Learning Path Information Model

Version 1.3

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1. Introduction

The European TENCompetence Integrated Project (TENCompetence, 2005) focuses on building an infrastructure for lifelong learning. This entails for instance development of tools to support lifelong learners in finding suitable ways to develop themselves professionally or personally, in a formal educational setting or informally etcetera. A learning path can be defined as a set of one or more learning actions that help to achieve particular learning goals. In order to support lifelong learners in finding, comparing, selecting, and navigating learning paths that best meet their needs, it is necessary to describe them in a formal and uniform way (Janssen, Berlanga, & Koper, 2009). For this purpose a learning path specification was developed which aims at describing both the contents and the flow of any kind of learning that takes place, be it formal, non-formal, informal, or a mixture of these. Whether or not a learning path meets the needs of a learner does not solely depend on its learning goals, but is determined by a mixture of variables: learning goals, delivery mode, planning, costs etc.. A need for the specification was felt for instance in a pilot from UNESCO in which competence development plans (i.e. learning paths) were modelled based on existing modules. Some of these modules had to be studied in a fixed order, others could be studied randomly and again others represented a choice. The specification enables to organise these types of structures and represent them to learners for navigation purposes. Requirements for this specification have been formulated based upon a review of literature on curriculum design and an analysis of different approaches to support selection of courses and programmes (Janssen, Berlanga, Vogten, & Koper, 2008). The same study revealed that we might draw on the existing IMS Learning Design specification (IMS-LD, 2003) to describe learning paths. However this would entail including a number of constructs which the learning path specification itself does not require, but which are needed to ensure compliancy with IMS-LD. Eventually it was decided not to use a subset of IMS Learning Design to specify learning paths but to develop a new ‘lean’ specification. A new learning path model has been developed, less closely connected to IMS-LD and its terminology. The learning path specification has clear links with IMS-LD, but distinguishes itself from this specification because it does not provide a detailed description of the actual learning process: the activities, assignments and materials involved. Instead the learning path specification is a vehicle to connect ‘units’ (i.e. learning actions) that describe learning processes and activities in more detail. A unit or learning action might be an IMS-LD Unit-of-Learning, but might also be a workshop, a manual, a video, a classroom course, a blog, and so forth. The specification intends to organise learning actions into learning paths and to provide ‘meta-metadata’ as it were over the entire path, following the premise that the whole might be greater than the sum of its parts. Though existing specifications like IEEE-LOM (2002), DC-ED (2006), CDM (2004), XCRU (2006), MLO-AD (2008) which aim at description of learning objects, learning opportunities, courses, programs, etc., may also be used to describe relations between ‘units’ their main focus seems to be on ‘units’ and on formal learning.

The revised conceptual (UML) model presented in section 2 looks different from the initial model but has not changed fundamentally. The new model shows more explicitly that a learning path has a start (formerly ‘prerequisites’) and a finish (formerly ‘learning objectives’) which are to be defined in terms of competences at particular levels of proficiency. A learning path further defines one or more learning actions that lead from the start to the finish, i.e. to attainment of specific competences at specific levels. Each action is further described by a set of metadata specifying content, process, and planning information (e.g. title, description, assessment, tutoring, delivery mode, attendance hours). These metadata are assumed to play a role in learners’ process of choosing a learning path. Their (relative) importance is currently investigated through semi-structured interviews with lifelong learners who recently have been searching for suitable learning opportunities. The results of this study may lead to adaptations of the learning path metadata in a next version of this document. The underlying document first describes the conceptual model of the Learning path specification (section 2). This model has been transformed into an XML schema using the Free Community Edition of the Liquid XML Studio 6.1.18.0 software. The more detailed information model of this schema is described in section 3. Finally section 4 addresses several deployment issues.
2. Conceptual Model

The basic pattern for learning paths is that a path has a start and a finish and describes the steps that must be taken to reach the finish. As Figure 1 illustrates, a LearningPath describes a set of 1 or more LearningActions, including the way they are related, leading to attainment of a set of one or more CompetenceLevels which constitute the path’s Finish. CompetenceLevels specify competences at a particular level of proficiency. So the Finish, i.e. the targeted endpoint of a Learning Path is defined in terms of competences with related proficiency levels. Competence is defined as the ability of a person to act effectively and efficiently in an ecological niche (e.g. occupation, hobby, sport, etc.). The methodical description of competences and subsequent proficiency levels is out of scope for the learning path specification: the model assumes that competences and their levels are described elsewhere and can be referred to internally by the Id attribute and externally by the URI attribute. Section 4 briefly discusses the implications of this choice for deployment of the specification.

