

LRMI™ as a Starting Point for IEEE P2881 Standard for Learning Metadata

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Date: 2020-10-13

What is LRMI™?

The Learning Resource Metadata Initiative (LRMI™) was begun in the spring of 2011 with the initial goal of developing a set of RDF properties and classes to augment Schema.org [SDO] for description of learning resources [LRMI]. The first terms from LRMI were added to schema.org in 2013, and in 2014 curation and further development was taken on by the Dublin Core Metadata Initiative LRMI Task Group [LRMI-TG]. Within schema.org, many (but not all) of the terms that originate from LRMI are now collected under the LearningResource type [SDO-LR]. The LRMI Task Group also maintains the terms in a DCMI namespace [LRMI-Terms] as a separate vocabulary aligned to their counterparts in schema.org, along with some concept schemes [LRMI-Concepts] that may be used to provide controlled value spaces for some of the properties. The terms in the DCMI namespace are more stable than those in schema.org and somewhat less bound to the overall modelling approach taken by schema.org; they are also currently under revision to incorporate the latest additions made by LRMI to schema.org.

Currently LRMI terms include the following properties and classes (concept schemes exist to provide controlled vocabularies for those marked with an asterisk *)

Properties associated directly with Learning Resources	Classes and other properties associated with them
<ul style="list-style-type: none">• learningResourceType• teaches• assesses• educationalLevel• educationalAlignment• educationalUse(*)• interactivityType(*)• timeRequired• typicalAgeRange• isBasedOn• license	<ul style="list-style-type: none">• AlignmentObject<ul style="list-style-type: none">◦ alignmentType(*)◦ educationalFramework◦ targetDescription◦ targetUrl• EducationalAudience<ul style="list-style-type: none">◦ educationalRole(*)

¹ Phil Barker is Chair of Dublin Core Metadata Initiative's task group on LRMI, but writes this in a personal capacity. The author has no affiliation with and in no way represents schema.org. Cetus LLP is a cooperative consultancy specializing in innovation in education technology.

Within schema.org there are also several terms relating to education that came from other initiatives, for example terms relating to Courses [SDO-Course], Programs [SDO-EOProg], and Educational and Occupational Credentials [SDO-EOCred].

Relevance of LRMI metadata to IEEE P2881

From the outset, the intention was that LRMI metadata would be a set of terms defined using RDF² that could be used with other vocabularies to build a complete description of a resource used for learning, education or training. It was recognised that other vocabularies existed that could describe the basic characteristics of various forms of learning resources—books, videos, simulations, web pages etc.—and that what was needed was a vocabulary that could describe their educational characteristics. So while LRMI does not include terms for some obvious generic characteristics, such as a "name", "description", "author", and neither does it provide terms for characteristics that are important for specialized formats, such as "video encoding", "scale", "technical requirements", in practice LRMI terms will always be used alongside a metadata schema that does provide these. This "mixing-and-matching" is especially easy with RDF vocabularies. However, the inclusion of LRMI properties in the very broad vocabulary of schema.org means that, in many cases, schema.org is sufficient to meet most requirements; where schema.org is not sufficient it can be augmented with classes and properties from other RDF-based vocabularies. For the sake of simplicity the examples below use LRMI properties within the schema.org vocabulary.

Examples of educational descriptions with LRMI

The two examples below show schema.org / LRMI metadata in JSON-LD format, with graphical representations of the metadata in each.

Points to note

The **name** property is used to provide the title of the resource.

The **about** property is used to provide the subject of the resource in example 1 as a reference to a wikidata item, which is a common practice in linked data. The URI of the wikidata item could be resolved to provide more information. An alternative would be to embed a description of the subject using the **name** and **description** properties.

The **audience** property can be used to state whether the resource is intended for teachers, learners, parents/carers or other stakeholders. A controlled vocabulary for these exists as an LRMI concept scheme though it is not referenced in these examples.

typicalAgeRange can be used to show the age of learners for which the content is suitable--in example 1 this is not the age of the audience.

² While LRMI and Schema.org are modeled using RDF/RDFS, the strong semantics of some properties in RDFS such as `rdfs:domain` and `rdfs:range` have been significantly softened by use instead of `sdo:domainIncludes` and `sdo:rangeIncludes`.

educationalLevel is used in example 1 to state the stage in the curriculum for which the resource is appropriate, in this case by reference to the Scottish national curriculum. Simple terms like "beginner", "intermediate", "advanced" are also allowed.

The **teaches** and **assesses** properties can be used to show alignments to competency frameworks or shared curricula; the **educationalAlignment** property allows other types of alignment to be shown.

