CHAPTER 3

eLearning Metadata Standards

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- Why Standards
- Types of Standards
- eLearning Content Metadata Standards and Specifications
- Mapping between Dublin Core and IEEE LOM
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3.1 Introduction

Standards can be defined as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose" [1].

An important part of the standardization process is the development of "specifications." Specifications can be said to represent standards early in their development, prior to receiving approval from standard bodies, and they tend to be experimental, incomplete and more rapidly evolving [2]. They capture a rough consensus, and are meant to enable technology development and the management of short-term risk. Standards, on the other hand, are much more conclusive, complete, and evolve much more slowly. They should capture general acceptance, can serve regulatory purposes, and be used to manage long-term risk [2].

In the context of eLearning technology, “standards are generally developed to be used in systems design and implementation for the purposes of ensuring interoperability, portability and reusability. These attributes should apply to both the systems themselves and of the content and metadata they manage. eLearning standards produce better learning, education, and training – which [will have] a positive effect upon all societies" [3].

The major organizations contributed to the development of eLearning standards are,

1. IMS Global Learning Consortium (www.imsproject.org)
2. IEEE LTSC (www.ltsc.ieee.org)
3. AICC (www.aicc.org)
4. ADL (www.adlnet.org)
5. CEN/ISSS
   (http://www.cen.eu/cenorm/businessdomains/businessdomains/isson/about_isss/index.asp)
The other organizations include ANSI (American National Standards Institute), NISO (National Information Standards Organization), DIN (Deutsches Institut für Normung), BSI (British Standards Institute), and the CSA (Canadian Standards Association) also are important milestones in context of eLearning standards. [4]

3.2 Why Standards
The goal of standards is to provide consistency in data structures and communication protocols for eLearning objects and cross-system workflows. In eLearning, standards help in achieving:

1. Interoperability
2. Re-usability
3. Manageability
4. Accessibility
5. Durability

3.3 Types of Standards
Most of the eLearning standards can be grouped into three, such as, [5]:

1. Metadata: Metadata is central and crucial in eLearning systems. Learning content and services must be catalogued in a consistent way to support the indexing, storage, discovery (search), and retrieval of learning objects by multiple tools across multiple repositories. The most widely acknowledged learning metadata standard is Learning Object Metadata (LOM), by IEEE - LTSC.

2. Content Packaging: The goal of content packaging specifications and standards is to enable organizations to transfer courses and content from one learning system to another. e.g., IMS Content Packaging Specification.

3. Learners Profile: Allow different system components to share information about learners across multiple system components. It includes personal data, learning plans, learning history, accessibility requirements, certifications and degrees, assessments of knowledge
(skills/competencies). Also systems need to communicate learner data to the content, such as scores or completion status.

In the following sections we discuss the eLearning content metadata standards and learner profile standards.

3.4 eLearning Content Metadata Standards and Specifications

Compared to traditional learning in which the instructor plays an intermediate role between the learner and the learning material, the learning scenario in eLearning is completely different: instructors no longer control the delivery of material and learners have a possibility to combine learning material in courses on their own. So the content of learning material must stand on its own. However, regardless of the time or expense put into creating advanced training material the content is useless unless it can be searched and indexed easily. This is especially true as the volume and types of learning content increase [6].

The most possible solution to the above stated problem is metadata. Metadata is the Internet-age term for information that librarians traditionally have used to classify books and other print documents. At its most basic level, metadata provides a common set of tags that can be applied to any resource, regardless of who created it, what tools they used, or where it is stored. Tags are, in essence, data describing data. Metadata tagging enables organizations to describe, index, and search resources and it is essential for reusing them. Metadata is used to structure and annotate data, which can then be easily reused, transformed, accessed, etc., in order to serve information on demand.

In general, metadata is set of structured data about data and it allows access at more granular levels. For example, instead of expecting a full text search engine to find the author’s name “John” over a learning resource, the resource can be annotated with a metadata description “author: John” which is conceivable. But at the same time this method holds two major
difficulties, such as, the technical realisation of attaching metadata to a resource and the standardisation of descriptions. Standardization is necessary to avoid misunderstanding created due to assigning different attributes for the same objective, for example, "author: John", "writer: John" or "creator: John”.

