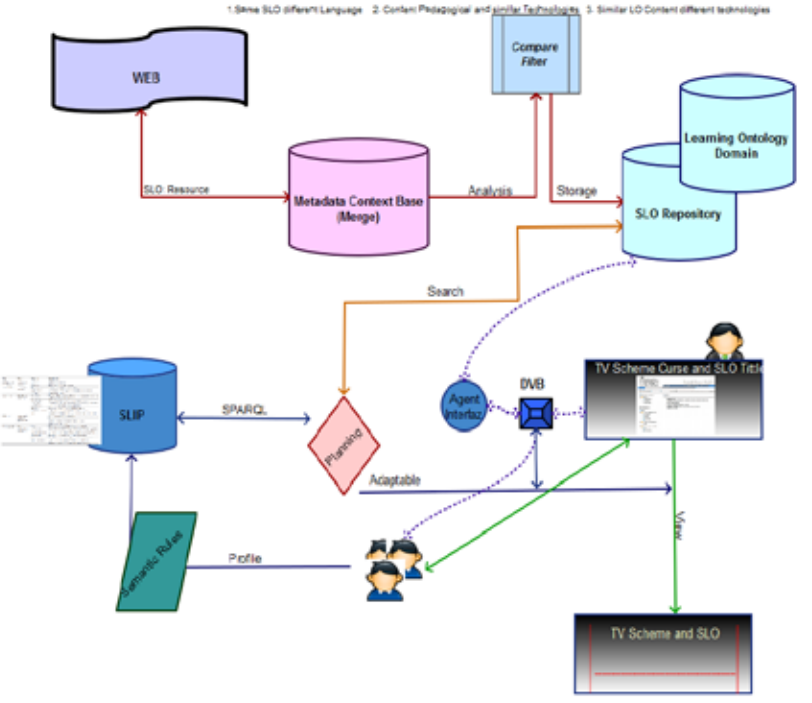

Figure 2. Proposed Architecture

4. THE PROPOSAL

The transformation of an e-learning process into a t-learning environment cannot be performed directly. It requires a method of adaptation and depth study, that depends largely on the interaction of each element in play, as shown in Figure 1 (LO, viewers, interaction devices and the management of processes). The architecture (see Figure 2) is defined by several ontologies. For example, the Metadata Context Base, is an macro ontology that allows the merging of different ontologies of available domains in the web or by ontologies properly built by us.

Table 1. Related works with LO and ontologies

Existing initiatives	Idea	Contribution	Focused on
T-maestro [16]	The content personalization in the field of IDTV	SCOS (Selft-adaptative Sharable Content Object) SCOCreator Templates	Work only about user preferences (with ontologies)
EDiTv: Virtual Education to support television-based distance learning programs [3]	Basic architecture that facilitates the introduction of new services in the IDTV	Inclusion of a pedagogical and technological architecture IDTV	In pedagogical model
Advertesing auction to IDTV [4]	Personalization of advertisements in digital interactive TV environments	Each advertising company enters an auction to buy time transmission of your ads through set-top-box and user preferences.	Work only about user preferences
A Ciencia Cierta [11]	Educational content developed from learning objects for IDTV	The user can expand their searches or they can complete questionnaires to assess their knowledge	On user preferences and knowledge gained by him
UPM [21]	Trends of digital television but projected on the convergence of web technologies	Offers different services: content of demand, personalization and feedback, semantics is used to define services.	Is only a theoretical work not implemented yet
RICAO [19]	Advanced search mechanism which allows the consultation of audiovisual content (non-educational)	A methodology that includes the recovery process and information integration using ontologies (case study portals ONO televisión programming and Digital +, and the film IMDb	In the recovery process and information integration but non-educational.
NOTUBE [2]	Reuse of flows to determine the activity of interest and generating tele-spectator recommendation	Aggregating user data from different applications web social and line	To present the data and recommendation process
OUR PROPOSAL	Reuse the LO adapting learning content to profile-viewer in real time. Then tries to build an unanticipated creation of a subordinated learning object sequence plan (i.e. learning route), which is attained from other previously existent objects.	Automatic construction of learning routes (in real time) adapted to the user profile. Enriched with semantic representations	To reuse or LO, Semantic an IA Planning to automate processes

The SLO is a Learning Object Repository; it has the resource web, the metadata (defined by SIMS, that is the semantic representing IMS metadata standard) and the formative intentionality, the URL pointing to a concept of an Learning Ontology Domain.

SLIP is other ontology that represents the user preference. These preferences are composed by pedagogical preferences, technological preferences and social level. The comparison filter, check that there isn´t redundancy between LO registered in the repository, i.e., check that: i) does not include twice the same LO, ii) that the LO not have different educational content with similar technologies or iii) LO does not have the same content with different pedagogical technologies. Semantic Rules (and SPARQL) are the logical reasoning mechanism, which will work with the adaptability the LO that composed the t-learning applications.

Finally, through the application of an AI planning technique [10], is possible to form a learning route (as plan), which may tend to a user's specific knowledge needs. The purpose of planning is then an unanticipated creation of a subordinated learning object sequence plan (i.e. learning route), which is attained from pre-existing LO registered in a repository.

5. FUTURE WORK

Our immediate future work is implementing the architecture proposed and all modules and using the different ontologies available in web (FOAF, GeneOntology, ontolingua, allmusic, etc) [5].

6. CONCLUSION

This work describes an approach that modeling various elements of the t-learning environment using AI planning and the ontologies reasoning in order to i) achieve to automate processes such as, the presentation and adaption of the Learning Object or the educational applications (composed of Learning Object), plus ii) address the differences of terms and meanings that can occur between different viewers, and finally, iii) allow a consensus between a group of interests of several viewers, with the objective of adequate the learning object to viewer's interests. The use of an ontology-based indexing scheme is a crucial element in the approach. It provides a unique vocabulary for query retrieval and reasoning on LO. While, IA Planning enables automation of processes such as search, personalization and presentation of learning units associated to the exact user interest.

ACKNOWLEDGMENT

This work present the preliminary results of the research project "Una Infraestructura para la Generación de Aplicaciones Educativas Basadas en Televisión Digital Usando Objetos de Aprendizaje Semánticos" funded by COLCIENCIAS (Administrative Department of Science, Technology, and Innovation of Colombia) and Universidad Nacional de Colombia under the Project with code 111856933723, and project "Caracterización de los Objetos de Aprendizaje para la Generación de Aplicaciones Educativas usando tecnologías Semánticas" partially supported by the Institución universitaria Salazar y Herrera y la Universidad Nacional de Colombia, sede Medellín.

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