A New Approach Based on Learning Services to Generate Appropriate Learning Paths

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Abstract: This article presents a new approach to provide learners learning paths adapted to their profiles. These courses are generated as the automatic composition of learning services. It is made up of three modules: search module, matching module and composition module. Our approach is based on new model of learning service (SWAP) that extends semantic web service (OWL-S) to describe the semantics of learning modules and facilitated the discovery of learning paths adapted to each learner.

1 INTRODUCTION

With the advance in technology, the mode of education has been changing its traditional method of teaching and learning toward online learning, which can be defined as the acquisition, use and dissemination of knowledge provided primarily by electronic media (Sultana, 2010).

e-Learning is a type of education that offers advantages to traditional learning in terms of independence. In fact, learners can study from anywhere at any time and communicate with the e-learning system or other learners by e-mail, electronic forums, chat, video and other forms of communication based on Web (Zhen, 2009).

It is not only characterized by easy access to learning resources (anytime and anywhere), but it also supports other functionalities such as the definition of personal learning goals, and communication and synchronous or asynchronous collaboration between learners and trainers. In this context, objects and learning resources and their providers play a very important role in learning applications (Gang, 2004). This content, which is created by educators and used by learners is usually handled, stored and exchanged in Learning object units (LOs).

Learning objects (LOs) are teaching units (studies) designed to meet specific learning objectives. These objects are modeled in terms of content items, practice items and evaluation elements to cover a subject of learning and an assessment. They represent reusable granules that can be drawn independently from the delivery medium and dynamically access the network (Zhen, 2009).

As the number of resources and suppliers grows, it becomes very difficult for the learner to search the needed resources. A first solution is to add metadata to the specification of the learning object.
At this stage, several standardization efforts have been launched including LOM and SCORM. They present a set of specifications adapted from multiple sources of learning.

These standard descriptions of learning resources are focused on the characterization of content rather than on their use. In fact, they have limitations in the context of heterogeneous learning objects. In addition, the definition of specialized courses according to desired skills requires a composition of learning objects to provide the learner a personalized learning course.

These problems of interoperability, reusability and composition of learning content can be solved by using the principles of Web service paradigm. Web services are defined as open standards that provide a flexible solution for integrating heterogeneous and dynamic applications that enable interoperability between different systems (Ngamnij, 2005).

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The rest of the paper is organized as follows: Section II presents an overview of approaches using learning services. Section III details a new approach to provide learners learning paths adapted to their profiles. This approach consists of three components or layers: Presentation layer, Business layer and Model layer. Section IV concludes the paper and outlines future works.

2 RELATED WORK

e-Learning and the integration of learning resources are topics of growing interest in recent years.

Zniber (ZNIBER, 2010) presented an approach to building personalized pathways called POPS (Process-Oriented Pedagogic Service) by composing services dynamically. This approach is a conceptual framework that defines a model for describing the pedagogical services. This model of Pedagogical Service provides a set of concepts to describe the services. According to Zniber, a pedagogical service is composed of three parts: "profile", "structure" and "behavior". The "Profile" part describes the general appearance of the pedagogical service.

It corresponds to the service interface and will be used when searching for a match between the available services and the learners' intentions. It is composed of the definition of a pedagogical objective and a learning context. The "structure" part describes the organization of the process to achieve the pedagogical objective. It is defined by a process and an initial position and a final position. The "behavior" part is the "executable" level of service. It describes the use of the service by a learner and it takes the form of an implementation plan with activities and resources to be mobilized. The behavior part is composed of resources and links to use these resources.

In this approach, the author has used ontologies to describe both pedagogical services and make the intentions of learners who need personalized pathways. This description of pedagogical services is based on two ontologies: one to describe pedagogy and another to describe the teached domain. These ontologies are used to associate a semantic description of the elements of services.

D'Mello (D'Mello, 2012) proposed a functional and semantic approach to describe the e-learning web services with various objects and learning resources. It defines a learning service as an extension of the WSDL2.0 document structure integrating functional semantics to e-learning web services and their operations in order to ensure the publication of these services. This extension is composed of a set of new elements. The element "documentation" is chosen to include the information necessary for better service discovery in WSDL. The label entitled "*operationDesc*" is defined to insert the functional semantics of all operations present in the learning service. The new elements "*operationList*", "operation", "action", "call", "object" and "name" are used within the element "*operationDesc*". These new elements are defined in the XML schema that governs the structure of the extended documentation element. Functional semantics of a transaction are defined inside the element "semantics", the element is placed inside of the element "operation". Elements such as "action", "qualify", "object" and "not" are used in the element "semantics" that provides a functional description of a learning operation.

```
< ?xml version="1.0" encoding="utf-8" ?>
<description>
  <documentation>
    <operationDesc
      xmlns :xf="http://www.w3.org/2011/XMLSchema-Instance"
        xf:schemaLocation="http://www.sejc.ac.in/csedept/desSchema/desc.xsd"
          xmlns =" http://www.sejc.ac.in/csedept/desSchema" >
        <operationList>
          <operation>
            <operationName> Get Course Material
            </operationName>
            <semantics>
              <action>get</action>
              <object>course</object>
              <object>material</object>
            </semantics>
          </operation>
        </operationList>
      </operationDesc >
  </documentation>
</description>
```

Figure 1: Example of a Web service learning.