![Figure 1: LearningPath conceptual model](image-url)
Whereas specification of the path’s Finish is mandatory, specification of prerequisite competence levels by defining a Start remains optional. Note that both Start and Finish could be as elaborate as a job profile.

Most importantly a LearningPath specifies the steps that have to be taken to reach the Finish: the LearningActions that lead to attainment of the CompetenceLevels one aims for.

LearningActions can be:

a) an existing learning path: ExternalLearningPath,
b) a LearningAction (e.g. ‘take workshop X’, ‘do course Y’, ‘consult expert Z’, ‘read manual A’)
c) a LearningActionsCluster (e.g. ‘choose one action out of the following set of actions’, ‘complete action X before you do action Y’).

A LearningActionsCluster can be of different types: the LearningActions it contains may constitute a free order, a sequence or a set of actions that have to be performed in parallel. Each LearningAction may contribute to mastery of one or more CompetenceLevels and may require mastery of one or more Competences at particular levels of proficiency.

Certain Rules may pertain to inclusion of LearningActions in the LearningPath, e.g. LearningAction X is only an option if choice X is made earlier in the LearningPath. Expression of these Rules is out of scope of the learning path specification and will require reliance on a script language.

LearningActions and LearningPaths are further characterised by a number of metadata: the attributes of the classes in Figure 1. Some of these metadata are compliant with the IEEE Learning Object Metadata (IEEE/LOM, 2002) (e.g. identifier, title, language, description, version, typical learning time) while others are specified in addition (URI, provider, start conditions, recognition, delivery mode, guidance, location, start date, end date, attendance hours, assessment, further information, completion, type, number to select).

Based on Figure 1 we developed a LearningPath XML binding (schema) to have an interoperable format to describe and interpret learning paths. The metadata of the LearningActions are included in the XML binding, for they represent information on the LearningActions in the context of the particular LearningPath they constitute part of. The schema will be described in the next section.

3. Information Model

The LearningPath XML schema is based on the UML conceptual model but is not an exact match. For pragmatic reasons some regrouping has been done. For instance the attributes from the UML model have been grouped in a container element ‘Metadata’ in the schema. Start, Finish and LearningActions have been grouped in an element ‘LearningPathDesign’. Thus at the highest level the schema distinguishes between:

1. Metadata - providing information about the LearningPath
2. LearningPathDesign – describing the structure of the LearningPath
3. CompetenceLevels – the stepping stones constituting a blueprint for the LearningPath Design
4. LearningActions - the actual steps the LearningPath proposes to the learner (in an order specified in the LearningPathDesign).

In other words: CompetenceLevels and LearningActions constitute the ‘ingredients’ of the LearningPathDesign. The LearningPathDesign can be considered the ‘recipe’ that describes how and in which order the ingredients are mixed.

The schema will be explained by presenting information tables for each of the elements mentioned above: LearningPath, Metadata, LearningPathDesign, CompetenceLevels, and LearningActions.
3.1 Information Table ‘Learning Path’

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Reqd</th>
<th>Mult</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LearningPath</td>
<td>Specification of 1 or more learning actions and the way they are structured, leading to a defined set of one or more competences at particular proficiency levels.</td>
<td></td>
<td></td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>Identifier of the LearningPath (local)</td>
<td>M</td>
<td>1</td>
<td>ID</td>
</tr>
<tr>
<td>Metadata</td>
<td>Container element for data which provide content, process and planning information on the LearningPath.</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>LearningPathDesign</td>
<td>Container element for specification of the Finish and Start (optional) of a LearningPath in terms of CompetenceLevels as well as the steps (LearningActions) that lead to the Finish.</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>CompetenceLevels</td>
<td>Container element for specification of CompetenceLevels which are referenced in the LearningPathDesign.</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>Learning Actions</td>
<td>Container element for specification of LearningActions which are referenced in the LearningPathDesign.</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
</tbody>
</table>
### 3.2 Information Table ‘Metadata’

