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# **Draft Standard for Information Technology — Learning Technology — Competency Definitions**

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Learning Technology Standards Committee  
of the  
IEEE

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## Introduction

(This introduction is not part of IEEE P1484.20, Draft Standard for Learning Technology Competency Definitions)

## Participants

At the time this standard was completed, the working group had the following membership:

Claude Ostyn, *Chair*

Valerie Archambeau, *Technical Editor*

To Be Done.

The following members of the balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention. (To be provided by IEEE editor at time of publication.)

## Acknowledgements

This document has its origins in IMS projects<sup>1</sup>, without which this document could not have been created.

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<sup>1</sup> <http://www.imsproject.org/>

**Contents**

Introduction..... ii

Participants..... ii

Acknowledgements..... ii

Contents..... iii

1. Overview ..... 5

    1.1 Scope..... 5

    1.2 Purpose ..... 6

2. References..... 6

3. Definitions and Acronyms..... 7

4 Data Elements..... 8

    4.1 Ordering of Data Elements..... 10

    4.2 Taxonomies of Competency or Objective Definitions..... 10

    4.3 Smallest Permitted Maximum Values..... 12

Annex A: Bibliography ..... 14

Annex B: Best Practice and Implementation Guide..... 15

Annex C: XML Binding..... 16



# Draft Standard for Information Technology — Learning Technology — Competency Definitions

## 1. Overview

This standard defines an information model for describing, referencing, and exchanging definitions of competencies, primarily in the context of online and distributed learning. The RDCEO standard provides a means to create common understandings of competencies that appear as part of a learning or career plan, as learning pre-requisites, or as learning outcomes. RDCEO provides unique references to descriptions of competencies or objectives for inclusion in other information models.

“Competency” is used in a very general sense to include skills, knowledge, tasks, and learning outcomes. This standard provides a way to formally represent the key characteristics of a competency, independent of its use in any particular context. It enables interoperability among learning systems that deal with competency information by providing a means for them to refer to common definitions with common meanings. The information model in this standard can be used to exchange these definitions between learning systems, human resource systems, learning content, competency or skills repositories, and other relevant systems (The RDCEO that conform to this standard are intended for interchange by machines, but the information they contain is currently intended for human interpretation).

### 1.1 Scope

This standard shall specify the mandatory and optional data elements that constitute a Competency Definition as used in a Learning Management System, or referenced in a Competency Profile. This standard is intended to satisfy the following objectives:

- Provide a standardized data model for reusable Competency Definition records that can be exchanged or reused in one or more compatible systems
- Reconcile various existing and emerging data models into a widely acceptable model
- Provide a standardized way to identify the type and precision of a Competency Definition
- Provide a unique identifier as the means to unambiguously reference any usable Competency Definition regardless of the setting in which this Competency Definition is stored, found, retrieved, or used. For example, metadata that describe learning content may contain a reference to one or more Competency Definition records that describe the learning objectives for the content.
- Provide a standardized data model for additional information about a Competency Definition, such as a title, description, and source, compatible with other emerging learning asset metadata standards
- \* Provide a controlled vocabulary to express how competency definitions are semantically related.

This standard specifically does not cover:

- A data format, bindings or coding, except as minimally required for the purpose of exchange between compliant implementations
- Quality and accuracy in the data itself, although it will describe recommended best practices. For example, this standard does not cover the quality or validation of the various parts of a learning objective statement.
- A competency model, or a taxonomy of competencies.
- How the relationships between competencies are stored in a database or learning management system.

- Certification data models. However, Certification records can reference Competency Definitions. For example, an accredited authority may grant certificates that acknowledge that an individual meets the requirements for a particular competency.
- Individual competency records, as would be found in the competency profiles of individuals or groups. However, such records can include references to specific Competency Definitions. For example, a competency profile for an individual may include a collection of certificates which in turn reference Competency Definitions, as well as a collection of references to the definitions for competencies to be acquired.

This standard does not address the aggregation of smaller competencies into larger competencies (e.g., “throws” plus “catches” equals “plays ball”) and does not address how competencies are to be assessed, certified, recorded, or used as part of a process such as instructional design or knowledge management. It also does not specify how records of competencies associated with an individual are structured, stored, or exchanged.

