

Activities' traces sharing for e-learners using heterogeneous LMS

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Abstract—Many Learning Management Systems (LMS) are available today and they are widely used. Many e-learners use two or more LMS simultaneously for different kinds of learning. The research question discussed in this paper is: how learners can benefit from their learning activities whatever the used LMS? We propose in this paper our approach to support the sharing of learners' activity traces when an e-learner uses simultaneously heterogeneous LMS. Use cases demonstrating the advantage of using our approach are given. The state of the art is presented. Finally the elements of our approach are explained.

Keywords—Learning activities traces; heterogenous Learning Management Systems.

I. INTRODUCTION

Nowadays many LMS provide adapted and personalized learning experience for e-learners [1]. To reach this goal LMS must gather information about them with an explicit or better with an implicit manner. LMS working with the explicit manner have to collect information throw questions and/or forms that must be answered and filled by e-learners such PERSO [2], [3], [4], [5], [14]. LMS with the implicit manner have to collect the maximum of information by analyzing learners' activity traces along the learning process such SIMBAD [6]. The implicitly collected information can include the e-learner knowledge, competencies, preferences, learning style, and so on.

The different proposals concerning learner profile construction concerns the case of e-learners using a single LMS. However, with the flourish of the e-learning and the wide use of LMS in different learning situations (e.g. university, training centers and vocational training) this process must be reviewed and adapted to the case of e-learners using simultaneously many LMS which can be heterogeneous [7], [8], [9].

The following scenarios illustrate two cases where our approach can be applied. The first one concerns the case of e-learner's prerequisites capture. Let's suppose that an e-learner is subscribed in a curriculum. The learning process is provided via a MOODLE¹ LMS. The e-learner has validated yet a course of JAVA programming. In the same time he/she subscribes in another curriculum to learn J2EE proposed by another institute and provided via a CLAROLINE² LMS.

However, to be able to learn the J2EE course it is necessary to learn first the JAVA programming language. Actually the current architecture of actual LMS is not able to know implicitly that the e-learner has yet this prerequisite throw the curriculum provided by a MOODLE LMS. In fact each LMS have no information about other activities of e-learners occurring in another LMS. Moreover if this information can be introduced by the e-learners it can't be dynamically updated.

The second scenario that we propose concerns the case of curriculums' intersections. An e-learner can be subscribed in two curriculums containing similar courses (e.g. Scientific English). The two curriculums are provided via two different LMS. This means that the e-learner must validate the similar course twice.

In general our goal is to allow each LMS to have access to e-learners' activity traces collected in other LMS. Our approach will especially be profitable for inter-LMS prerequisite validation and for redundant activity elimination.

In the next section we present the state of the art concerning the design and the management of e-learners information. In the third section we introduce our approach

¹ <http://moodle.org/>

² <http://www.claroline.net/>

to support activities' traces sharing for e-learners using heterogeneous LMS. The conclusion and future works are discussed in the last section.

II. E-LEARNERS INFORMATION STATE OF THE ART

E-learners are described by their information. Thus, the use of many LMS by the same e-learner needs an information exchange between them. To reach this goal two questions must be answered. First, how the e-learner must be described? Secondly, how the interoperability will be assured? A learner profile standard seems to be the answer. In this context three proposals are analyzed: IEEE PAPI³, IMS LIP⁴ and IMS ePortfolio⁵.

PAPI is the acronym of "Personal And Private Information". This IEEE standard covers six categories of information related to learners: contact, relations, security, preferences, performance and portfolio. Two categories can be used to share e-learners activity traces. First the learner performance information category which contains especially learner's history and current work can be used. Secondly the learner portfolio information which contains especially justification of his abilities and achievements can be used too.

The IMS LIP is the acronym of "Learner Information Package". It is composed of nine categories of information: interest, affiliation, QCL (Qualifications, Certifications and licenses), activity, goal, identification, competency, relationship, security key, transcript and accessibility. More complete than the IEEE PAPI and thus it seems to be useful too for e-learners activity traces sharing.

