Towards a Learning Situation Application Profile

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Abstract: The new education program proposed for Quebec focuses on the development of competencies. Knowledge and skills are organized in terms of competencies and learning processes. The three main components of the program - the broad areas of learning, the cross-curricular competencies and the subject-specific competencies - may be combined in different ways and offer a wide range of learning situations (LS). To increase accessibility, facilitate localization and, ultimately, the sharing and re-use of learning situations, this paper initiates a reflection and proposes a specific application profile that is compliant with recent work intended to standardize the description of learning objects.

Key words: Knowledge management, Education, Competencies

1   INTRODUCTION

Over the last few years, important efforts have been undertaken to define standards in order to solve problems of description, indexing and classification of pedagogical resources. The prodigious increase of pedagogical resources available on the Web has led to the development of standards such as the IEEE LOM [2] or application profiles such as CanCore [1] in Canada and Normetic [4] in the province of Quebec.

The new Quebec education program gives four orientations that provide guidelines for the practical application of the program's aims:
- success for all,
- education that focuses on the development of competencies,
- evaluation that promotes learning,
- integrated learning.

Therefore, knowledge and skills are organized in terms of competencies and learning processes. The three main components of the program - the broad areas of learning, the cross-curricular competencies and the subject-specific competencies - may be combined in different ways and offer a wide range of learning situations. A learning situation (LS) is a complex set of activities that involve multiple competencies, concepts and skills.

Although it exists a minimal uniformity in educational material that are compliant with the new education program, and although there exists evaluation criteria to be approved by the ministry, the available resources do not always present the same elements and are not always structured in the same manner. The document, provided by the approval office of educational material "Évaluation des aspects pédagogiques du matériel didactique, enseignement primaire et secondaire"[1] [8], defines the criteria to evaluate the compliance of educational material with the development of the competencies. Nevertheless, during the analysis of existing learning situations, we observed that some of them introduce elements that are not well defined. This is the case for educational approaches, teaching strategies, means of evaluation, cultural indicators, exercises practice, necessary equipment, approximate length and class management. Often learning situations do not use the same vocabulary to describe similar things. For example, it is possible to find the three steps of the educational process (preparation, realization and integration) inside one of the activities of the LS or to find several activities inside a same step of the process.

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[1] Evaluation of the educational aspects of educational resource - elementary and secondary school education.

Currently, there is no consensus amongst the various LS designers to classify cross-curricular and subject-specific competencies and concepts. In this paper we initiate here a reflection on these problems and we propose a specialization of existing standards in order to solve this problem. The rest of this paper is organized as follows. In section 2 we briefly present the standards we use in our work. Section 3 details the solution we propose to model LS. Section 4 concludes and presents future work.

2   STANDARDS AND APPLICATION PROFILES

In this section, we introduce the standards LOM, IMS Content Packaging and IMS Learning Design that are used to describe learning objects, as well as the two application profiles CanCore and Normetic. An application profile consists of a subset of an existing standard that proposes the use of some of the descriptors. Guidelines complete the application profile by formulating usage rules and recommendations and by offering examples.

LOM

The IEEE LTSC has defined the IEEE LOM (Learning Object Metadata) [2] to allow standardized descriptions of learning objects. This standard has been widely disseminated and selected, amongst others, by GTN-Québec (Groupe québécois de travail sur les normes) to create the Normetic application profile.

IMS Content Packaging

IMS Content Packaging (IMS-CP) [6] proposes an information model to describe the exchange of instructional resources on the Internet. It suggests a set of structures to describe the various components of a resource, as well as interoperability between pedagogical resource design tools, instructional resource management systems and pedagogical resource execution systems.

IMS Learning Design

IMS Learning Design (IMS-LD) [5] proposes an information model to describe reference and exchange learning process specifications. More particularly, IMS-LD makes it possible to specify the competencies or objectives targeted by the process or its associated activities. In the context of our study, IMS-LD permits more refined LS descriptions by indicating the targeted competencies for each activity.

