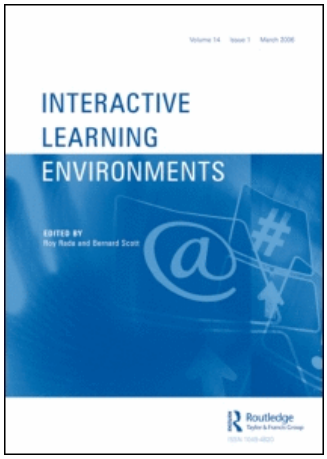

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Developing a Common Metadata Model for Competencies Description

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Competence-based approaches are frequently adopted as the key paradigm in both formal or non-formal education and training. To support the provision of competence-based learning services, it is necessary to be able to maintain a record of an individual's competences in a persistent and standard way. In this paper, we investigate potential issues related with the definition of a common metadata model for competencies description. This is done by applying the current state-of-the-art specification, IMS Reusable Definition of Competency or Educational Objective (IMS RDCEO), in a real case study, that is, the EuroPass Language Passport. We, then, identify four open issues with the description capabilities of the IMS RDCEO specification, and propose possible extensions to its information model, demonstrating their application in practice.

Introduction

Competence-based approaches are frequently adopted as the key paradigm in both formal or non-formal education and training and appear to offer the opportunity to develop programmes that meet the needs of both learners and potential employers (Aspin & Chapman, 2000; Field, 2001; Gonczi, 2000; Koper & Tattersall, 2004; Lucia & Lepsinger, 1999). Competence is defined as the integrated application of knowledge, skills, values, experience, contacts, external knowledge resources and tools to solve a problem, to perform an activity, or to handle a situation (Friesen & Anderson, 2004; Sandberg, 2000). Among other things, supporting competence-based learning services requires maintaining a record of an individual's competences in a persistent and standard way (Griffin, 1999; Williamson, Bannister, & Schauder, 2003). Therefore, a common agreed model for describing competencies is essential (CEN/ISSS CWA15455, 2005).

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In this paper, we investigate potential issues related with the definition of a common metadata model for competencies description. This is done by applying the current state-of-the-art specification, IMS Reusable Definition of Competency or Educational Objective (IMS RDCEO), in a real case study, that is, the EuroPass Language Passport. We then identify four open issues with the description capabilities of the IMS RDCEO specification, and propose possible extensions to its information model, demonstrating their application in practice.

Open Issues Related with the Existing Competencies Description Models

In order to support and use effectively the link between competence and education, there is a need to provide commonly agreed definitions of competences that can be re-used, across the different systems (CEN/ISSS CWA15455, 2005). Description models for competencies, such as the IEEE Reusable Competency Definition (IEEE RCD) (IEEE P1484.20/D01, 2004) and the IMS RDCEO (2002) specification, are starting to provide a solution to this problem.

The IMS RDCEO specification defines an information model for describing, referencing, and exchanging definitions of competencies, primarily in the context of online and distributed learning. This specification, aims to provide the means for formally representing the key characteristics of a competency, independently from its use in a particular context. Hence, it aims to guarantee interoperability among e-training systems that deal with competency information, by allowing them to refer to common definitions of competencies with commonly recognized categories. However, the IEEE RCD specification describes a competency definition as used in a learning management system or referenced in a competency profile, by making direct reference of the IMS RDCEO specification.

Based on the description capacity of the IMS RDCEO specification, we have identified the following open issues:

(a) *How to represent the level of a competency?* The IMS-RDCEO specification supports the representation of a competency level, within the element ''title''. The information stored within this element is in a narrative format without a pre-defined commonly identifiable vocabulary. Thus, it is not machine understandable and limits the scope of interoperability among different systems.

(b) *How to represent the grading scale of a competency?* The IMS-RDCEO specification does not provide a way to represent the ''grading scale'' of a competency. Thus, it provides limited support for the assessment of competencies. Competencies must be measurable in order to be quantified for a given purpose. A grading scale may be used for direct assessment of performance and/or may be used to report an examination result.

(c) *How to represent the success threshold of a competency?* The IMS RDCEO specification does not support the definition of a ''success threshold'' for a competency. Therefore, a learning system cannot interpret the existence of a competency or not. The success threshold is a criterion that must be

accomplished in order to confirm the existence of a competency (that is, an educational degree may be evidence of a competency) (Simms & Erickson, 2003).

(d) *How to describe complex competencies in an interoperable way?* The IMS RDCEO already supports the definition of complex competencies (that is, any competency consisting of other—simple or complex—competencies) through the use of the element ''metadata/relation''. However, it does not provide a way to represent the weighting factors of sub-competencies when assessing a complex one, assuming that all sub-competences are equally important. Since this is not always the case, it means that eventually IMS RDCEO provides limited support for the assessment of complex competencies.

