Re-Use, Re-Authoring, and Re-Purposing of Learning Resources
Definitions and Examples

Technical Report

by

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1 Introduction

Reusability of Learning Objects has been propagated as an instrument to reduce the high costs, in time and money, for the production of E-Learning content in recent years and to increase the return on investment. Much of the research in E-Learning has focused on the concept of Reusable Learning Objects, on metadata, and digital repositories for Learning Objects.

Standards, like LOM [IE02] and SCORM [AD04] for Re-Use of Learning Objects exist and the infrastructures, like Learning Object Repositories, are developed. Experiences of Re-Use are gained in different scenarios. These experiences allow to define different short comes of the “Reusable Learning Objects approach” and to develop perspectives beyond this approach. One central aim of this Technical Report is to contrast the concept of a re-usable Learning Object by our concept of a re-usable Learning Resource.

In this Technical Report we present a short overview of state of the art in the concept of Reusable Learning Objects, describing the standards and existing tools in section 2. At the end of section 2 we resume the experiences made with the approach and specify open questions. Section 3 describes new ideas and perspectives beyond the concept of Reusable Learning Objects, based on a Re-Use of Learning Resources. We present some basic definitions for different kinds of Re-Use and show the practical relevance of our approach with some examples.
2 Reusable Learning Objects

Due to the high costs, in time and money, to produce high-quality electronic and multimedia-based E-Learning content, especially Web Based Trainings (WBTs), reusability of Learning Objects has been propagated as an instrument to reduce the costs of the production of E-Learning content and to increase the return on investment.

2.1 Learning Objects

There exist different definitions of Learning Objects. First of all Learning Objects have been defined by the Learning Technology Standard Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE): “a learning object is defined as any entity, digital or non-digital, that may be used for learning, education or training” [IEEE02] Wiley rightly criticizes that the definition is too broad. It includes also physical objects. He defines a Learning object as “any digital resource that can be reused to support learning” [Wil02]. Polansi focuses on R-Use of Learning Objects and define: “A Learning Object is an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts.” [Pol03] In the MASIE Center S3-guide a Learning Object is defined as “a reusable, media independent chunk of information used as a modular building block for E-Learning content” [Mas03].

2.2 Learning Object Repositories

Learning Objects are stored in Learning Object Repositories.

Definition: A Learning Object Repository (LOR) is a system that provides Learning Objects from different authors described by metadata and allows retrieval of Learning Objects by different users (trainers normally or learners exceptionally), which want to re-use the Learning Objects.

A Learning Object Repository stores Learning Objects, which are provided by different authors. The Learning Objects are described with metadata, which supports the indexing of, and the search for Learning Objects. The functionality of such Learning Object Repositories that manage content is beyond the scope of standard database systems. For example they provide authorization mechanisms, different searching capabilities, and advanced configuration management.

Many efforts have been made recently to implement LORs [ND02]. Much effort has been put into Learning Object research by the ARIADNE Foundation [Ar05] especially. Ariadne provides a variety of tools to handle Learning Objects. One of the core tools is the Knowledge-Pool-System, a LOR, which allows indexing and storage as well as search for various Learning Objects [DF01]. Examples of other LORs are Multimedia Educational Resource for Learning and Online Teaching (MERLOT) [Me05], the SMETE Digital Library [Sm05], Campus of Alberta Repository of Educational Objects
(CAREO) [Car05] and DSpace [DS05], which is used, for example in the MIT Open Content Initiative and which is not restricted to Learning Objects only. At Multimedia Communications Lab we developed an own Learning Object Repository, called Resource Center [HHR05][RC05]. A complex overview of existing Learning Object Repositories is given in [ND02].

With respect to LORs, the IMS Global Learning Consortium Working Group Digital Repository Interoperability (DRI) [IM05] specified a reference model for digital repositories [IM03], which is not specialized for Learning Objects, but for digital documents in general.