Cancore

CanCore [1] is an application profile used in Canada and designed to facilitate the search and localization of online instructional resources. It consists of a structured method to create and exchange high quality standardized metadata records that describe LOs. CanCore consists of a set of guidelines for the usage of the IEEE LOM 1484.12.1-2002 Standard.

Normetic

To facilitate a standardized description of French LOs, GTN-Québec has proposed the implementation of its Normetic [3] application profile, version 1.111 in the province of Quebec. This profile is based on the EEE LOM 2002 Standard.

3   THE LS APPLICATION PROFILE

In the context of the project "Sac d'école électronique" funded by the McConnel Foundation, we work on electronic tools to support students and teachers in their tasks. More specifically, we propose an LS application profile based on the Normetic v1.0 application profile, the IMS Content Packaging and IMS Learning Design standards. The LS profile specifies the elements of the LS information model.

In the LS application profile we propose, we define two different description levels: general description and detailed description. The LOM/Normetic version, corresponding to the first level, is suited for learning situations where activities are not described or learning situations for which details of activities are not desired. The main objective of this version is to document and index learning situations. The second level, the IMS-CP version, is defined to specify learning situations where the descriptions of learning activities are needed. This level targets the exchange of learning situations between pedagogical environments. Both levels are complementary and the second one, the IMS-CP version, integrates the first one, the LOM/Normetic version.

3-1   The LS LOM/Normetic Application Profile

A learning situation can be described by a set of characteristics, called attributes and by a set of links with the components of the new Quebec education program. These components are: subject areas and its subject-specific programs, broad area of learning, concepts, cross-curricular and subject-specific competencies, assessment criteria, and techniques or processes.

Attributes are well supported by the LOM/Normetic profile and Table 1 presents the LOM/Normetic descriptors used to encode the LS attributes.

Attributes	Descriptors
identifier	1–General : identifier / catalog / entry
title	1–General : title
author	2–LifeCycle : contribute
abstract	1–General : description
level and cycle	5–Pedagogy : context
duration	5–Pedagogy : typicalLearningTime
type	5–Pedagogy : learningResourceType
url	4–Technical : location
format	4–Technical : format

Table 1. Attributes Encoding

The LOM/Normetic standard proposes the use of the descriptor 9-Classification to specify categories in which the learning situation may be categorized. Therefore we use this descriptor to specify the links between the LS and the components of the education program. We detail below how each link may be represented.

Broad Area of Learning (BAL). The new Quebec education program defines five broad areas of learning: Environmental awareness and consumer rights and responsibilities, Citizenship and community life, Media Literacy, Personal and career planning, and Health and well-being.

We use the value `idea` for the descriptor `purpose` to specify the broad area of learning. The link to the broad area of learning is done by a hierarchical list of entries that are more and more precise. The first entry specifies that is a BAL. The second states the teaching level (elementary or secondary). The third entry gives the cycle (1, 2 or 3 for elementaty school; 1 or 2 for secondary school) and the last entry determines the BAL itself. We illustrate below how to encode the link to the BAL Health and Well-being. The path to the BAL is `Broad Area of Learning/Secondary/Cycle 1/Health and Well-Being`. In XML format the path is encoded by a list of `taxon` as illustrated below.

```
<classification>
  <purpose>
    <source>LOMv1.0</source>
    <value>idea</value>
  </purpose>
  <taxonPath>
    <source>
      <string>SAE-OWL http://www.matimtl.ca/sae/saeOWL.owl</string>
    </source>
    <taxon>
      <id>DGF</id>
      <entry>
        <string language="fr">Domaine général de formation</string>
        <string language="en">Broad Areas of Learning</string>
      </entry>
    </taxon>
    <taxon>
      <id>secondaire</id>
      <entry>
        <string language="fr">Secondaire</string>
        <string language="en">Secondary</string>
      </entry>
    </taxon>
    <taxon>
      <id>seccycle1</id>
      <entry>
        <string language="fr">Cycle 1</string>
        <string language="en">Cycle 1</string>
      </entry>
    </taxon>
    <taxon>
      <id>DGF1</id>
      <entry>
        <string language="fr">Santé et bien-être</string>
        <string language="en">Health and Well-Being</string>
```

```
        </entry>
      </taxon>
    </taxonPath>
  </classification>
```