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Reqd</th>
<th>Mult</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metadata</td>
<td>Container element for data which provide content, process and planning information on the LearningPath.</td>
<td></td>
<td></td>
<td>container</td>
</tr>
<tr>
<td>URI</td>
<td>Uniform resource identifier of the LearningPath</td>
<td>M</td>
<td>1</td>
<td>anyURI</td>
</tr>
<tr>
<td>Title</td>
<td>Title of the LearningPath</td>
<td>M</td>
<td>1</td>
<td>string</td>
</tr>
<tr>
<td>Version</td>
<td>Version of the LearningPath; necessary to allow for updates of LearningPaths and to enable identification of specific versions.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>Language</td>
<td>Language of the LearningPath. Can be derived from the language attributes of the subsequent LearningActions; the value is a generated enumeration of all unique languages specified within the LearningActions (language attribute).</td>
<td>O</td>
<td>0..*</td>
<td>language</td>
</tr>
<tr>
<td>Description</td>
<td>Short general description of the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>Provider</td>
<td>Provider of the LearningPath. If the LearningPath involves more than one provider this element contains the main provider. Other providers can be specified through</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
</tbody>
</table>

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**Diagram**

- **E Metadata**
  - **E MetaData**
  - **E Uri** : anyURI
  - **E Title** : string
  - **E Version** : string
  - **E Language** : language
    - 0..*
  - **E Description** : string
  - **E Provider** : string
  - **E DeliveryMode** : string
  - **E Recognition** : boolean
  - **E Guidance** : string
  - **E AttendanceHours** : int
  - **E RunInformation**
    - 0..*
  - **E Assessment** : string
  - **E FurtherInformation** : string
  - **E StartConditions** : string
  - **E Workload** : int
  - **E Costs** : integer
  - **E Completion** : string
<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Req</th>
<th>Mult</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeliveryMode</td>
<td>Mode(s) used for the delivery of the Learning-Path: distance education, face-to-face, or mixed.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>Recognition</td>
<td>Specifies whether successful completion of the LearningPath leads to a formally recognized diploma or certificate.</td>
<td>O</td>
<td>0..1</td>
<td>boolean</td>
</tr>
<tr>
<td>Guidance</td>
<td>Description of available support in terms of tutoring, counselling, feedback, et cetera.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>AttendanceHours</td>
<td>Estimation of number of hours for realtime learner attendance within the LearningActions; the value is the generated summation of the AttendanceHours of all LearningActions within the LearningPath. Note that attendance may be on location or virtual.</td>
<td>O</td>
<td>0..1</td>
<td>integer</td>
</tr>
<tr>
<td>RunInformation</td>
<td>Container element grouping metadata which are connected to a specific ‘run’ of a LearningPath: Location, StartDate, Enddate.</td>
<td>O</td>
<td>0..*</td>
<td>sequence</td>
</tr>
<tr>
<td>Location</td>
<td>Optional element for specification of the physical location for face-to-face meetings.</td>
<td>O</td>
<td>0..*</td>
<td>anyType</td>
</tr>
<tr>
<td>StartDate</td>
<td>Optional attribute to specify fixed starting dates for the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>date</td>
</tr>
<tr>
<td>EndDate</td>
<td>Optional attribute to specify fixed end dates for the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>date</td>
</tr>
<tr>
<td>Assessment</td>
<td>Description of the formative and/or summative assessments available to determine to what extend the learner has acquired the competence(s) at the specified level.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>FurtherInformation</td>
<td>Description of more detailed information on the LearningPath (may contain URL’s).</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>StartConditions</td>
<td>Specification of practical, pedagogical and technical issues that must be satisfied to be able to follow the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>Workload</td>
<td>Estimated workload of the LearningPath specified in hours and ECTS; the value of this attribute is the generated summation of the workload attribute values of all LearningActions within the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>integer</td>
</tr>
<tr>
<td>Costs</td>
<td>Total costs of enrolment and specific expenses (books, tools, et cetera). The Costs element contains an attribute ‘currency’.</td>
<td>O</td>
<td>0..1</td>
<td>integer</td>
</tr>
<tr>
<td>Completion</td>
<td>Specification of the rule(s) for completion of the LearningPath, e.g. does it involve formal completion via a test, or is it up to the learner to decide the Finish has been reached.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
</tbody>
</table>
### 3.3 Information Table ‘LearningPathDesign’