### 2.3 Metadata for Learning Objetcs

In the metadata area, the most significant standard is the IEEE Learning Objects Metadata Standard (LOM) [IE02], which was finalized by the IEEE LTSC in 2002. LOM defines 58 data elements, structured in 9 categories. Each category covers specific aspects, such as technical or educational characteristics to describe Learning Objects. LOM is almost identical to IMS Learning Resource Meta-data Information Model 1.2.1. More general, and not specialized for Learning Objects, is the Dublin Core (DC) metadata element set that defines 15 metadata elements.

### 2.4 Lifecycle of Reusable Learning Objects

In the Reusable Learning Objects approach as described so far and as standardized by LOM, SCORM and the IMS Global Learning Consortium the lifecycle of Learning Objects consists of three phases as shown in Figure 1 and Figure 2.

*Figure 1: Lifecycle of Reusable Learning Objects*

Learning Objects are produced by authors using authoring tools. This production is done for a defined learning context most times. After production Learning Objects are used by trainers for teaching or by learners for learning via a Learning Management system directly (indicated by the dashed arrow in Figure 1) or they are provided via a Learning Object Repository first. After downloading from a
Learning Object Repository they are used, potentially in combination with other Learning Objects, again by trainers for teaching or by learners for learning. Re-Use is done by trainers or learners after the initial use of the Learning Objects in the context they have been produced for. Use and learning context can be defined as follows:

Definition: Use of Learning Objects is the usage of a Learning Object in a teaching or learning context it is assigned to.

Definition: The teaching or learning context can be described by different characteristics of the participants in learning or teaching process and of the learning or teaching process itself. Characteristics of learners and teachers are the knowledge of the learners, the business sector or company learners are from, the preferred language of the learners, the preferred teaching strategy of teachers e.g. Characteristics of the learning or teaching process are especially the learning objectives or the learning period e.g.
In this scenario Re-Use can be defined as follows.

**Definition:** *Re-Use of Learning Objects* is any kind of use of existing Learning Objects which are already used in a certain context used Learning Objects for teaching or learning by trainers or learners in a new context. Learning Objects can be combined with other Learning Objects.

Re-Use is understood as re-using a Learning Object “as it is”; the Learning Object is not changed only the context of its use is assumed to change.

### 2.5 Experiences and open questions

In different projects Learning Object Repositories exist based on the existing standards. And meanwhile they are used for a Re-Use of Learning Objects. The experiences are the following:

- It is very difficult to generate Reusable Learning Objects which meet all demands quoted for Reusable Learning Objects in section 2.2.
- Authors of Learning Objects do not feel competent to describe Learning Objects with metadata and to provide them via Learning Object Repositories. The process is too cumbersome, compared to the personal benefits for the authors. Additionally no culture of Re-Use exists.
- Most Learning Objects which are stored in Learning Object Repositories are either afflicted with context or not self-contained or they are Information Objects. Information Objects are such resources which consist of raw information and do not refer to educational issues.
- Learning Objects cannot be re-used in significantly different learning or teaching contexts, especially for didactic reasons but also for other reasons. Often there are only minor issues that do not allow a Re-Use, like an unfitting layout. To re-use Learning Objects, users must be able to modify them to suit to a new learning context. The content has to be adapted regarding different dimensions such as layout, language, terminology, or even previous knowledge.
- A lot of digital learning contents exist in form of presentations, tutorials, or Web based Trainings, which do not have the properties of Learning Objects. Re-Use of such E-Learning content which is not prepared for Re-Use as a Reusable Learning Object is not supported by the approach. It would be worth to develop mechanisms allowing Re-Use of such E-Learning content by transformation to different learning or teaching contexts.

To sum it up: The infrastructure for Re-Use of Learning Objects exists, but Re-Use of Learning Objects remains a theoretical approach and does not happen in practice.
3 Beyond Learning Objects - new perspectives

As shown in the last section, the concept of Reusable Learning Objects has some major short comes. In our future work we will focus on two aspects: The first aspect is the Re-Use of smaller resources than Learning Objects in the authoring phase instead of the Re-Use in the learning phase, to reduce the costs of the production of new content. The second aspect is the Re-Use or more precisely the transformation of existing E-Learning Content, which is not prepared as a reusable Learning Object, to new learning or teaching contexts.