The Case Study of Europass Language Passport

The Europass Language Passport, a European common model for language competencies, was developed by the Council of Europe as part of the European Language Portfolio (European Commission, 2000). It supports the definition of individuals' language skills on a six-level scale and it was designed to enhance the motivation of language learners to improve their ability to communicate in different languages and to pursue new learning and intercultural experiences (European Commission, 2001).

The EuroPass Language Passport defines a competency ontology consisting of five simple competencies and three complex competencies. Each of these competencies is associated (directly or indirectly) with a list of language topics (see Figure 1).

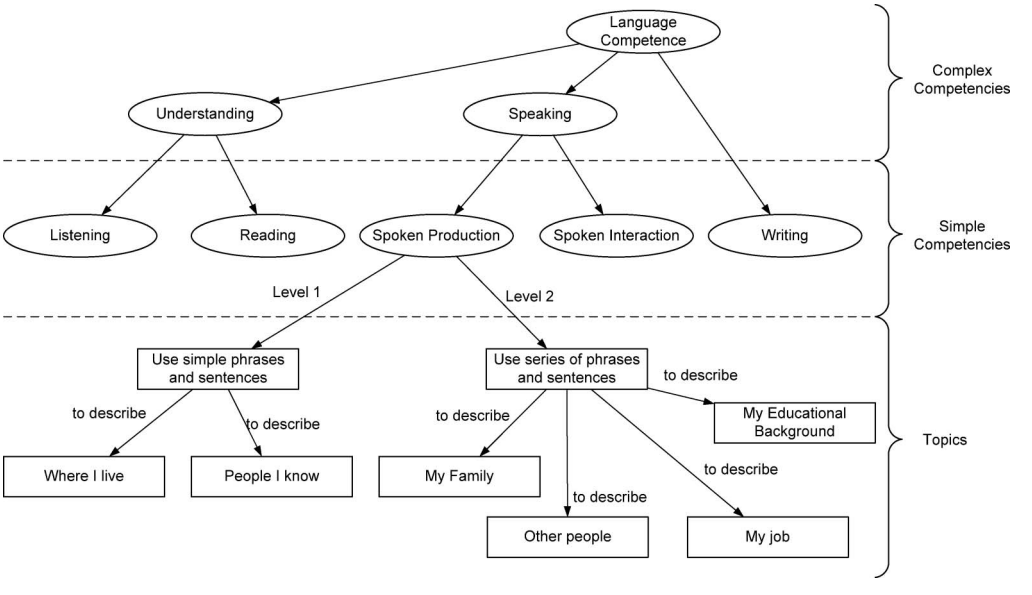

Figure 1. Partial view of the competency ontology used in the Europass Language Passport

In this paper, we use the Europass Language Passport as a case study of the open issues recognized in the previous section. For each open issue, we provide an example of the existing support that the IMS RDCEO specification offers, we present our extension proposal and demonstrate its use in practice.

How to Represent the Level of a Competency?

The Europass Language Passport defines common reference levels for the description of language proficiency levels based on a six-level scale derived from the Common European Framework of Reference for Languages (European Commission, 2001). These levels are: level A1 and A2 for basic users, level B1 and B2 for independent users and level C1 and C2 for proficient users. The example below illustrates the use of IMS RDCEO specification in expressing A1 Level of the Reading Language Skill.

```
<title>
  <langstring xml:lang=''en'' >European A1 Reading Language
Skill</langstring>
</title>
<description>
  <langstring xml:lang=''en'' >Can understand familiar names,
words and very simple sentences, for example on notices and
posters or in catalogues</langstring>
</description>
```

As it is shown, the IMS RDCEO specification allows the description of the proficiency level via the element ''title'', which does not discriminate the narrative description of the name (that is, ''Proficiency in written and spoken English and use of English for meaningful oral or written expression.'') from the level of the described competency (that is, ''A1 level''). We propose that a possible solution to this problem is the addition of two new elements, namely, the element ''level'' and the element ''value'', under the element ''description'' of the IMS RDCEO specification. The element ''description/level'' aims to provide the space for describing the level of the competency and the ''description/value'' element aims to provide the space for the narrative description of the competency. The proposed new elements are depicted in Table 1.