IMS ePortfolio specification [10] was created to make ePortfolios interoperable between different systems and institutions can import or export all or part of electronic portfolios. It allows teachers and institutions to better track skills, it improves the learning experience and development. It is composed of nineteen categories of information: owner, affiliation, identification, security key, qualification, rubric (notation guide), rubriccell, transcript, accessibility, goal, interest, competency, participation, product, assertion/reflexion, view, presentation and relationship.

However, if the e-learner information in general and activity traces especially are well described by IEEE PAPI, IMS LIP and IMS ePortfolio, they are not designed and are not appropriate for an implicit sharing. In fact, the three standards are used to be exported from a LMS and then imported to another LMS explicitly by a LMS user. They are adequate when a learner wants to migrate from a LMS to another one or when he/she wants to initialize his/her profile

by his information extracted from another LMS [11], [12]. More than the explicit/implicit aspects the fact of non adequacy for simultaneous LMS use and for dynamic activities traces sharing scenarios, a new approach must be proposed.

III. ACTIVITIES' TRACES SHARING APPROACH

A. Describing Problem

E-learner's information can be split on two categories: static and dynamic.

Static information concerns identification, preferences and all descriptive and no frequently changing information.

Dynamic information was those frequently changing. We are concerned especially by the activities' traces which can be used to determine the e-learner current knowledge. The current activities traces can be useful to avoid redundancy when similar activities are provided to the same e-learner by different LMS. The current e-learner knowledge is considered for prerequisite satisfaction verification process.

E-learners' activities traces can be extracted from LMS databases. The following XML extracts are two files having the same structure of consecutively the table mdl_quiz_attempts and mdl_quiz_grades used by MOODLE to store e-learners quiz use activities:

```
<!-- Table mdl_quiz_attempts -->
<mdl_quiz_attempts>
  <id>1</id>
  <quiz>1</quiz>
  <userid>3</userid>
  <attempt>1</attempt>
  <timestamp>1321512942</timestamp>
  <timefinish>0</timefinish>
  <timemodified>1321512942</timemodified>
</mdl_quiz_attempts>
```

```
<!-- Table mdl_quiz_grades -->
<mdl_quiz_grades>
  <id>1</id>
  <quiz>1</quiz>
  <userid>3</userid>
  <grade>10</grade>
  <timemodified>1321513701</timemodified>
</mdl_quiz_grades>
```

Two tables are used to determine that the user having the identifier "3" have used the quiz identified by "1" and in one attempt he/she have "10" as a score.

To track e-learners quiz answering activities with the CLAROLINE LMS we must use the table c_ca_qwz_tracking. The following XML file has the same structure of the table:

```
<!--Table c_ca_qwz_tracking -->
<c_ca_qwz_tracking>
  <id>1</id>
```

³ <http://www.ieeeltsc.org>

⁴ <http://www.imsglobal.org/profiles/index.html>

⁵ http://www.imsglobal.org/ep/epv1p0/imsep_bestv1p0.html

```

<user_id>3</user_id>
<date>2011-11-17 11:34:27</date>
<exo_id>1</exo_id>
<result>6</result>
<time>5</time>
<weighting>10</weighting>
</c_ca_qwz_tracking>

```

Therefore, in the case of CLAROLINE tracking e-learners quiz answering is different from the case of MOODLE. The analysis of many LMS demonstrates that implicit exchange of information about e-learners activity is a challenge. The difficulties concerns mainly two aspects. The first one is the syntactic aspect. In fact, some entities have the same semantic but described by different terms. For example, as shown by the XML extracts concerning MOODLE the term “grade” is used for the e-learner’s score. However, in CLAROLINE the term “result” is used to describe the same thing.

The second aspect that must be solved to be able to exchange implicitly e-learners activity traces between heterogeneous LMS is the databases’ design. Each LMS have a database designed different to another LMS. For example the two XML extracts demonstrate that MOODLE uses two tables to store e-learners quiz answering activity when CLAROLINE uses one table.