3.1 Learning Resources

As a base of our future work we use the narrower term Learning Resource instead of Learning Object.

Definition: A Learning Resource is a digital resource used for E-Learning.

This definition of Learning Resource covers small resources like media objects or single hypertext-like documents as well as bigger resources like complete courses or Web based Trainings. Learning Resources can consist of several documents, written in different formats, like SCORM Content Packages.

The definition of Learning Resources differs from the definition of Learning Objects. A Learning Resource can be afflicted with context and does not have to be self-contained. From a practical perspective Learning Resources are bound to learning or teaching context in most of the times.

3.2 Re-Use of Learning Resources

Following the definition of Learning Resources they are re-used in different ways. Re-Use can be defined as follows.

Definition: Re-Use of Learning Resources is every kind of use of existing Learning Resources, which are already used in a certain context.

A Learning Resource may be re-used in learning or teaching without any modification. A Learning Resource may be re-used in Authoring by Aggregation. A Learning Resource may be re-used in Re-Authoring.

Further on we use this extended definition of Re-Use. The different kinds of Re-Use are shown in Figure 3 in their chronological order.
An existing Learning Resource A, which is used for learning or teaching and provided via a Learning Object Repository, can be re-used by another learner or trainer for learning or teaching. This corresponds to the scenario in which Reusable Learning Objects are re-used. It can be re-used in form of modification to build a new Learning Resource A’ or it can be re-used as part of a new Learning Resource B. The new Learning Resources (A’ and B) can be provided as well and be used for learning or teaching.

Re-Authoring and Authoring by Aggregation we define as follows:

Definition: **Re-Authoring** is the modification of an existing Learning Resource before the Learning Resource is used in learning or teaching twice. During the modification parts of another (smaller) Learning Resource can be re-used. Re-Authoring is independent of the reason for a modification of the Learning Resource.

In Re-Authoring the modification is done based on one logical Learning Resource, which in the technical realisation can consist of different documents in different formats. Only parts of another Learning Resource can be re-used during the modification, as we will see later on (compare figure 11).

Definition: **Authoring by Aggregation** is the process of aggregating existing and partially new Learning Resources to create a new Learning Resource, which has a higher
Authoring by Aggregation is done by authors instead of trainers. Modification of a Learning Resource as part of Authoring by Aggregation can be done by editing the Learning Resource or by performing one or more adaptations. (Adaptation is defined in the following section.) The term Authoring by Aggregation was defined for the first time in [DH03] in a somehow different way. Duval and Hodgins do not allow the integration of new Learning Resources and the modification of existing Learning Resources in their definition.

**Figure 4: Example for Authoring by Aggregation**

Figure 4 shows an example of Authoring by Aggregation. Existing Learning Resources (A to C), taken from a repository for instance, are aggregated together with a new Learning Resource (D) which is created during the Authoring by aggregation. The existing Learning Resource (B) is also modified during the Authoring by Aggregation process.

In Authoring by Aggregation different smaller Learning Resources are re-used to create a completely new Learning Resource, as shown before, whereas in Re-Authoring only one Learning Resource is modified, maybe using parts of other Learning Resources. In this sense Authoring by Aggregation is a specialized kind of Authoring and not a kind of Re-Authoring. In Authoring by Aggregation the existing Learning Resources are in a structural “used by” relation to the new created Learning Resource. In Re-Authoring the old and the new Learning Resource are in a content or similarity relation.
Due to this distinction and the definition of Re-Authoring we have to extend the Learning Resources Lifecycle, as shown in Figure 5. Re-Authoring has to be added as an additional step. After the Re-Authoring of the Learning Resource the modified Learning Resource can be provided again or can be used for learning or teaching purposes immediately.