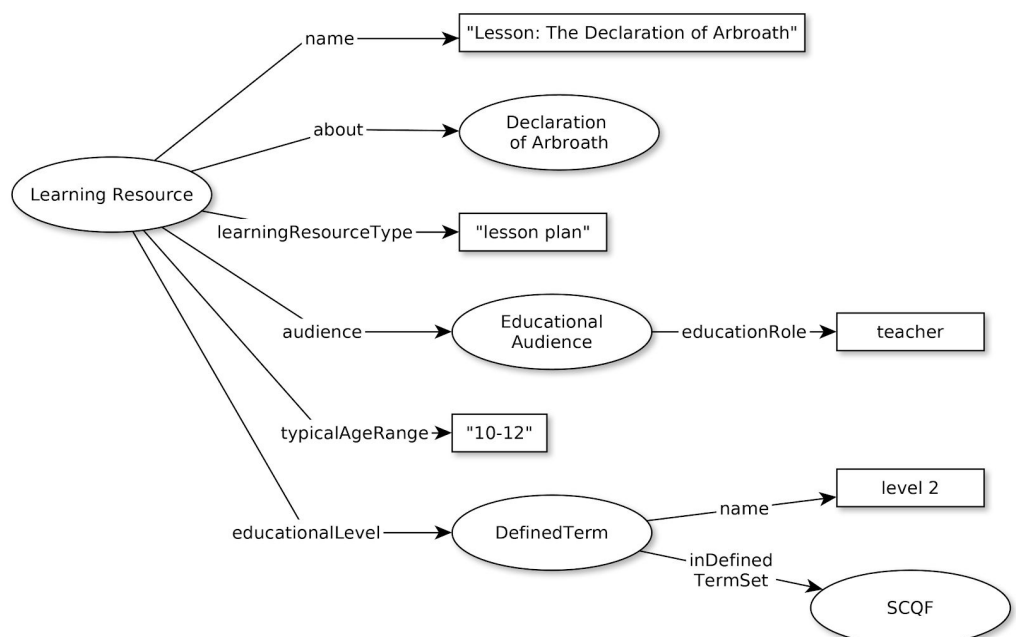
Example 1: a description of a lesson plan available as a web page.

```

01 {
02   "@context": "https://schema.org/",
03   "@type": ["WebPage", "LearningResource"],
04   "url" : "http://example.org/lessonplan",
05   "name": "Lesson: The Declaration of Arbroath",
06   "about": {
07     "@id": "https://www.wikidata.org/entity/Q598496"
08   },
09   "learningResourceType": "lesson plan",
10   "audience": {
11     "@type": "EducationalAudience",
12     "educationalRole": "teacher"
13   },
14   "typicalAgeRange": "10-12",
15   "educationalLevel": {
16     "@type": "DefinedTerm",
17     "name": "Level 2",
18     "inDefinedTermSet": {
19       "@type": "DefinedTermSet",
20       "name": "SCQF",
21       "url": "https://scqf.org.uk/"
22     }
23   }
24 }

```

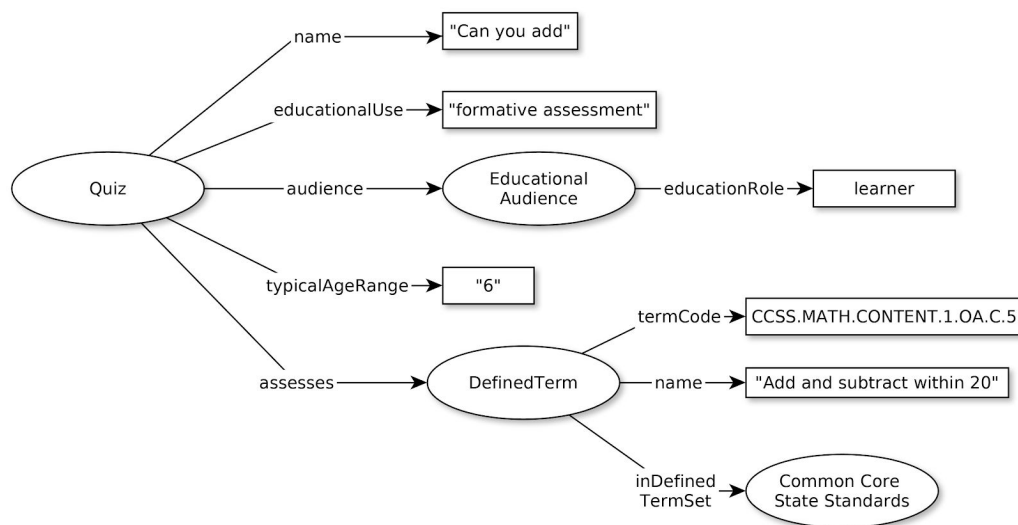
Figure 1: a graphical depiction of the metadata from example 1.