Different communities have developed their own standardized metadata vocabularies to meet specific needs. However, most of those metadata standards lack a formal semantics. Although the standards enable interoperability within domains, they introduce the problem of incompatibility between disparate and heterogeneous metadata descriptions or schemas across domains. At present several widely implemented eLearning metadata standards exist including IEEE Learning Object Metadata (LOM), IMS Learning Resource Meta-data, Universal Learning Format, etc.

3.4.1 Dublin Core (DC)
Dublin Core is established by Dublin Core Metadata Initiative (DCMI) to describe all kinds of web-based resources [7]. It is a group that promotes the adoption of interoperable metadata standards across a wide range of application domains and disciplines. It is true that almost all the existing learning object metadata standards use DC as a basis and then extend it with more specialized elements.

In 1999 the Dublin Core Education Working Group [8] emerged as one of several special interest groups with the objective to discuss and develop a proposal for the use of Dublin Core metadata in the description of education resources [9]. The work plan of 2002-2003 included the development of an IEEE LTSC LOM and DCMI application profile and vocabulary development.

Dublin core metadata standard consists of fifteen core elements, such as,

1. Title: A name given to the resource
2. **Creator**: An entity primarily responsible for making the resource
3. **Contributor**: An entity responsible for making contributions to the resource
4. **Subject**: The topic of the resource
5. **Publisher**: An entity responsible for making the resource available
6. **Date**: A point or period of time associated with an event in the lifecycle of the resource
7. **Type**: The nature or genre of the resource
8. **Coverage**: The spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant
9. **Description**: An account of the resource
10. **Format**: The file format, physical medium, or dimensions of the resource
11. **Identifier**: An unambiguous reference to the resource within a given context
12. **Language**: A language of the resource
13. **Relation**: A related resource
14. **Rights**: Information about rights held in and over the resource
15. **Source**: A related resource from which the described resource is derived

Dublin Core also allows more complex and precise metadata descriptions. It has a set of qualifiers enlisted in [10]. Qualifiers are used to refine a DC element’s semantics in order to make it more suitable for the application context. For example, the qualifier "educationLevel" of element "Audience" is to give additional and more specific information about the audience to whom the resource is most useful. Another use of qualifiers is to identify the encoding schemas that contain controlled vocabularies to which the possible values of some metadata element will be restricted. This helps in implementing standards with regard to data in different elements.
Example:
The following example is an excerpt from the document ontology which shows the DC OWL binding.

```
<rdf:RDF
    xmlns="http://localhost/doc-onto#"
    xml:base="http://localhost/doc-onto"
    xmlns:xsd=http://www.w3.org/2001/XMLSchema#
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xmlns:dcterms="http://purl.org/dc/terms/#"
    xmlns:dc="http://purl.org/dc/elements/1.1/#">
  <owl:Class rdf:ID="Atom">
    ....................
  </owl:Class>
  ....................
  <Atom rdf:ID="Atom_1">
    <dc:title xml:lang="en"
      >Pre-coordinate indexing system</dc:title>
    <dc:creator rdf:resource="#Kiran_Majumder"/>
    dcterms:educationLevel rdf:resource="#Undergraduate"/>
    <dc:language rdf:resource="#eng"/>
    dc:subject rdf:resource="&dom;Pre-coordinate_indexing"/>
    ....................
  </Atom>
  ....................
</rdf:RDF>
```

In the above table, following the `<rdf:RDF>` element, the XML namespaces are declared (XML Namespace, RDF, OWL are separately discussed in chapter 4). These declarations specify that all tags in this content prefixed by for example, with `<rdf:` is part of the namespace identified by the URIRef, http://www.w3.org/1999/02/22-rdf-syntax-ns#. The same is applicable for others, such as, for `<rdfs:`, `<dc:`, `<dcterms:`, `<owl:`, etc. as well. It is worth to mention that, the following namespaces are common for other examples provided for other metadata standards and OWL binding in this chapter in
the succeeding sections. So, these namespaces are not mentioned further, in other examples, but they are used.