3.3 Re-Authoring of Learning Resources

In this section the process of Re-Authoring of Learning Resources shall be considered in detail. First we distinguish different kinds of Re-Authoring and define Re-Purposing.

Re-Authoring can be done to update or correct an existing Learning Resource, if the Learning Resource is not up to date or mistakes are found inside the Learning Resource. A new version of the original Learning Resource is created. Furthermore Re-Authoring can be done to transform a Learning Resource to serve a new purpose, so that it suites a new learning or teaching context. Figure 6 shows the different kinds of Re-Authoring.

*Figure 5: Extended Lifecycle of Learning Resources*
Due to this we define Re-Purposing as specialised kind of Re-Authoring.

**Definition:** \textit{Re-Purposing} is the transformation of a Learning Resource to suit a new learning or teaching context (compare section 2.5), which differs from the learning or teaching context the Learning Resource was created for.

Correcting or updating a Learning Resource, if there have been mistakes in the Learning Resource or if there are new facts that have to be updated, does not change the learning or teaching context. Especially the learning objective and the target group remain the same. In such a case Re-Authoring is done by the author of the original learning resource using the authoring tool in most of the cases.

After updating or correcting a course “Bookkeeping for Beginners” still remains a course “Bookkeeping for Beginners” whereas in Re-Purposing the course can be transformed to a course “Bookkeeping for Beginners in Pharmacology-Industry” with a specialized terminology from the Pharmacology industry and a new corporate layout. For more examples see picture 8.

**Figure 6:** Re-Authoring and Re-Purposing

**Figure 7:** Example of a Re-Purposing process

Re-Purposing can be composed of different steps, as shown in Figure 7.
Definition: **Modularization** means splitting a large Learning Resource into several smaller Learning Resources. The process that is needed to perform the modularization is called modularization process.

Definition: **Adaptation** means changing a Learning Resource with regard to one aspect to make it fit to a new context of use. Aspects are for example language, layout or terminology. To perform an adaptation an adaptation process is execute.

Modularization of the Learning Resource is especially necessary if the Learning Resource consist of several documents, written in different formats, like a SCORM Content Package or hypertext like documents. The adaptation has to be done on document base in most of the cases. In a Re-Purposing process it can be necessary to perform more than one single adaptation to transform a Learning Resource to a new context. An example is shown in figure 8. Starting with a course “Bookkeeping for Beginners” in English. In a first adaptation the course is translated into German and in a second adaptation the layout is changed. The figure shows different other adaptations also.

![Diagram](image)

*Figure 8: Examples for Adaptations in Re-Purposing*
**Definition:** *Aggregation* is the process of aggregating small Learning Resources into a larger Learning Resource.

In an aggregation process it is not mandatory, that all Learning Resources, generated through modularization, have to be part of the aggregation, like in the example in Figure 7, where the *Learning Resource D* is not part of the aggregated *Learning Resource E’*. In this manner Learning Resources or parts of Learning Resources can be deleted.

The three steps of modularization, adaptation and aggregation are not mandatory, as shown in the following examples.

*Figure 9: Example for a Re-Purposing process without adaptation*

Re-Purposing can be done without adaptation of modularized learning resources, as shown in Figure 9. In this case the Re-Purposing process consists only of a modularization and an aggregation after a permutation of learning resources. This example is realistic in case of an adaptation of the learning strategy, where examples and theoretic explanations are interchanged in a course, e.g.
Re-Purposing can consist of one or more adaptations without modularization and aggregation, as shown in Figure 10. An example is the translation of a Learning Resource and the adaptation to a new layout, if the adaptation can be performed on the whole Learning Resource, then it has not to be modularized in different learning resources for translation and layout adaptation. This is the case for example if the Learning Resource is represented in form of a single document.

Re-Purposing can use modularized Learning Resources which are parts of different source Learning Resources to Re-Purpose a new Learning Resource as shown in Figure 11. In this case we assume that the bigger Learning Resource is the base Learning Resource which is re-purposed using parts of another Learning Resource.
References