Example 2: a Quiz

```
1 {
2   "@context": "https://schema.org/",
3   "@type": "Quiz",
4   "url" : "http://example.org/quiz",
5   "name": "Can you add?",
6   "educationalUse": "formative assessment",
7   "audience": {
8     "@type": "EducationalAudience",
9     "educationalRole": "learner"
10  },
11  "typicalAgeRange": "6",
12  "assesses": {
13    "@type": "DefinedTerm",
14    "name": "Add and subtract within 20",
15    "termCode": "CCSS.MATH.CONTENT.1.OA.C.5",
16    "inDefinedTermSet": {
17      "@type": "DefinedTermSet",
18      "name": "Common Core State Standards. Math.",
19      "url": "http://www.corestandards.org/Math/"
20    }
21  }
22 }
23 }
```

Figure 2: a graphical depiction of the metadata from example 2.



Ways Forward

Both LRMI and schema.org are available under Creative Commons licenses (CC:BY for LRMI, CC:BY-SA for schema.org), so you could just use and adapt the terms, though you may want to discuss other rights and assurances with the relevant organizations (not me).

The LRMI Task Group liaises with standards bodies, and is happy to discuss how to use LRMI terms to meet specific use cases. They may be able to help provide concept schemes and additional terms should that prove necessary.

I would suggest that a profile of schema.org (or similar broadly scoped, widely used, rdf-based vocabularies) with LRMI terms and additional concept schemes could meet most use cases. Such a profile could provide better interoperability than the specifications on which it is based by adding constraints to limit redundant options in how metadata can be expressed, and that make data easier to validate.

Aside from the specifics of LRMI, the following points encapsulate the successful features of the approach of LRMI that we would recommend for IEEE P2881³:

1. An entity centric as opposed to record centric model;
2. Modeled as semantic metadata through commitment to RDF/RDFS (which includes emerging property-graph related specifications notably RDF*);
3. Syntax independence with non-normative examples in RDF/XML, Turtle, JSON-LD etc.;
4. Following the Dublin Core 1-to-1 rule—i.e., a description describes one entity and one entity only (related to #1);
5. Commitment to supporting interoperability through the reuse of existing properties where appropriate and coining new properties only where necessary;
6. Supporting semantic local extensions to express local or community needs (i.e., things not "said" in the base P2881 standard can be added to local profiles of P2881 with clear semantics for downstream understanding and use);
7. No defined constraints on properties and classes in the specification—leave such constraints to downstream profiles of the spec (e.g. no "mandatory", "repeatable" or record-like notions of field size limitations etc.);
8. No composite attributes (structured values); e.g., VCARD records. Attributes of structured values are decomposed into individual properties (also related to #1);
9. Defining and maintaining the needed value spaces—enumerations, classifications, and concept schemes as separate RDF entities using W3C's SKOS (Simple Knowledge Organization System) Recommendation, and expressing them in instance data using an entity like sdo:DefinedTerm / sdo:DefinedTermSet;
10. Allowing referencing of any appropriate value spaces defined by others (in other words, defined outside the P2881 spec) that are identified by URI, including competency frameworks.

³ With acknowledgement to Stuart Sutton for enumerating these principles.

References

[LRMI] DCMI About LRMI. <https://www.dublincore.org/about/lrmi/>

[LRMI-Concepts] LRMI Concept Schemes

https://www.dublincore.org/specifications/lrmi/concept_schemes/

[LRMI-Terms] LRMI Metadata Terms (RDF)

https://www.dublincore.org/specifications/lrmi/lrmi_terms/

[LRMI-TG] DCMI LRMI Task Group <https://www.dublincore.org/groups/lrmi-task-group/>

[SDO] Schema.org <https://schema.org/>

[SDO-Course] Schema.org Course <https://schema.org/Course/>

[SDO-EOcred] Schema.org EducationalOccupationalCredential type

<https://schema.org/EducationalOccupationalCredential>

[SDO-EOProg] Schema.org EducationalOccupationalProgram type

<https://schema.org/EducationalOccupationalProgram>

[SDO-LR] Schema.org LearningResource type <https://schema.org/LearningResource>