<table>
<thead>
<tr>
<th><strong>Element</strong></th>
<th><strong>Explanation</strong></th>
<th><strong>Reqd</strong></th>
<th><strong>Mult</strong></th>
<th><strong>Type</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>LearningPathDesign</td>
<td>Element specifying the Finish (and possibly Start) of a Learning Path in terms of Competences at particular levels as well as the steps (Learning Actions) to be taken to reach this Finish.</td>
<td>-</td>
<td>-</td>
<td>sequence</td>
</tr>
<tr>
<td>Start</td>
<td>Container for specification of one or more CompetenceLevels which constitute the starting point of the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>An identifier for the Start specified for this Learning Path which is unique within the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>ID</td>
</tr>
<tr>
<td>Title</td>
<td>Optional attribute for the title of a set of competences at particular levels that are prerequisite to start the LearningPath. This may be an existing competence profile or a job profile.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>URI</td>
<td>Uniform resource identifier to be used for referencing existing profile definitions outside the LearningPath as the Start for the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>anyURI</td>
</tr>
<tr>
<td>CompetenceLevelRef</td>
<td>Reference to a competence at a particular level.</td>
<td>M</td>
<td>1..*</td>
<td>Idref</td>
</tr>
<tr>
<td>Finish</td>
<td>Container for specification of one or more CompetenceLevels which constitute the targeted endpoint of the LearningPath.</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>An identifier for the Finish specified for this Learning Path which is unique within the LearningPath.</td>
<td>M</td>
<td>1</td>
<td>ID</td>
</tr>
<tr>
<td>Title</td>
<td>Optional attribute for the title of a set of competences with specific proficiency levels the LearningPath helps to attain. This may be an existing competence profile or a job profile.</td>
<td>O</td>
<td>0..1</td>
<td>string</td>
</tr>
<tr>
<td>URI</td>
<td>Uniform resource identifier to be used for referencing existing profile definitions outside the LearningPath as the Finish for the LearningPath.</td>
<td>O</td>
<td>0..1</td>
<td>anyURI</td>
</tr>
<tr>
<td>Element</td>
<td>Explanation</td>
<td>Reqd</td>
<td>Mult</td>
<td>Type</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>CompetenceLevelRef</td>
<td>Reference to a competence at a particular level.</td>
<td>M</td>
<td>1..*</td>
<td>Idref</td>
</tr>
<tr>
<td>LearningActions</td>
<td>Container element used to reference one or more Learning Actions, Learning Actions Clusters or LearningPaths.</td>
<td>M</td>
<td>1</td>
<td>Choice</td>
</tr>
<tr>
<td>LearningActionRef</td>
<td>Reference to a LearningAction to be performed by a learner which has been declared elsewhere within the LearningPath (see LearningPath - LearningAction).</td>
<td>M</td>
<td>0..*</td>
<td>Idref</td>
</tr>
<tr>
<td>LearningActions</td>
<td>Reference to a collection of LearningActions which has been declared elsewhere within the Learning Path (See LearningPath - LearningActionsCluster).</td>
<td>M</td>
<td>0..*</td>
<td>Idref</td>
</tr>
<tr>
<td>ExternalLearningPathRef</td>
<td>Reference to an existing external LearningPath to be included.</td>
<td>M</td>
<td>0..*</td>
<td>Idref</td>
</tr>
</tbody>
</table>