\[
\text{xmlns:xsd} = \text{http://www.w3.org/2001/XMLSchema#} \\
\text{xmlns:rdf} = \text{http://www.w3.org/1999/02/22-rdf-syntax-ns#} \\
\text{xmlns:rdfs} = \text{http://www.w3.org/2000/01/rdf-schema#} \\
\text{xmlns:owl} = \text{http://www.w3.org/2002/07/owl#}
\]

In the above example, the use of \textit{rdf:ID} specifies a fragment identifier, given by the value of the \textit{rdf:ID} attribute, \textit{Atom}_1, is an abbreviation of the complete URIref of the resource being described. The fragment identifier \textit{Atom}_1 will be interpreted relative to a base URI. The full URIref is formed by taking the base URI, and appending the character "#" (to indicate that what follows is a fragment identifier) and then \textit{Atom}_1 to it, giving the absolute URIref http://localhost/doc-onto#Atom_1. The above excerpt can be represented using the following figure.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{dc_owl_binding.png}
\caption{DC OWL binding}
\end{figure}

The figure shows that, \textit{Atom}_1 is an instance of class \textit{Atom}. \textit{rdf:type} is an RDF property that ties an individual to a class of which it is a member. The ellipses are represents the properties value (\textit{dc:creator}, \textit{dcterms:educationLevel}, \textit{dc:language}, \textit{dc:subject}) of \textit{Atom}_1 written using the \textit{rdf:resource} attribute. The \textit{rdf:resource} attribute indicates that the
property element's value is another resource, identified by its URIRef, http://localhost/doc-onto. dc:title represent the predicate and the value of it is the object of the statement. The content of this property element is the object of the statement, the plain literal “Pre-coordinate indexing”.

3.4.2 IMS Learning Resource Metadata

In 1997, the IMS Project, part of the non-profit EDUCOM consortium (now EDUCAUSE) of US institutions of higher education and their vendor partners, established an effort to develop open, market-based standards for online learning, including specifications for learning content metadata. Also in 1997, groups within the National Institute for Standards and Technology (NIST) and the IEEE P.1484 study group IEEE- LTSC (Learning Technology Standards Committee) began similar efforts. The NIST effort merged with the IMS effort, and IMS began collaborating with the ARIADNE Project, a European Project with an active meta-data definition effort. In 1998, IMS and ARIADNE submitted a joint proposal and specification to IEEE, which formed the basis for the IEEE Learning Object Meta-Data (LOM) Draft Standard [11].

IMS has two primary goals, such as,

1. Defining the technical specifications for interoperability of applications and services in distributed learning; and
2. Supporting the incorporation of the IMS specifications into products and services worldwide.

IMS is involved in the development and promotion of “open specifications for facilitating online distributed learning activities such as locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems”. IMS produces a suite of specifications, including a metadata specification and a content packaging specification.
3.4.3 IEEE LOM

Among the eLearning metadata standards the most popular one is IEEE Learning Object Metadata (LOM) (also known as IMS Learning Resource Meta-data) published by the Institute of Electrical and Electronics Engineers (IEEE) in 2002 supersedes the IMS Learning Resource Metadata specification [12], which had been developed and used through several versions since the mid-1990s. The LOM standard mainly builds on the Dublin Core and is based on the recommendations of IMS and ARIADNE project. LOM metadata specification forms the basis of almost all existing implementations of metadata specifications for learning objects [13].

The purpose of the IEEE LOM is to facilitate acquisition, search, evaluation and use of learning objects. It is intended to facilitate the sharing and exchange of learning objects by enabling the development of catalogs and inventories while taking into account the diversity of cultural and lingual contexts in which the learning objects and their metadata are reused [30]. Learning objects are defined as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Learning objects include, multimedia content, instructional content, learning objectives, instructional software and software tools, persons, organizations, or events referenced during technology supported learning.

The purposes of LOM are as follows [14],

1. To enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects.
2. To enable the sharing and exchange of Learning Objects across different technology supported learning systems.
3. To enable the development of learning objects into units that can be combined and decomposed in meaningful ways.
4. To enable computer agents to automatically and dynamically compose personalized lessons for an individual learner.
5. To compliment the direct work on standards that are focused on enabling multiple Learning Objects to work together within an open distributed learning environment.