B. Presenting Solution

Our proposal to support e-learners’ activities traces share when heterogeneous LMS are simultaneously used, is composed of two elements. First a generic activity trace model having the following structure:

```

<activity>
  <source> </source>
  <type> </type>
  <state> </state>
  <objective> </objective>
  <grade> </grade>
  <concept> </concept>
</activity>

```

In our model, each activity has a source which is a specific LMS (throw a unique identifier), a type (e.g. quiz answering, lecture, chat, etc.), a state (e.g. done, in progress, etc.), a grade (depending on the type of the activity and normalized to a weighting of 100) and a concept (i.e. a learning concept from a common ontology).

An example of structure instance present a learner quiz activity which is done on the LMS identified by 1. This activity allows attempting the objective 2 (for example writing in English). He/She obtains 10 as score.

```

<activity>

```

```

<source> 1</source>
<type>quiz</type>
<state>done</state>
<objective>2</objective>
<grade> 10</grade>
<concept>1</concept>
</activity>

```

The second element of our approach is the architecture of the system. To allow the sharing of e-learners-traces between heterogeneous LMS and as shown by the Figure 1, we have two main components: Mediator and Middleware. The following scenario illustrates the role of each component.

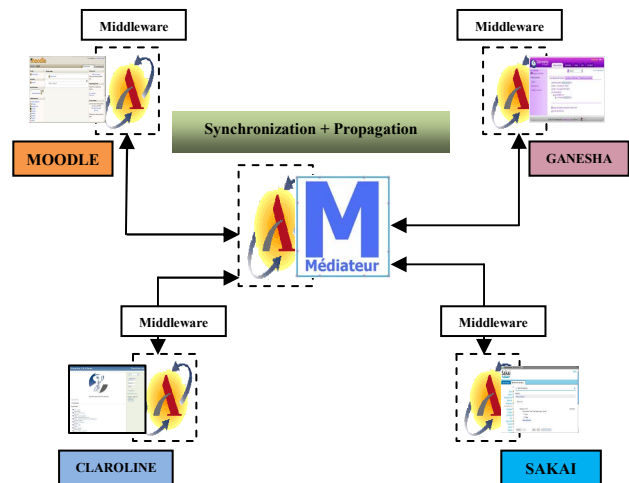


Figure 1. Overview of the system architecture allowing e-learners’ activity traces sharing between heterogeneous LMSs

An e-learner using MOODLE for example will subscribe in a new curriculum available on a CLAROLINE LMS. To avoid similar activities available on the two curriculums provided by the two LMS and to considerate each validated activity as a prerequisite in the two LMS the e-learner must subscribe them on the mediator. The mediator collects e-learners activities’ traces and stores them in his own database conforming two the data-model presented above.

Since this moment each time when the e-learner connect to a LMS the middleware call the mediator to check if new e-learner activities are done on the another LMS. If the answer is yes the middleware synchronize the LMS database to be up to date.

To accomplish this task the middleware must convert the generic e-learner activities traces to feet with the LMS database structure. When the e-learner logout from the LMS the middleware sent new e-learner’s activities traces to the mediator.

IV. CONCLUSION AND FUTURE WORKS

In this paper we have discussed the necessity to share e-learners' activities traces when using many LMS. The goal is to have a best management of e-learners information in such as distributed environment.

Our approach is based on the use of a generic activities traces model. It is simple and semantically rich thanks to the use of domain ontology the syntactic and semantic terms matching problems can be solved.

Our approach is based on an architecture using two main components. First the mediator, it stores and manages the e-learner's activities traces coming from the different LMS. Secondly middleware, it executes two kinds of algorithms: synchronisation algorithms and traces converting algorithms.

Actually we are working to improve the mediator semantic capabilities, especially how to detect similar activities by using semantic metrics proposed in [13]. Moreover we are testing different approaches related to maximise the benefit from using e-learners activities traces especially when the LMS don't consider prerequisite and when it has a poor activities description model.

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