3 APPROACH BASED LEARNING SERVICES

We propose an approach that allows us to provide learners with learning paths adapted to their profiles. These courses are compositions learning services.

This approach consists of three components or layers:

- Presentation layer: it provides the learner with an interface to formulate queries.
- Business layer: is the functional part which processes the learner's queries by searching and composing pedagogical services

- Model layer: represents the basis for existing pedagogical services and the used ontologies (both teached domain ontology and objectives ontology).

Our approach is described by three modules including: search module, matching module and composition module.

The learner expresses these learning needs as a query (search module). The system takes the learning query and verifies the correspondence between the request of the learner and the learning web service model (SWAP) in order to eliminate any conflict of information presentations (matching module). Once the request is approved, the system starts the search of appropriate learning web services from a SWAP database. This search may lead to a composition of services to satisfy the learner (composition module).

The result is a personalized path. At this stage, the learner can give its opinion on the proposed path, if the opinion is positive, the SWAP database is fed by the composed service.

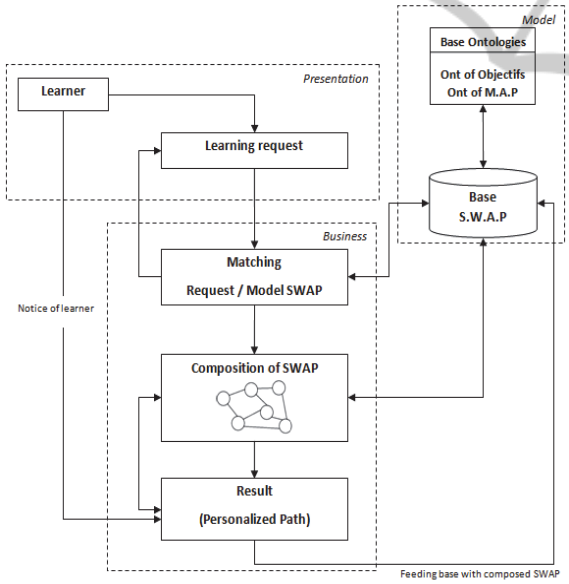

Figure 2: Architecture-based learning Web services.

3.1 Presentation Layer

In this layer, we define the profile of the learner and these learning needs in the form of learning requests. The learner profiles are used to provide the learning system with relevant information to adapt learning to the knowledge, skills, characteristics, preferences and learning goals of the learner. In our approach, we define a profile of learner as the learning level and all learning services consumed by the learner. This profile will help us to provide the best and the most appropriate learning service suited to learners.

3.2 Business Layer

At this layer, we proceed the matching between the request and the model of learning service. This step can correctly interpret the semantics of the request of learner and improve the accuracy of responses. In this context, this matching can offer better speed of execution from a first simple filtering of learning services that corresponds to check if the learning request corresponds to a simple learning service. After the first filtering step, we proceed to the composition of a set of learning services to satisfy the learner request. The result of this composition is a personalized path in the form of an oriented graph.

3.3 Model Layer

This layer contains a basis of learning services and the used ontology. These ontologies are ontology of objectives and ontology of learning.

- Model of a learning service: We present the model of learning service (SWAP) as an extension of semantic web service (OWL-S) to describe the semantics of learning modules and facilitated the discovery of learning paths adapted to each learner.

This model is composed of two layers:

- Environment layer: that describes the basic information of a learning service.
- Action layer: present the various existing learning operations as well as interactions between them represented in the form of oriented graphs.

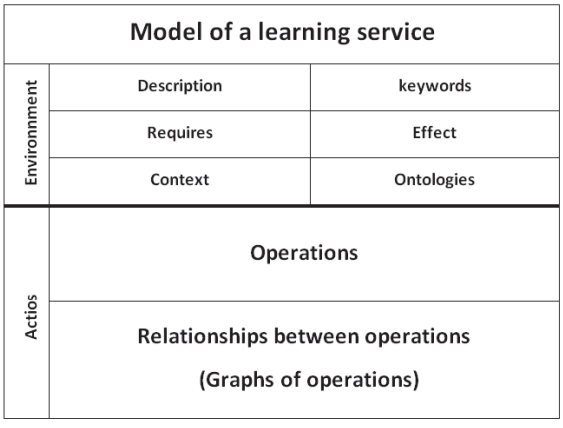

Figure 3: Model of a learning service.

4 CONCLUSION

This paper is a study to implementing a new e-learning approach that enables to provide learners with learning paths adapted to their profiles. These paths are compositions of learning services. At present our work is at an early stage and we still need to evaluate the approach. In the future, we will proceed to detail the different layers of our approach.

We relied on MEMORAe project conducted in the laboratory Heudiasyc of the University of Technology of Compiègne (UTC), whose goal is to model and design a collaborative environment fostering organizational learning and knowledge management (Leblanc, 2008).

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