6. To enable, where desired, the documentation and recognition of the completion of existing or new learning & performance objectives associated with Learning Objects.

7. To enable a strong and growing economy for Learning Objects that supports and sustains all forms of distribution; non-profit, not-for-profit and for profit.

8. To enable education, training and learning organizations, government, public and private, to express educational content and performance standards in a standardized format that is independent of the content itself.

9. To provide researchers with standards that support the collection and sharing of comparable data concerning the applicability and effectiveness of Learning Objects.

10. To define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied.

11. To support necessary security and authentication for the distribution and use of Learning Objects.

IEEE LOM Draft standard defines a set of meta-data elements that can be used to describe learning resources. LOM includes [31],

1. element names;
2. definitions;
3. data types; and
4. field lengths.

LOM generally comprises a hierarchy of elements. At the first level, there are nine categories, each of which contains sub-elements; these sub-elements may be simple elements that hold data, or may themselves be aggregate elements, which contain further sub-elements. The
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semantics of an element are determined by its context. They are affected by the parent or container element in the hierarchy and by other elements in the same container. The following figure 3.2 shows a schematic representation of hierarchy elements in the LOM data model [15].

Figure 3.2: Schematic representation of LOM data model

Example:
A small excerpt from document ontology is showing the IEEE LOM OWL binding.
The above excerpt can be represented in a graphical form as shown below.

![IEEE LOM OWL binding](image-url)

**Figure 3.3: IEEE LOM OWL binding**
Here, \textit{CU\_71\_doc} is an instance of class \textit{Text} which is expressed using RDF property \textit{rdf:type}. \textit{rdf:type} ties an individual to a class of which it is a member. The value of the predicate, \textit{lom-tech:location} is the object of a statement. The content of this property element is the object of the statement, the plain literals. The value for the predicate \textit{lom-tech:format}, \textit{lom-edu:difficulty}, \textit{lom-edu:intendedEndUserRole} provided using the \textit{rdf:resource} attribute. The \textit{rdf:resource} attribute indicates that the property element's value is another resource, identified by its URIref, http://localhost/doc-onto.

3.4.4 Sharable Content Object Reference Model (SCORM) - 2004 (3rd Edition)
SCORM, the Sharable Content Object Reference Model is a set of standards and specifications for web-based eLearning software. SCORM was proposed in 2003 by Advanced Distributed Learning (ADL) initiative. It is a model that references and integrates a set of interrelated technical standards, specifications and guidelines designed to meet ADL’s functional requirements, such as, accessibility, interoperability, durability and reusability for learning content and systems. It aims to foster the creation of reusable learning content as "instructional objects” within a common technical framework for computer-based and Web-based learning. SCORM describes the technical framework by providing a harmonized set of guidelines, specifications and standards within a single reference model based on the work of the following eLearning specifications and standards bodies to specify consistent implementations that can be used across the eLearning community [25].

1. Alliance of Remote Instructional Authoring & Distribution Networks for Europe (ARIADNE) (http://www.ariadne-eu.org/)
2. Aviation Industry CBT Committee (AICC) (http://www.aicc.org/)
3. Institute of Electrical and Electronics Engineers (IEEE) Learning Technology Standards Committee (LTSC) (http://ieeeltsc.org/)
ADL continues to work with the above organizations to develop those specifications and standards. The role of ADL includes:

1. Contributing technical ideas and concepts
2. Integrating and testing these specifications, standards and derivative works
3. Helping to bridge the gap between initial development and ultimate adoption by industry.

SCORM defines communication between client and run-time environment, and specifies format of ZIP packages into which content may be packed. SCROM specification is divided into three basic parts:

1. Run-time Environment (RTE)
2. Sequencing and Navigation (SN)
3. Content Aggregation Model (CAM)

“Content Aggregation Model” and a “Run-Time Environment” for instructional objects to support adaptive instruction based on a learner's goals, preferences, prior performance and other factors. The “Sequencing and Navigation” model for the dynamic presentation of content based on learner needs.
3.4.5 Universal Learning Format (ULF)

Universal Learning Format, a set of XML-based formats for capturing various types of eLearning data, including content, catalog, certification, competency, and learner profile information developed (Figure 3.5) by Saba Software (http://www.saba.com/).