### 3.4 Information Table ‘CompetenceLevels’

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Reqd</th>
<th>Mult</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CompetenceLevels</td>
<td>Container element for specification of CompetenceLevels which are referenced in the LearningPathDesign.</td>
<td>-</td>
<td>-</td>
<td>container</td>
</tr>
<tr>
<td>CompetenceLevel</td>
<td>Element to declare a competence at a particular level of proficiency which is referenced in the LearningPathDesign.</td>
<td>M</td>
<td>1..*</td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>Identifier (local) of the CompetenceLevel.</td>
<td>M</td>
<td>1</td>
<td>ID</td>
</tr>
<tr>
<td>URI</td>
<td>URI of the addressed CompetenceLevel; the assumption is that each combination of competence and proficiency level actually has an URI that can be addressed.</td>
<td>M</td>
<td>1</td>
<td>anyURI</td>
</tr>
</tbody>
</table>
### 3.5 Information Table ‘LearningActions’

#### Learning Actions

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Reqd</th>
<th>Mult</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LearningActions</td>
<td>Container element used to group all LearningActions, LearningActionsClusters or ExternalLearningPaths which are referenced in the LearningPathDesign.</td>
<td>-</td>
<td>-</td>
<td>choice</td>
</tr>
<tr>
<td>LearningActionsCluster</td>
<td>Collection of one or more LearningActions with specification of order rules (Type: sequence, free order, parallel).</td>
<td>O</td>
<td>0..*</td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>Identifier of the LearningActionsCluster (local)</td>
<td>M</td>
<td>1</td>
<td>ID</td>
</tr>
<tr>
<td>Metadata</td>
<td>Container element for data which provide content, process and planning information on the LearningActionsCluster (Id, Title, Language, Description, DeliveryMode, Recognition, StartConditions, Guidance, Assessment, Workload, Completion).</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>Type</td>
<td>Specifies whether the LearningActions within the LearningActionsCluster have to be performed in a certain order (sequence or parallel) or can be done in a random order (free order).</td>
<td>M</td>
<td>1</td>
<td>string</td>
</tr>
<tr>
<td>AdvisedOrder</td>
<td>Specifies whether the order in which LearningActions are included in the cluster is the recommended order to study them in. When the Cluster is of the type ‘sequence’ or ‘parallel’</td>
<td>O</td>
<td>1</td>
<td>boolean</td>
</tr>
<tr>
<td>Name</td>
<td>Explanation</td>
<td>Reqd</td>
<td>Mult</td>
<td>Type</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>NumberToSelect</td>
<td>This element is used to specify a choice from the collection of LearningActions within the LearningActionsCluster. When this element is not specified, all LearningActions within the LearningActionsCluster should be completed.</td>
<td>O</td>
<td>1</td>
<td>integer</td>
</tr>
<tr>
<td>TargetCompetenceLevel</td>
<td>Element to specify the CompetenceLevel which successful completion of the LearningActionsCluster will contribute to.</td>
<td>O</td>
<td>0..*</td>
<td>Idref</td>
</tr>
<tr>
<td>RequiredCompetenceLevel</td>
<td>Element to specify the CompetenceLevel a learner is expected to have mastered before starting the LearningActionsCluster.</td>
<td>O</td>
<td>0..*</td>
<td>idref</td>
</tr>
<tr>
<td>Rule</td>
<td>A Rule specifies how to handle a LearningAction within the LearningPath when instantiated for a specific learner. Rules refer to characteristics (e.g. background, mastered competences, preferences, performance) of the learner and may pertain to: - inclusion of the LearningAction - version of the LearningAction - delivery of the LearningAction - etcetera.</td>
<td>O</td>
<td>0..*</td>
<td>sequence</td>
</tr>
<tr>
<td>LearningAction</td>
<td>Any action to be performed by a learner with the aim to develop one or more competences. The element contains a sequence of elements to describe the LearningAction.</td>
<td>O</td>
<td>0..*</td>
<td>sequence</td>
</tr>
<tr>
<td>Id</td>
<td>Identifier of the LearningAction (local)</td>
<td>M</td>
<td>1</td>
<td>ID</td>
</tr>
<tr>
<td>Metadata</td>
<td>Container element for data which provide content, process and planning information on the LearningAction (Id, URI, Title, Version, Language, Description, ActionType, Provider, DeliveryMode, Recognition, StartConditions, Guidance, AttendanceHours, RunInformation, Assessment, Workload, Completion).</td>
<td>M</td>
<td>1</td>
<td>sequence</td>
</tr>
<tr>
<td>TargetCompetence Level</td>
<td>Identification of the CompetenceLevel successful completion of the LearningAction will contribute to.</td>
<td>O</td>
<td>0..*</td>
<td>Idref</td>
</tr>
<tr>
<td>RequiredCompetence Level</td>
<td>Identification of the CompetenceLevel a learner is expected to have mastered before starting the Learning Action</td>
<td>O</td>
<td>0..*</td>
<td>Idref</td>
</tr>
<tr>
<td>ExternalLearningPath</td>
<td>An existing LearningPath to be included in the current LearningPath. Though the specification places no constraint on including only one LearningPath it would only result in wrapping an existing LearningPath in an extra layer of metadata.</td>
<td>O</td>
<td>0..*</td>
<td>Idref</td>
</tr>
</tbody>
</table>
4. Deployment issues