Following the proposed extensions, the earlier mentioned example of expressing A1 Level of the Reading Language Skill takes the following form:

```
<title>
  <langstring  xml:lang=''en'' >European  Reading  Language
Skill</langstring>
</title>
<description>
  <value>
```

Table 1. Representing the level of a competency: application to the Europass Language Passport

No.	Name	Explanation	Required	Mult	Value space	Datatype	Notes
3	Description	Description of the competency or educational objective	O	Single			
3.1	Value	The actual description of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "Proficiency in written and spoken English and use of English for meaningful oral or written expression."
3.2	Level	The proficiency level of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "A1 Level"

*Elements with type "LangString" and multiplicity "single" must appear at most once per language but may appear multiple times with different language attributes. The smallest permitted maximum of such expressions of a LangString is 10.

```
    <langstring xml:lang=''en''>Can understand familiar
names, words and very simple sentences, for example on notices
and posters or in catalogues</langstring>
  </value>
  <level>
    <langstring xml:lang=''en''>A1 Level</langstring>
  </level>
</description>
```

How to Represent the Grading Scale of a Competency?

The Europass Language Passport also defines grading scales for the earlier mentioned common reference competency levels, to support the assessment of each language proficiency level. This numeric scale takes values from 1 to 10. The example later illustrates the use of IMS RDCEO specification in describing A2 Spoken Production Language Skill.

```
<title>
  <langstring xml:lang=''en''>European A2 Spoken Production
Language Skill</langstring>
</title>
<description>
  <langstring xml:lang=''en''>Can use a series of phrases and
sentences to describe in simple terms my family and other people,
living conditions, my educational background and my present or
most recent job</langstring>
</description>
```

As it is shown, the IMS RDCEO specification does not allow the definition of the grading scale of a competency. A possible solution to this problem is the addition of a new element, namely, the element ''scale'', under the element ''description'' of the IMS RDCEO specification. We propose that this new element could consist of two sub-elements, namely, the sub-element ''minvalue'' that represents the minimum value of the scale and the sub-element ''maxvalue'' that represents the maximum value of the scale. The proposed new elements are depicted in Table 2.

Following the proposed extensions the earlier mentioned example of expressing A2 Spoken Production Language Skill takes the following form for the scale taking values from 1 to 10:

```
<title>
  <langstring xml:lang=''en''>European Spoken Production
Language Skill</langstring>
</title>
```

Table 2. Representing the grading scale of a competency: application to the Europass Language Passport

No.	Name	Explanation	Required	Mult	Value space	Datatype	Notes
3	Description	Description of the competency or educational objective	O	Single			
3.1	Value	The actual description of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "Proficiency in written and spoken English and use of English for meaningful oral or written expression."
3.2	Level	The proficiency level of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "A1 Level"
3.3	Scale	The grading scale of the competency's level	O	Single			
3.3.1	Minvalue	The minimum value of the scale	O	Single		#PCDATA Integer in the range 1 to 100	Example: "1"
3.3.2	Maxvalue	The maximum value of the scale	O	Single		#PCDATA Integer in the range 1 to 100	Example: "10"

*Elements with type "LangString" and multiplicity "single" must appear at most once per language but may appear multiple times with different language attributes. The smallest permitted maximum of such expressions of a LangString is 10.

```
<description>
  <value>
    <langstring xml:lang=''en'' >Can use a series of phrases and
    sentences to describe in simple terms my family and other
    people, living conditions, my educational background and my
    present or most recent job</langstring>
  </value>
  <level>
    <langstring xml:lang=''en'' >A2 Level</langstring>
  </level>
  <scale>
    <minvalue>1</minvalue>
    <maxvalue>10</maxvalue>
  </scale>
</description>
```

How to Represent the Success Threshold of a Competency?

As it was already mentioned, the Europass Language Passport defines a grading scale from 1 to 10 for each language proficiency level recognized. Additionally, a threshold that indicates the existence of the relevant competency is also defined. In the Europass Language Passport, this threshold has been defined as equal to 3. Again the IMS RDCEO specification does not allow the definition of the success threshold of a competency. We propose that the possible solution to this problem is the addition of a new element, namely, the element ''threshold'', under the element ''description'' of the IMS RDCEO specification. The proposed new elements are depicted in Table 3.

Following the proposed extensions, we provide later an example of expressing A1 Writing Language Skill with scale taking values from 1 to 10 and threshold defined equal to 3.

```
<title>
  <langstring xml:lang=''en'' >European Writing Language
Skill</langstring>
</title>
<description>
  <value>
    <langstring xml:lang=''en'' >Can write a short, simple
postcard, for example sending holiday greetings. Can fill in
forms with personal details, for example entering my
name, nationality and address on a hotel registration form
</langstring>
  </value>
  <level>
    <langstring xml:lang=''en'' >A1 Level</langstring>
```

Table 3. Representing the success threshold of a competency: application to the Europass Language Passport