![Universal Learning Format Diagram](image)

It is intended for use by authors and integrators of learning-based resources to describe learning data in a format that allows universal portability. The formats comprising Universal Learning Format are based on and can be mapped (using style sheets) to and from IMS, ADL, IEEE LTSC, Dublin...
Core, vCard and other specifications. This standard is based upon the philosophy of open standards.

### 3.5 Mapping between Dublin Core and IEEE LOM

The following Table 1 shows a mapping of IEEE Learning Object Metadata (LOM) elements to the unqualified Dublin Core elements with explanations [17, 18].

<table>
<thead>
<tr>
<th>Dublin Core #</th>
<th>Dublin Core Name</th>
<th>Dublin Core Label</th>
<th>IEEE Learning Object Metadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Title</td>
<td>TITLE</td>
<td>general.title</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The name given to the resource by the CREATOR or PUBLISHER.</td>
</tr>
<tr>
<td>2</td>
<td>Creator</td>
<td>CREATOR</td>
<td>lifecycle.contribute.entity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>when lifecycle.contribute.role has a value of &quot;Author&quot;.</td>
</tr>
<tr>
<td></td>
<td>Subject</td>
<td>SUBJECT</td>
<td>general.keywords.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“classification” category could be used when the purpose equals &quot;Discipline (or Idea)&quot;. “classification” has elements for description, keywords, and taxonpath(s) that are specific for the</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Subject**

Subject generally expressed as keywords or phrases that describe the subject or content of the resource. The use of controlled vocabularies and formal classification schemas is encouraged.

**Description**

A textual description of the content of the resource, including abstracts in the case of document-like objects or content descriptions in the case of visual resources.

**Publisher**

The entity responsible for making the resource available in its present form, such as a publishing house, a university department, or a corporate entity.

**Other Contributor**

A person or organization not specified in a CREATOR element, who has made a significant intellectual contributions to the resource but whose contribution is secondary one (for example, editor, illustrator, second author and so forth) to any person or organization specified in a CREATOR element.

**Date**

The date of the contribution specified in the lifecycle contribute role.
The date the resource was made available in its present form. Recommended best practice is an 8 digit number in the form YYYY-MM-DD as defined in http://www.w3.org/TR/NOTE-datetime, a profile of ISO 8601. In this scheme, the date element 1994-11-05 corresponds to November 5, 1994. Many other schema are possible, but if used, they should be identified in an unambiguous manner.

<table>
<thead>
<tr>
<th>8</th>
<th>Resource Type</th>
<th>TYPE</th>
<th>educational.learningResourceType</th>
</tr>
</thead>
<tbody>
<tr>
<td>The learning resource types, such as, exercise, questionnaire, diagram, figure, index, slide, lecture, slide, exam, table, etc. To follow the consistency and for the sake of interoperability, TYPE value should be taken from a standard list.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>Format</th>
<th>FORMAT</th>
<th>technical.format</th>
</tr>
</thead>
<tbody>
<tr>
<td>This data element shall be used to identify the software and possibly hardware that might be needed to display or operate the learning object. For example, text/html, image/tiff, application/zip, non-digital (for non-digital learning objects), etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10</th>
<th>Resource Identifier</th>
<th>IDENTIFIER</th>
<th>general.identifier.entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>A globally unique label that uniquely identifies the learning object. For example, example, for networked resources URIs, DOI, etc. and other globally-unique identifiers, such as, ISBN, ISSN, or other formal names would also be candidates for this element in the case of off-line resources.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 11 | Source | SOURCE | relation.resource when the value of relation.kind is "isBasedOn" |
A string or number used to uniquely identify the work from which this resource was derived (if applicable). For example, a PDF version of a novel might have a SOURCE element containing an ISBN number for the physical book from which the PDF version was derived.