## 1.2 Purpose

The purpose of this standard is to define a universally acceptable Competency Definition model to allow the creation, exchange and reuse of Competency Definition in applications such as Learning Management Systems, Competency or Skill Gap Analysis, Learner and other Competency profiles, etc. The standard is needed because there are currently many definitions of the terms "Learning Objective", "Competency" and "Skill", and very little agreement between how those definitions can be used to define reusable data models. This standard uses a general definition that can be semantically "tightened" or "loosened" in the data itself, while conserving the same data model regardless of how strictly a particular organization or institution requires the data to be formulated. This standard also addresses the following needs:

- A common data model that allows the building of various competency models, hierarchies and maps (however, the definitions for such applications are outside the scope of this standard).
- A standard that allows persistent, long lived Competency Definitions to be created, exchanged among systems, and maintained.
- A standard method by which Competency Definitions can be identified as globally unique among compliant systems and repositories.
- A standard method to mark a superseded or obsolete Competency Definition, and to point to a more current Competency Definition.
- A common data model for the meta data that give a reusable Competency Definition its value in a reuse environment, such as the source of the Competency Definition, validation information, and other meta information useful to locate an objective in a repository or collection.
- Correspondence with the Learning Objects Metadata Standard developed by a parallel group.

## 2. References

- |                    |                                                                                                                                                                                                                                                                    |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A2A                | <a href="http://www.aligntoachieve.org">http://www.aligntoachieve.org</a> (Align to Achieve)                                                                                                                                                                       |
| ACRL               | <a href="http://www.ala.org/acrl/ilstandardlo.html">http://www.ala.org/acrl/ilstandardlo.html</a> (Association of College and Research Libraries. Information Literacy Competency Standards for Higher Education: Standards, Performance Indicators, and Outcomes) |
| CASAS              | <a href="http://www.casas.org/">http://www.casas.org/</a>                                                                                                                                                                                                          |
| CPA                | <a href="http://www.cpavision.org/poll/corecomp.cfm">http://www.cpavision.org/poll/corecomp.cfm</a> (Core Competencies for CPAs)                                                                                                                                   |
| HR-XML             | <a href="http://www.hr-xml.org/">http://www.hr-xml.org/</a> (HR-XML Consortium)                                                                                                                                                                                    |
| IEEE 1484-12:2002: | Standard for Learning Object Metadata                                                                                                                                                                                                                              |

|          |                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMSBUND  | <a href="http://www.imsglobal.org/implementationhandbook/imspack_handv1p0.html">http://www.imsglobal.org/implementationhandbook/imspack_handv1p0.html</a> (Using IMS Content Packaging to Package Instances of LIP and Other IMS Specifications)        |
| IMSMD    | <a href="http://www.imsglobal.org/metadata/">http://www.imsglobal.org/metadata/</a> (IMS Meta-Data Specification)                                                                                                                                       |
| IMSPLID  | <a href="http://www.imsglobal.org/implementationhandbook/imsrid_handv1p0.html">http://www.imsglobal.org/implementationhandbook/imsrid_handv1p0.html</a> , IMS Persistent, Location-Independent, Resource Identifier Implementation Handbook version 1.0 |
| LSDA     | <a href="http://www.lsd.org.uk/">http://www.lsd.org.uk/</a> (Learning and Skills Development Agency)                                                                                                                                                    |
| Mager    | Robert Mager, 1984. <i>Preparing Instructional Objectives</i> , 2nd Edition. Lake Pub. Co., Belmont, CA.                                                                                                                                                |
| NOCN     | <a href="http://www.nocn.org.uk/">http://www.nocn.org.uk/</a> (National Open College Network)                                                                                                                                                           |
| NOICC    | <a href="http://www.academicinnovations.com/noicc.html">http://www.academicinnovations.com/noicc.html</a> (National Occupational Information Coordinating Committee: High School Student Competencies and Indicators)                                   |
| O*NET    | <a href="http://online.onetcenter.org/">http://online.onetcenter.org/</a> (or <a href="http://www.access.gpo.gov/o_net/datadict/datadict.pdf">http://www.access.gpo.gov/o_net/datadict/datadict.pdf</a> )                                               |
| Ostyn    | <a href="http://ltsc.ieee.org/doc/wg20/CompDefInit.doc">http://ltsc.ieee.org/doc/wg20/CompDefInit.doc</a> (Base document from P1484.20)                                                                                                                 |
| PASS     | <a href="http://www.ous.edu/pass/standards/admission.html">http://www.ous.edu/pass/standards/admission.html</a> (Oregon Proficiency-based Admissions Standards System)                                                                                  |
| RFC 2396 | <a href="http://www.ietf.org/rfc/rfc2396.txt">http://www.ietf.org/rfc/rfc2396.txt</a> (Uniform Resource Identifiers)                                                                                                                                    |
| SCANS    | <a href="http://www.tier.net/tcenters/scans.htm">http://www.tier.net/tcenters/scans.htm</a> (Secretary's Commission on Achieving Necessary Skills: Competencies)                                                                                        |
| SCORM    | <a href="http://www.adlnet.org">http://www.adlnet.org</a> (ADL SCORM)                                                                                                                                                                                   |
| TATS     | <a href="http://www.adtdl.army.mil/atdls.htm">http://www.adtdl.army.mil/atdls.htm</a> (Total Army Training System)                                                                                                                                      |
| XPOINTER | <a href="http://www.w3.org/TR/xptr-framework/">http://www.w3.org/TR/xptr-framework/</a> (XPointer Framework, Working Draft 10 July 2002)                                                                                                                |