Deployment of the learning path schema is likely to raise some questions. Some questions we anticipated will be addressed in this section.

4.1 Can I combine different modes of a learning path in one description?

When you want to describe a LearningPath that is offered in two different ways, e.g. part-time and fulltime or face-to-face and at a distance, can I express this in one LearningPath description? Though the Metadata set allows specification of different runs of a program (Location, Startdate, Enddate), the element DeliveryMode and AttendanceHours have a maximum occurrence of 1. This means that for each different type of delivery a new learning path description has to be made. It is assumed that different modalities are likely to involve different LearningActions as well, making it necessary to include different LearningPathDesigns as well. In that respect creating a new LearningPath is likely to be easier and more straightforward than trying to include several modalities in one description.

4.2 How does it work referring to CompetenceLevels?

Competence descriptions are out of scope of the learning path specification. However, CompetenceLevels are referred to at different points within the LearningPath: at the macro level of the LearningPath, but also at the level of LearningActions. Ideally standardised competence descriptions are available and can be referenced through an URI. The element CompetenceLevel indicates a competence at a particular level of proficiency. This assumes external competence descriptions which enable referencing to this particular combination: competence + level.

The LearningPath’s mandatory element Finish can also be used to reference to an existing competence profile or job profile. This should lead to automated import of the related competences+levels into for instance a learning path editor. Such an editor should enable import of these descriptions and render them for example as a competence map or a dropdown list to facilitate referencing / selection of relevant competences and related proficiency levels by a single click.

At the micro level of LearningActions required CompetenceLevels and targeted CompetenceLevels can be identified optionally. The TargetCompetenceLevel is optional since a LearningAction can also consist of a reference to an existing LearningPath which already has a Finish. It is recommended though that LearningActions and LearningActionsClusters are associated with at least one or more TargetCompetenceLevels. Despite this recommendation no constraints should be placed on the relation between competences referenced at this lower level and the competences referenced in the Finish and possibly Start of the LearningPath, since these relations are rarely an exact one to one match.

4.3 When do I use LearningActionsClusters?

Usually a LearningPath consists of more than one LearningAction, and you will have to specify how these LearningActions are related: can they be studied in a random order or is it necessary that they are
completed sequentially or in parallel? This is why overall, a LearningPath is modelled as a LearningActionsCluster.

LearningActionClusters can also be used to define a subset of LearningActions which have to be studied in a particular order or a subset which the learner can choose from. They could also be used simply to group a set of learning actions under one meaningful header.

4.4 Which Metadata should I add?

Metadata are crucial when it comes to supporting search of learning paths. So even though only few metadata are mandatory it is recommended that all relevant metadata are added.

Some learning paths may involve face-to-face meetings at a particular location or fixed start and end dates. These more dynamic metadata which refer to a particular occurrence of for example a program, workshop or course are grouped in the container element RunInformation: Location, StartDate and EndDate. Location is defined as anyType because several standards might be used to specify a location. GeoRSS Simple (GeoRSS, 2007), for instance, offers a lightweight solution in those cases where Location element is used to enable a search engine to identify learning paths with face-to-face meetings within a limited distance from the users location.