<table>
<thead>
<tr>
<th></th>
<th>Language</th>
<th>LANGUAGE</th>
<th>general.language</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td></td>
<td>The primary human language or languages used within this learning object to communicate to the intended user. If the resource is multilingual, list all languages that apply in any convenient order. For the sake of interoperability, the standard schema should be followed. For example, <a href="http://www.loc.gov/standards/iso639-2/php/code_list.php">http://www.loc.gov/standards/iso639-2/php/code_list.php</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Relation</th>
<th>RELATION</th>
<th>relation.kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td></td>
<td>The relationship of this resource to other resources. Intention of this element is to provide a means to express relationships among resources that have formal relationships to others, but exist as discrete resources themselves. For example, images in a document, chapters in a book, or items in a collection. The LOM datamodel indicates that DC.Relation as a whole is equivalent to LOM element 7.2:Resource (and its child elements). The LOM also indicates that the vocabulary for 7.1:Kind &quot;is based on Dublin Core.&quot; This means that the LOM adopts the vocabulary recommended by Dublin Core, but at the same time, makes it difficult to indicate these vocabulary values when the LOM is &quot;crosswalked&quot; or translated to Dublin Core. For this reason, CanCore recommends that the 7:Relation element as a whole be considered equivalent to DC:Relation [19]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Coverage</th>
<th>COVERAGE</th>
<th>general.coverage</th>
</tr>
</thead>
</table>
The spatial and/or temporal characteristics of the resource. “Coverage” typically includes spatial location (a place name or geographic coordinates), temporal period (a period label, date, or date range) or jurisdiction (such as a named administrative entity). For the sake of interoperability, the value should be chosen from a controlled vocabulary (for example, the Thesaurus of Geographic Names [TGN]) and that, where appropriate, named places or time periods be used in preference to numeric identifiers such as sets of coordinates or date ranges [20].

<table>
<thead>
<tr>
<th>15</th>
<th>Rights Management</th>
<th>RIGHTS</th>
<th>rights.description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A link to a copyright notice, to a rights-management statement, or to a service that would provide information about terms of access to the resource.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3.6 Learner Profile Standards and Specifications

Learner profile is a data model, which describe the learner characteristics, such as, learning style, learning goals, skills including the learners personal information, for example, name, address, etc. Learner profile is an important component of adaptive learning systems, since the adaptive functionality (e.g., adaptive presentation, adaptive navigation and adaptive content) is based on learner models. It models knowledge about the learner in a structured way. According to Eklund and Zeilinger [21] the main tasks of a learner model are:

1. Identification of the current and relevant goals of the user.
2. Saving and actualisation of the user’s knowledge about the system and its usage possibilities.
3. Saving and actualisation of the user’s background knowledge.
4. Analysis of the user’s experience that can be useful for knowledge transfer.
5. Saving and actualisation of the user’s preferences and interests.
There are several open learner profile standards available including IMS Learner Information Package, vCard (adapting to learners data), IEEE Personal and Private Information, eduPerson, etc. In the following sections we discuss a few of them.

3.6.1 vCard

vCard is a file format standard for electronic business cards. It is a powerful new means of Personal Data Interchange (PDI). The motivation is to enable the common and consistent description of persons. vCards are often attached to e-mail messages, but can be exchanged in other ways, such as on the World Wide Web. They can contain name and address information, phone numbers, URLs, logos, photographs, and even audio clips [26].

The vCard or Versitcard was originally proposed in 1995 by the Versit consortium, which consisted of Apple, AT&T Technologies (later Lucent), IBM and Siemens. In December 1996, ownership of the format was handed over to the Internet Mail Consortium, a trade association for companies with an interest in Internet e-mail [26].

3.6.1.1 Important Features

The important features of vCard are [27],

1. vCards carry vital directory information such as name, addresses (business, home, mailing, parcel), telephone numbers (home, business, fax, pager, cellular, ISDN, voice, data, video), email addresses and Internet URLs (Universal Resource Locators)
2. All vCards can also have graphics and multimedia including photographs, company logos, audio clips (for instance, it helps to know how to pronounce a name).
3. Geographic and time zone information in vCards let others know when to contact you
4. It supports multiple languages
5. The vCard spec is transport and operating system independent
6. vCards are Internet friendly, standards based, and have wide industry support
7. Allows RDF/XML binding