### 3. Definitions and Acronyms

For the purposes of this standard, the following terms and definitions apply. IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition should be referenced for terms not defined in this clause.

**3.1 Definition:** An optional structured description that provides a more complete definition of the competency or educational objective, usually using attributes taken from a specific model of how a competency or educational objective should be structured or defined.

**3.2: Definition Element:** provides a structure for including an arbitrary collection of statements that determine a competency or educational objective. The Definition element contains the following sub-elements:

**(A) Model Source:** An identifier of the model or structure upon which the definition is based. The model defines which statements are used to define the competency; it defines the namespace and value-set of content for "Statement Name."

**(B) Statement:** A Statement is a description of a single characteristic of a definition. A definition must contain at least one and generally contains multiple statements. A statement has the following parts:

**(C) Statement Id:** An optional string that is a local identifier for the statement within the model.i

**(i) Statement Name:** An optional name that is a token used to label the statement.

**(ii) Statement Text:** An optional unstructured textual description of those aspects of the competency referred to by the StatementName.

**(iii) Statement Token:** An optional vocabulary token, along with an identifier of the source of the vocabulary.

**3.3 Description:** A human readable description of the competency. This is an optional unstructured (opaque) “text blob” meant to be interpretable only by humans.

**3.4 LangString:** as defined in IEEE 1484-12.1-2002: Standard for Learning Object Metadata (IEEE LOM), a composite datatype that includes a character string and information that identifies the language of the string.

**3.5 Identifier:** A globally unique label that identifies this Definition of Competency or Educational Objective.

**3.6 Title:** A single mandatory text label for the competency or objective. This is a short human-readable name for the competency. The Title provides a convenient alternative readable form, but one which is not the definitive label.

**3.7 Vocabulary:** as defined in IEEE LOM, a vocabulary data element type is a composite datatype that includes an identifier of the source vocabulary and a token value.

### 3.8 Acronyms

|       |                                                                |
|-------|----------------------------------------------------------------|
| ADL   | Advanced Distributed Learning                                  |
| DTD   | Document Type Definition                                       |
| IEEE  | Institute of Electronic & Electrical Engineering               |
| ISO   | International Standards Organization                           |
| JTC   | Joint Technical Committee                                      |
| LTSC  | Learning Technology Standards Committee                        |
| RDCEO | IMS Reusable Definition of Competency or Educational Objective |
| SCORM | Shareable Courseware Object Reference Model                    |
| W3C   | World Wide Web Consortium                                      |
| XML   | Extensible Mark-up Language                                    |

## 4 Data Elements

The RDCEO data model is minimalist and extensible. It is purposely neutral with regard to models of competencies and the use of competencies. Competencies are defined and structured in many ways in different communities of practice (ACRL, CASAS, CPA, Mager, NOICC, O\*Net, PASS, SCANS, TATS). This standard allows communities of practice to exchange information according to the model they use.

Extensibility can be achieved by defining the structure of the Definition of Competency or Educational Objective or by including Learning Object Metadata (LOM) elements in the Metadata portion.

The information model contains the following elements:

- a) Identifier: A globally unique label that identifies this Definition of Competency or Educational Objective. This identifier uses the same data elements as the Identifier element defined in the IEEE LOM standard, and consists of two sub-elements: Catalogue and Entry. The Identifier is sufficient to reference the competency in any other system.
- b) Title: A single mandatory text label for the competency or objective. This is a short human-readable name for the competency. While the Identifier provides the definitive reference to the definition, it is typically unintelligible. The Title provides a convenient alternative readable form, but one which is not the definitive label. The Title may be repeated in multiple languages.
- c) Description: A human readable description of the competency. This is an optional unstructured (opaque) “text blob” meant to be interpretable only by humans. The Description may be repeated in multiple languages.
- d) Definition: An optional structured description that provides a more complete definition of the competency or educational objective, usually using attributes taken from a specific model of how a competency or educational objective should be structured or defined. Typically, such models define a competency or educational objective in terms of a “statement, conditions, criteria,” “proficiency, criteria, indicators,” “standards, performance indicators, outcomes,” “abilities, basic skills, content, process,” and similar sets of statements.