The metadata referring to the learning process show limited overlap with the main standard in this area, the IEEELOM (2002) metadata. So rather than name spacing the IEEE LOM metadata set, a set of metadata elements has been specified of which the following can be directly mapped on the IEEE LOM metadata:

<table>
<thead>
<tr>
<th>Element label</th>
<th>IEEE LOM element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>1.1 Identifier</td>
</tr>
<tr>
<td>Title</td>
<td>1.2 Title</td>
</tr>
<tr>
<td>Language</td>
<td>1.3 Language</td>
</tr>
<tr>
<td>Description</td>
<td>1.4 Description</td>
</tr>
<tr>
<td>Version</td>
<td>2.1 Version</td>
</tr>
<tr>
<td>Workload</td>
<td>5.9 Typical Learning time</td>
</tr>
</tbody>
</table>

Though the LOM metadata also contain an element Cost, this element is used to indicate whether or not use of the Learning Object is free of costs, whereas the metadata element Cost of the learning path specification is used to specify total costs involved in following the learning path.

Metadata can be specified at the level of the LearningPath as well as the level of its constituent LearningActions. When a LearningPath consists of a single LearningAction the Metadata for the LearningPath are in fact identical to the LearningAction Metadata. When a LearningPath consists of a sequence of LearningActions some Metadata at the LearningPath level may be automatically derived from the Metadata of its constituent LearningActions, e.g. the workload of the LearningPath is the sum of the workload of the LearningActions, the language of the LearningPath is a list of all the languages mentioned in the Metadata of the LearningActions etcetera. However there are some limitations to automatically deriving LearningPath Metadata. A first limitation consists of the fact that no or not all Metadata may be specified at the LearningAction level. A second limitation arises in the case of a LearningActionsCluster, which consist of a set of LearningActions the learner can choose from. To the extent that the constituent LearningActions have different metadata values associated to them, the higher level LearningPath Metadata cannot automatically be derived. In those cases a solution might be found in specifying an 'average' number.
4.5 How and when do I add Rules?

As was stated in section 2 of this document the expression of rules is out of scope of the learning path specification. Existing script languages might be used for this purpose (Oussena & Barn, 2009). Another deployment issue relating to the Rule element is that the possibility to express rules will only be required in those cases where the learning path specification is used to recommend a specific route through a learning path or otherwise support navigation – i.e. when the specification is deployed to support a particular learning path instantiation. To the extent that the learning path specification is used to inform comparison and selection of learning paths, the Rule element is not needed. To the extent that rules pertaining to a particular learning path are relevant to the process of comparing and selecting learning paths they will be described through Metadata like StartConditions or Completion.

Acknowledgement

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References


Appendix 1  Worked out example

<?xml version="1.0" encoding="utf-8"?>
  <Id>FR1</Id>
  <Metadata>
    <Uri>http://mirror.mricon.com/french</Uri>
    <Title>Rapid Language Learning - French</Title>
    <Language>English</Language>
    <Description>Faced with a task of quickly learning French to pass a standardized test, this tried and tested method using easily-accessible technology together with cheap or free resources, will give you a few pointers on how to achieve that goal using the things I have found useful for myself.</Description>
    <DeliveryMode>mixed</DeliveryMode>
    <Recognition>0</Recognition>
    <Guidance>None</Guidance>
    <AttendanceHours>0</AttendanceHours>
    <Assessment>There are no formal assessments included in this learning path, but several suggestions are made as to how to assess your progress.</Assessment>
    <FurtherInformation>http://mirror.mricon.com/french</FurtherInformation>
    <StartConditions>computer and internet access</StartConditions>
    <Costs Currency="EURO">60</Costs>
    <Completion>Though designed to pass a standardized test, more specifically TEF, or Test d'Evaluation de Français, the test does not constitute part of this learning path.</Completion>
  </Metadata>
  <LearningPathDesign>
    <Finish>
      <Id>FIN-BF</Id>
      <Title>Basic Level French</Title>
      <Uri>http://french.about.comp/</Uri>
      <CompetenceLevelRef ref="FrenchReadingSkill-1"/>
      <CompetenceLevelRef ref="FrenchSpeakingSkill-1"/>
    </Finish>
  </LearningPathDesign>
</ns:LearningPath>
<CompetenceLevelRef ref="FrenchWritingSkill-1"/>
</Finish>
<LearningActions>
  <LearningActionsClusterRef ref="DIY-French-1"/>
</LearningActions>
</LearningPathDesign>
<CompetenceLevels>
  <CompetenceLevel>
    <Id>FrenchReadingSkill-1</Id>
    <Uri>http://french.about.comp/</Uri>
  </CompetenceLevel>
  <CompetenceLevel>
    <Id>FrenchSpeakingSkill-1</Id>
    <Uri>http://french.about.comp/</Uri>
  </CompetenceLevel>
  <CompetenceLevel>
    <Id>FrenchWritingSkill-1</Id>
    <Uri>http://french.about.comp/</Uri>
  </CompetenceLevel>
</CompetenceLevels>
<LearningActions>
  <LearningActionsCluster>
    <Id>DIY-French-1</Id>
    <Metadata>
      <Title>Rapid Language Learning</Title>
    </Metadata>
    <LearningActionRef ref="FBR-act1"/>
    <LearningActionRef ref="FBR-act2"/>
    <LearningActionRef ref="FBS-act1"/>
    <LearningActionRef ref="FBR-act3"/>
    <LearningActionRef ref="FBR-act4"/>
    <LearningActionRef ref="FBW-act1"/>
    <LearningActionRef ref="FBS-act2"/>
    <LearningActionRef ref="FBS-act3"/>
  </LearningActionsClusterRef ref="FB-conversation"/>
</LearningActions>
<Type>sequence</Type>
</LearningActionsCluster>