Example

```xml
<rdf:RDF
 xmlns="http://localhost/doc-onto#"
 xml:base="http://localhost/doc-onto"
 xmlns:vcard="http://www.w3.org/2001/vcard-rdf/3.0#"
 xmlns:dcterms="http://purl.org/dc/terms/#"
 xmlns:dc="http://purl.org/dc/elements/1.1/#">
    <owl:Class rdf:about="&lom-life;Entity">
        ...
    </owl:Class>
    ...
    <lom-life:Entity rdf:ID="Kiran_Majumder">
        <vcard:country rdf:datatype="&xsd;string">India</vcard:country>
        <vcard:email xml:lang="en" >jsmith@gmail.com</vcard:EMAIL>
        <vcard:pcode xml:lang="en">721106</vcard:pcode>
        <vcard:street xml:lang="en">Shyamnagar</vcard:street>
        <vcard:FN xml:lang="en">Kiran Majumder</vcard:FN>
        <dc:language rdf:resource="#ben"/>
        <isCreatorOf rdf:resource="#Atom_1"/>
    </lom-life:Entity>
    ...
</rdf:RDF>
```

The above is an excerpt from the document ontology showing vCard OWL binding. The same is represented using the following figure 3.6. The figure shows that :Kiran_Majumder, an instance of class lom-life:Entity which is expressed using RDF property rdf:type. rdf:type ties an individual to a class of which it is a member. The value of the predicates, such as, vcard:FN,
vcard:street, vcard:postcode, vcard:country and vcard:email are the objects of the statement, the plain literals. The value for the predicate dc:language of entity :Kiran_Majumder is #eng, provided using the rdf:resource attribute. The rdf:resource attribute indicates that the property element's value is another resource, identified by its URIref, http://localhost/doc-onto#.

3.6.2 IMS Learner Information Package
IMS Learner Information Package is a structured information model. The information model contains both data and metadata. The model defines fields into which the data can be placed and the type of data that may be put into these fields. Typical data might be the name of a learner, a course or training completed, a learning objective, a preference for a particular type of technology, and so on. The IMS Learner Information Specifications are designed to meet the requirements, such as, “distributed information”, “scalability”, “privacy and data protection” and “flexibility and external references” [22]. The specification supports the exchange of learner information among learning management systems, human resource systems, student information systems, enterprise eLearning systems, knowledge management systems, resume repositories, and other systems used in the learning process.
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IMS Learner Information Package is based on a data model that describes the characteristics of a learner needed for the general purposes of [22]:

1. Recording and managing learning-related history, goals, and accomplishments;
2. Engaging a learner in a learning experience;
3. Discovering learning opportunities for learners.

Metadata about each field can include:

1. Time-related information;
2. Identification and indexing information;
3. Privacy and data protection information.

This metadata is available for each and every field in the information model, either directly or via inheritance. The Learner information is delineated into eleven main categories as follows.

1. Identification: Biographic and demographic data relevant to learning, such as, names, addresses, contact information, etc.
2. Goal: Learning, career and other objectives and aspirations. A goal can be defined in terms of sub-goals.
3. Qualifications, Certifications and Licenses (QCL): Qualifications, certifications and licenses granted by recognized authorities;
4. Activity: Any learning-related activity in any state of completion. Could be self-reported. Includes formal and informal education, training, work experience, and military or civic service;
5. Transcript: A record that is used to provide an institutionally-based summary of academic achievement. The structure of this record can take many forms;
6. Interest: Information describing hobbies and recreational activities;
7. Competency: Skills, knowledge, and abilities acquired in the cognitive, affective, and/or psychomotor domains;
8. Affiliation: This learner information is used to store the descriptions of the affiliations associated with the learner, e.g., professional
organizations, etc. Membership of groups is covered by the IMS Enterprise specification;

9. Accessibility: General accessibility to the learner information as defined through language capabilities, disabilities, eligibilities and learning preferences including cognitive preferences (e.g. issues of learning style), physical preferences (e.g. a preference for large print), and technological preferences (e.g. a preference for a particular computer platform);

10. Securitykey: The set of passwords and security keys assigned to the learner for transactions with learner information systems and services;

11. Relationship: The set of relationships between the core components. The core structures do not have within them identifiers that link to the core structures. Instead all of these relationships are captured in a single core structure thereby making the links simpler to identify and manage.