The Definition element provides a structure for including an arbitrary collection of statements that determine a competency or educational objective. The author of a RDCEO is free to use the Definition element in the way that best describes the competency or objective. The accompanying best practices guide and examples will illustrate potential ways to express different types of competencies, objectives, and competency or objective models using the Definition element. The Definition element contains the following sub-elements:

- 1) Model Source: An identifier of the model or structure upon which the definition is based. The model defines which statements are used to define the competency; it defines the namespace and value-set of content for “Statement Name” below.  
NOTE: The value of Model Source should be specific enough to avoid conflict with other source names; therefore it is recommended that this value be a URI. If the value of Model Source is a URI, it may point to an actual document that defines the source formally. However, this is not required.
- 2) Statement: A Statement is a description of a single characteristic of a definition. A definition must contain at least one and generally contains multiple statements. A statement has the following parts:
  - i) Statement Id: An optional string that is a local identifier for the statement within the model.
  - ii) Statement Name: An optional name that is a token used to label the statement. The token is taken from a sourced vocabulary defined in the model identified by the Source element.
  - iii) Statement Text: An optional unstructured textual description of those aspects of the competency referred to by the StatementName. The StatementText may be repeated in multiple languages.
  - iv) Statement Token: An optional vocabulary token, along with an identifier of the source of the vocabulary.

NOTE: Although all elements are optional, in practice a statement should contain at least one or more of these elements in order to be useful. For example, a particular learning objective model requires a list of specific statement strings, each of which has a specific name, such as “Condition,” “Performance,” and “Standard”; a Definition matching this model would use the elements Statement Name and Statement Text.

- E) Metadata: Optional meta-data record that further describe the RDCEO. If a meta-data record is included, it is recommended that this record conform to IEEE 1484-12.1-2002: Standard for Learning Object Metadata (IEEE LOM). In such conforming records, the version of the Metadata Specification standard is given in the meta-metadata element of the meta-data record.

NOTE: Useful meta-data defined in the IEEE LOM include additional identification as an entry in one or more catalogues, information about the author, the creation date, and the coverage (in the sense of the Dublin Core as adopted by the IEEE LOM.) The Relation element may be used to relate a definition to a prior version of the definition, and one or more Classification elements may be used to indicate where this particular definition fits in a taxonomy of competencies or educational objectives.

More than one meta-data record is allowed, but if there is more than one record each record should conform to a different meta-data specification. An implementation must accept any meta-data record that it cannot interpret, but it is not required to interpret such meta-data records.

NOTE: A particular binding specification or application profile may impose additional restrictions or requirements.

#### 4.1 Ordering of Data Elements

All elements in this data model are intrinsically unordered. The order of the elements in the data model summary and the order of the values in a list of values bear no meaning. For example, if the model includes three statements, then the order of these statements is not significant. They may appear in any order without loss of information.

NOTE: A binding may impose a particular ordering on RDCEO data instances that conform to that binding. Other than conformance to the binding, no significance is associated or should be inferred from that ordering requirement. In particular, the ordering of Statement elements in a Definition is undefined.

#### 4.2 Taxonomies of Competency or Objective Definitions

There are various ways to classify competencies or educational objectives. This standard is intended to meet the simple need of referencing and cataloguing a competency or objective, not classifying it. Nonetheless, an implementation might want to include relation and classification information, which can be done through the embedding of optional meta-data as specified in the information model.

**Table 1—Summary of RDCEO Elements**

| Name       | Explanation                                                                                              | Reqd | Mult   | Value Space                                                | Datatype                                                       | Notes                                                            |
|------------|----------------------------------------------------------------------------------------------------------|------|--------|------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------|
| Identifier | A globally unique label that identifies this Definition of Competency or Objective                       | M    | Single |                                                            |                                                                |                                                                  |
| Catalog    | The name or designator of the identification or cataloguing scheme for this entry. A cataloguing scheme. | M    | Single | Repertoire of ISO/IEC 10646-1:2000, as allowed by RFC 2396 | Character String (smallest permitted maximum: 1000 characters) | Examples: "ISBN", "ARIADNE", "URI", "http://acme.org/compmodcat" |