Subject-specific Area.   The new program organizes content into five subject areas and more precisely into sixteen subject-specific areas as English, second language, History, Mathematics, Dance, etc.

We use the purpose value `discipline` to specify the subject-specific area. Subject areas are defined by a `taxonpath` and a `taxon` that refers to the LS information model. Below we give an example in XML that encodes the path `Science and Technology`.

```
<classification>
   <purpose>
     <source>LOMv1.0</source>
     <value>discipline</value>
   </purpose>
   <taxonPath>
     <source>SAE-OWL http://www.matimtl.ca/sae/saeOWL.owl</source>
     <taxon>
       <id>ScienceTechno</id>
       <entry>
         <string language="fr">Science et technologie</string>
         <string language="en">Science and Technology</string>
       </entry>
     </taxon>
   </taxonPath>
</classification>
```

Concepts.   Each subject-specific area has its own concepts that are studied. Encoding concepts associated with a LS is more complicated. In the program, concepts are organized in a three-level hierarchy : the first level is the major area (The Material World, The Living World, The Earth and space and The Technological World are the four major areas in Science and Technology) ; the second level is the General Concept (Properties and Changes are the general concepts of the major area The Material Word) ; the last level is the compulsory concept (Characteristic properties, Mass, Volume, Temperature, States of matter and Acidity/alkalinity are the compulsory concepts of the general concept Properties).

For each compulsory concept associated with a LS, in the category 9-Classification, we have a list of `taxon` to encode the level, the cycle, the specific-subject area, the major area, the general concept and the compulsory concept. For example, the path to acidity/alkalinity is `Contenu/Secondary/Cycle 1/Science and Technology/The material world/Properties/Acidity/alkalinity`.

Cross-Curricular and Subject-Specific Competencies.   The education program defines nine cross-curricular competencies and forty-eight subject-specific competencies for the cycle1 of secondary school. Links between the LS and the targeted competencies by the LS are encoded using the purpose value `competency` of the 9-Classification descriptor. For each competency, we specify the level, the cycle, the subject area for subject-specific competencies and the competency. For example, the path to the cross-curricular competency "Exercises critical judgment" is `Competency/Secondary/Cycle 1/Exercises critical judgment` and the full path to the subject-specific competency "Makes the most of his/her knowledge of science and technology" is `Competency/Secondary/Cycle 1/Science and Technology/Makes the most of his or her knowledge of science and technology`.

Assessment Criteria.   Assessment criteria depend on competencies being evaluated. We use the purpose value `competency` of the 9-Classification descriptor with the first entry: Evaluation Criteria. An example of a full path is `Evaluation Criteria/Secondary/Cycle 1/Science and Technology/Makes the most of his or her knowledge of science and technology/Formulation of Appropriate questions`.

Techniques or processes.   Techniques or processes will be encoded in category 9 - classification using the purpose value `idea`. An example of a full path to a mathematical process is `Techniques/Secondary/Cycle 1/Mathematics/Overall representation of a situation by means of a graph`.

3-2   The LS IMS-CP Profile

In the document presenting the IMS Learning Information Model [5], it is stated that the main function of the IMS Learning Design is to model learning units by integrating them into a "content package", preferably into an IMS Content Package.