No.	Name	Explanation	Required	Mult	Value space	Datatype	Notes
3	Description	Description of the competency or educational objective	O	Single			
3.1	Value	The actual description of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "Proficiency in written and spoken English and use of English for meaningful oral or written expression."
3.2	Level	The proficiency level of the competency or educational objective	O	Single*		LangString (smallest permitted maximum: 2000 characters)	Example: "A1 Level"
3.3	Scale	The grading scale of the competency's level	O	Single			
3.3.1	Minvalue	The minimum value of the scale	O	Single		#PCDATA Integer in the range 1 to 100	Example: "1"
3.3.2	Maxvalue	The maximum value of the scale	O	Single		#PCDATA Integer in the range 1 to 100	Example: "10"
3.3.3	Threshold	The value of the scale	O	Single		#PCDATA Integer in the range 1 to 100	Example: "5"

*Elements with type "LangString" and multiplicity "single" must appear at most once per language but may appear multiple times with different language attributes. The smallest permitted maximum of such expressions of a LangString is 10.

```
    </level>
    <scale>
      <minvalue>1</minvalue>
      <maxvalue>10</maxvalue>
    </scale>
    <threshold>3</threshold>
  </description>
```

How to Describe Complex Competencies in an Interoperable Way?

The IMS RDCEO already supports the definition of complex competencies through the use of the element ''Metadata/Relation''. However, it does not provide a way to represent the weighting factor (importance) of sub-competencies when assessing a complex one. A possible solution to this problem is the addition of a new element, namely, the element ''weight'', under the sub-element ''Metadata/Relation/Kind'' of the IMS RDCEO specification. This element represents the weighting factor (that is, the importance) of a specific competency when it is aggregated within a more complex one. The proposed extension is depicted in Table 4.

The example later illustrates the use of the proposed extensions of the IMS RDCEO specification in describing ''Understanding'' competency as a synthesis of ''Listening'' and ''Reading'' competencies (see also Figure 1). In this example, the importance of listening skill is defined equal to 0.4 in a scale from 0 to 1 and the importance of reading skill is defined equal to 0.6 in the same scale.

```
<title>
  <langstring xml:lang=''en''>European Understanding
Language Skills</langstring>
</title>
<description>
  <langstring xml:lang=''en''> ..... </langstring>
</description>
<definition>
  <model>http://culture2.coe.int/portfolio/documents/
  0521803136txt.pdf</model>
  <statement statementid=''1'' statementname=''Content
  Area''>
    <statementtext>
      <langstring xml:lang=''en''>Language Skills
      </langstring>
    </statementtext>
  </statement>
</definition>
<metadata>
  <rdceoschema>IMS RDCEO</rdceoschema>
```

Table 4. Describing complex competencies: application to the Europass Language Passport

No.	Name	Explanation	Required	Mult	Value space	Datatype	Notes
	{Additional Metadata}	Additional embedded Metadata describing this RDCEO	O	Multiple	The information contained in this section is defined by the IMS Metadata specification	Smallest permitted maximum: 10	See Best Practice document guidance for Metadata records
7	Relation	This category defines the relationship between this competency and the "child" competencies, if any	O	Multiple		Smallest permitted maximum: 100 items	
7.1	Kind	Nature of the relationship between this competency and the "child" competencies	O	Single	Consists of is part of	Vocabulary	
7.2	Weight	The importance of the "child" competency	O	Single		#PCDATA Float in the range 0 to 1	Example: "0.7"

```
<rdceoschemaversion>1.0</rdceoschemaversion>
<lom>
  <relation>
    <kind>
      <source>LOM v1.0</source>
      <value>Consists of</value>
    </kind>
    <weight>0,4</weight>
    <resource>
      <identifier>
        <catalog>URL</catalog>
        <entry> ..............................</entry>
      </identifier>
      <description>
        <langstring   xml:lang=''en'' >European   Listening
           Language Skill</langstring>
      </description>
    </resource>
  </relation>
  <relation>
    <kind>
      <source>LOM v1.0</source>
      <value>Consists of</value>
    </kind>
    <weight>0,6</weight>
    <resource>
      <identifier>
        <catalog>URL</catalog>
        <entry> ..............................</entry>
      </identifier>
      <description>
        <langstring    xml:lang=''en'' >European    Reading
    Language Skill</langstring>
      </description>
    </resource>
  </relation>
```

Conclusion

In this paper, we investigated potential issues related with the definition of a common metadata model for competencies description. This was done by applying the current state-of-the-art specification, IMS RDCEO for Reusable Competencies Definition, in a real case study, that is, the EuroPass Language Passport. We then identified four

open issues with the description capabilities of the IMS RDCEO specification, and proposed possible extensions to its information model, demonstrating their application in practice.

Future work, includes the application of the proposed extensions of the IMS RCDEO specification in the description of other competence models (that is, the EuroPass Curriculum Vitae), so as to verify the generality of the proposed extensions. Additionally, in our future work we will investigate how other models than the competency ones (that is, human resources description models, such as HR-XML (2006)) could contribute towards defining a common metadata model for competencies.

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