**Example**

The following example shows the IMS Learner Information Package elements representation in OWL. Here, ims-lip:competency and ims-lip:interest are used as predicate of Student class and value of these predicates are the objects of the statements. For example, the value of predicate ims-lip:competency is `Competency_19`, an object of Student_1, where, Student_1 is an instance of Student class.

```xml
<rdf:RDF
   xmlns="http://localhost/student#"
   xml:base=" http://localhost/student ">
   <owl:Class rdf:about="Student">
   .................
   </owl:Class>
   <Student rdf:about="Student_1">
       <ims-lip:competency
```
3.6.3 IEEE Personal and Private Information (PAPI) draft standard

PAPI specify the syntax and semantics of a 'Learner Model'. It characterises a learner (student or knowledge worker) and his or her knowledge/abilities. It includes elements such as knowledge (from coarse to fine-grained), skills, abilities, learning styles, records, and personal information. The standard allows these elements to be represented in multiple levels of granularity, from a coarse overview, down to the smallest conceivable sub-element. It allows different views of the Learner Model (learner, teacher, parent, school, employer, etc.) and substantially addresses issues of privacy and security. The PAPI Learner standard may be integrated with other systems, protocols, formats, and technologies [28].

3.6.3.1 Key Features

A key feature of the PAPI Learner Standard is the logical division, separate security, and separate administration of several types of learner information, such as, (1) personal information. e.g., name, address, social security number; (2) relations information, e.g., cohorts, classmates, (3) security information, e.g., public keys, private keys, credentials; (4) preference information, e.g., useful and unusable I/O devices, learning styles, physical limitations; (5) performance information, e.g., grades, interim reports, log books; (6) portfolio information, e.g., accomplishments and works. These six types of information are also known as "profile information" and "learner profiles".

3.6.3.2 Purpose

The purpose of this standard is [29]:

1. To enable learners (students or knowledge workers) of any age, background, location, means, or school/work situation to create and build a personal Learner Model, based on standards, which they can
utilise throughout their education, learning experiences, and work life.

2. To enable courseware developers to develop materials that will provide more personalised and effective instruction.

3. To provide educational researchers with a standardised and growing source of data.

4. To provide a foundation for the development of additional educational standards, and to do so from a student-centered learning focus.

5. To provide architectural guidance to education system designers.

PAPI Learner was initially developed for learning technology applications but may be easily extended to other types of human-related information such as medical and financial applications [29].

3.6.4 eduPerson

eduPerson is an auxiliary object class for campus directories (A directory service is based on an integrated institutional data store, and provides authorized users and services on the network with access to information regardless of where or how the original information is stored) designed to facilitate communication among higher education institutions. It consists of a set data elements, or attributes, about individuals within higher education, along with recommendations on the syntax and semantics of the data that may be assigned to those attributes. Many of the eduPerson attributes are intended to support inter-realm applications such as controlled access to web pages or licensed resources [23].

The attributes within this object class are of two types:

1. Attributes already given in higher-level or “parent” object classes pre-configured in most commercial directory server products (such as the names, email addresses and security settings found in inetOrgPerson). For these attributes, the work of the eduPerson group has focused on developing higher education appropriate
recommendations on syntax, semantics and use to reduce the ambiguity and indeterminacy of the existing documentation and specifications.

2. Attributes newly created to facilitate inter-institutional collaborations and applications. This group consists of a few carefully chosen attributes that have clear collaborative benefit within higher education but are not found in available directory schema. For these attributes, eduPerson has defined syntax, semantics and guidance on use.

The difference between IMS Learning Information Package and eduPerson is that, The IMS Learner Information Packaging (LIP) Specification defines application independent structured data models for representing rich panoply of learner information. Whereas the eduPerson object class defines how some subset of the same person information might be represented in an enterprise directory.

3.7 Conclusion
This chapter introduced the concept of standard and established the importance of metadata standard. Contributions of major organizations playing roles in the area of eLearning metadata standards were also presented. The existing metadata standards in describing the learning objects and learners, their content and syntax and prevalent issues were presented. In the next chapter we discuss Semantic Web and the related technologies that have a bearing on the present work.

3.8 References
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