<LearningAction>
    <Id>FBR-act1</Id>
    <Metadata>
        <Uri>http://mirror.mricon.com/french/french.html#introduction</Uri>
        <Title>Introduction</Title>
        <Description>Some basic knowledge of grammar to begin with.</Description>
        <Costs Currency="EURO">30</Costs>
    </Metadata>
    <TargetCompetenceLevel ref="FrenchReadingSkill-1"/>
</LearningAction>

<LearningAction>
    <Id>FBR-act2</Id>
    <Metadata>
        <Uri>http://mirror.mricon.com/french/french.html#id2696762</Uri>
        <Title>Learn to Read French</Title>
        <Description>Learn by reading and using free tools on internet.</Description>
    </Metadata>
    <TargetCompetenceLevel ref="FrenchReadingSkill-1"/>
</LearningAction>

<LearningAction>
    <Id>FBS-act1</Id>
    <Metadata>
        <Uri>http://mirror.mricon.com/french/french.html#id2697140</Uri>
        <Title>Pronunciation is easy</Title>
        <Description>This brief text explains French pronunciation.</Description>
    </Metadata>
    <TargetCompetenceLevel ref="FrenchSpeakingSkill-1"/>
</LearningAction>

<LearningAction>
    <Id>FBR-act3</Id>
    <Metadata>
        <Uri>http://mirror.mricon.com/french/french.html#id2697322</Uri>
        <Title>Flip-card strategy</Title>
    </Metadata>
</LearningAction>
Using cards to learn words and noun genders.

Phrases and expressions: More reading... and use these tools to find out about phrases and expressions you don't understand.

Developing French writing skills from exercises in a book.

Drill and practice listening and speaking through audio material. Costs: 30€.

Learning actions:

- Id: FBR-act4
- Title: Phrases and expressions
- Description: Phrases and expressions you don't understand.
- TargetCompetenceLevel: FrenchReadingSkill-1

- Id: FBW-act1
- Title: Writing French
- Description: Developing French writing skills from exercises in a book.
- TargetCompetenceLevel: FrenchWritingSkill-1

- Id: FBS-act2
- Title: Listening and speaking exercises
- Description: Drill and practice listening and speaking through audio material.
- Costs: 30€
- TargetCompetenceLevel: FrenchSpeakingSkill-1

- Id: FBS-act3
Stay away from French audiobooks!

Finding the right material to train your audial recognition skills.

Practice your French speaking skills in face-to-face conversations.

Practice your French speaking skills through teleconferencing.

Computer with audio set. Internet access.
</LearningAction>
</LearningActions></ns:LearningPath>