We follow this recommendation and use IMS-CP to encapsulate the IMS-LD specification of complex learning situations as a unit of learning (see Figure 1).
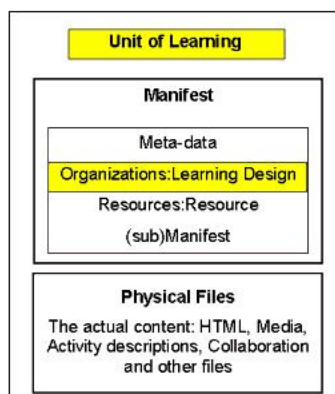
Figure 1. Structure of a learning unit - [5], Figure 2.4 page 13

The Global Structure. The specification is structured in two sections: `metadata` and `organizations`. The metadata section contains the LOM/Normetic description of the learning situation as described in the previous section. The Organizations section contains the IMS-LD description of the learning activities.

Activities of a situation. In the `learning-activity` tag of the `learning-design/activities` tag, we give details of each activity. Using the LS LOM/Normetic profile, we describe each activity (label, description, duration, targeted cross-curricular or subject-specific competencies, studied concepts and techniques or processes used).

Breaking Down Activity Components. The `activities/activity-structure` tag is used to specify the breakdown structure. In the example below, we present in XML the breakdown structure of Figure 2.
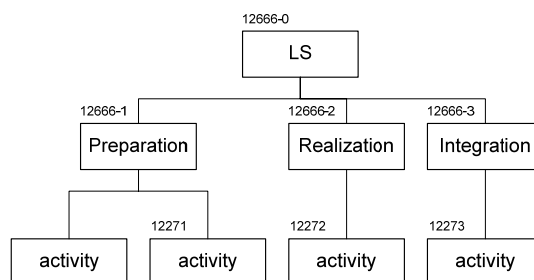

Figure 2. Learning Situation Breakdown

```
<imsld:activity-structure identifier="12266-1" sort="as-is" structure-type="sequence">
  <imsld:title>Preparation</imsld:title>
  <imsld:learning-activity-ref ref="12270" />
  <imsld:learning-activity-ref ref="12271" />
</imsld:activity-structure>
<imsld:activity-structure identifier="12266-2" sort="as-is" structure-type="sequence">
  <imsld:title>Realization</imsld:title>
  <imsld:learning-activity-ref ref="12272" />
</imsld:activity-structure>
<imsld:activity-structure identifier="12266-3" sort="as-is" structure-type="sequence">
  <imsld:title>Integration</imsld:title>
  <imsld:learning-activity-ref ref="12273" />
</imsld:activity-structure>
<imsld:activity-structure identifier="12266-0" sort="as-is" structure-type="sequence">
  <imsld:title>sae</imsld:title>
  <imsld:learning-activity-ref ref="12266-1" />
  <imsld:learning-activity-ref ref="12266-2" />
  <imsld:learning-activity-ref ref="12266-3" />
</imsld:activity-structure>
```

The Situation-Structure Link. Finally, the link between the situation and the structure of activities is done in the `learning-design/method` tag.

4   CONCLUSION

The new Quebec educational program led to the creation of numerous learning situations (LS). In this period of implementation of the new program, finding, using and sharing LS become very important and will benefit significantly from a concerted standardization effort.

This paper contributes to this normalization effort by proposing a LS application profile [3] that combines various standards and specifications. We developed a simplified version of LS application profile using LOM/Normetic standards and a complete version using IMS-CP/IMS-LD standards.

However, implementing an operational application profile requires much more work. Aside from modifying and detailing the LS model, numerous mandatory steps will need to be addressed. More specifically, the reform vocabulary must be studied closely (subject-specific competencies, concepts, etc.) and online catalogues must be set up to inventory the domains, the subjects, the concepts, the processes and techniques. This normalization process generated by all interested parties in secondary schools can lead to LS design environments adapted to local practices, yet be freely available through search engines adapted to the LS application profile, for the purposes of sharing and collaboration.

5   ACKNOWLEDGEMENTS

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