| Name         | Explanation                                                                                                                                                                                   | Reqd | Mult      | Value Space                                                | Datatype                                                       | Notes                                                                                                                                                                                    |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Entry        | The value of the identifier within the identification or cataloguing scheme that designates or identifies this Definition of Competency or Educational Objective. A namespace specific string | M    | Single    | Repertoire of ISO/IEC 10646-1:2000, as allowed by RFC 2396 | Character String (smallest permitted maximum: 1000 characters) | Examples: "2-7342-0318", "LEAO875", "http://imglobal.org/dco/1234"                                                                                                                       |
| Title        | Text label of this RCEOD                                                                                                                                                                      | M    | Single(a) |                                                            | LangString(smallest permitted maximum: 1000 characters)        | Examples: "English proficiency", "Schmiblick failure diagnostic level 4", "Demonstrates conflict resolution skills"                                                                      |
| Description  | Description of the Competency or Educational Objective                                                                                                                                        | O    | Single(a) |                                                            | LangString(smallest permitted maximum: 2000 characters)        | Examples: "Proficiency in written and spoken English and use of English for meaningful oral or written expression.", "Performance of level 4 diagnostic as specified in IETM #SCMBLK007" |
| Definition   | A list of statements according to a particular definition model                                                                                                                               | O    | Multiple  |                                                            |                                                                |                                                                                                                                                                                          |
| Model Source | Source of the Model being used                                                                                                                                                                | O    | Single    | Repertoire of ISO/IEC 10646-1:2000, as allowed by RFC 2396 | Character String (smallest permitted maximum: 1000 characters) | Examples: "3-part-learning-objective", "http://foo.edu/ref/lo s.xml"                                                                                                                     |
| Statement    |                                                                                                                                                                                               | O    | Multiple  |                                                            |                                                                |                                                                                                                                                                                          |
| Statement ID | A local identifying label for the Statement                                                                                                                                                   | O    | Single    |                                                            | Character String (smallest permitted maximum: 4096 characters) |                                                                                                                                                                                          |

| Name                  | Explanation                                               | Reqd | Mult       | Value Space                                                                            | Datatype                                                      | Notes                                                                                         |
|-----------------------|-----------------------------------------------------------|------|------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Statement Name        | Name of the Statement                                     | O    | Single     | String                                                                                 |                                                               | Examples:<br>"Condition",<br>"Action",<br>"Standard",<br>"Outcome",<br>"Criteria"             |
| Statement Text        | Text of the statement                                     | O    | Single (a) | LangString                                                                             |                                                               | Example: "Given a set of integer numbers in the range 1 to 49"                                |
| Statement Token       | Token value for the statement                             | O    | Single     | Vocabulary defined in definition model                                                 | Vocabulary (state)                                            |                                                                                               |
| Metadata              | Embedded Metadata about this RDCEO                        | O    | Single     |                                                                                        |                                                               |                                                                                               |
| RDCEO Schema          | Describes the schema that defines and controls this RDCEO | O    | Single     | Repertoire of ISO/IEC 10646-1:2000, as allowed by RFC 2396                             | Character String (smallest permitted maximum: 100 characters) | If no schema element is present in a RDCEO instance, its value is assumed to be "IMS RDCEO"   |
| RDCEO Schema Version  | Describes the version of the above schema.                | O    | Single     | Repertoire of ISO/IEC 10646-1:2000, as allowed by RFC 2396                             | Character String (smallest permitted maximum: 20 characters)  | If no schema version element is present in a RDCEO instance, its value is assumed to be "1.0" |
| {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 Annex A) for Metadata records                                                            |

(a) 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 LangStrings is 10.

### 4.3 Smallest Permitted Maximum Values

In the Information Model, smallest permitted maximum values are defined for:

- Items with multiple values: All applications that process RDCEO instances shall process at least that number of entries stated. In other words: an application may impose a maximum on the number of entries it processes for a data element with multiple values, but that maximum shall not be lower than the smallest permitted maximum value.
- Data elements with type `CharacterString` or `LangString`: All applications that process RCD instances shall process at least that length for the `CharacterString` value (either directly or contained in the `LangString`) of that data element. In other words: an application may impose a maximum on the number of characters it processes for the `CharacterString` value of that data element, but that maximum shall not be lower than the smallest permitted maximum value for the data type of the data element.

#### NOTES

- 1—The intent is for the smallest permitted maximum values to cover most cases.
- 2—What “processing” means in the above depends on the nature of the application.

## **Annex A: Bibliography**

(informative)

To be added.

## **Annex B: Best Practice and Implementation Guide**

(informative)

To be added.

## **Annex C: XML Binding**

(informative)

To be added.