

Writing and Using Reusable Educational Materials

A Beginners Guide

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1. Introduction

Anyone who has had to create learning materials from scratch knows just how labour intensive and time consuming the process can be, even with the existence of a detailed course descriptions and lesson plans. This creative process can be made easier by the reuse of existing teaching and learning materials. This guide is designed to show you how educational materials can be written so that other users and yourself can make them easily reusable. This becomes more achievable as more materials are made available online to students and also more necessary as teaching becomes more of a shared team activity.

This guide is the first in a series aimed at those who want to create teaching and learning materials that are going to be easily reusable in the future by themselves or others. The aim of this guide is to introduce in a non-technical and approachable manner some of the basic concepts and techniques required to support the design of reusable educational materials. The guide assumes that the materials are going to be stored digitally but the techniques and methods described here apply equally to non-digital storage and retrieval facilities. Reuse in this context spans a whole range of activities from taking and editing pieces of material at the sub-lesson level to utilising complete courses.

2. Designing for Reuse

2.1 *The Design problem*

We want to be able to search for and find teaching and learning materials and retrieve them with enough information to be able to adapt and reuse them in new situations. We need the materials to be structured in such a way that we can also retrieve their smaller constituent parts (i.e. parts of individual lessons) and be able to adapt and reuse them in new situations as well.

In this section we will examine how we can use design techniques to effectively structure the materials and generate the reference information needed to support productive searches for teaching materials.

Before we start examining the design process it might help first to describe the typical characteristics of a piece of teaching material that is very easy to reuse.

- *Plenty of information about the material and its context of use as well as where it fits into a larger unit of material*
- *The material is well structured and has consistent formatting*
- *There is information about what precedes and follows it*
- *An outline structure*
- *Information about what is supposed to be learnt*
- *An introduction*
- *Description of content*
- *Description or explanation of links to other materials such as handouts, course readings, lectures etc*
- *Course description and assessment criteria for prospective students*

2.2 *Specifying what is to be learnt*

2.2.1. Learning Outcomes

Design for reuse starts at the beginning of the course writing process with clear statements of what we expect the student to learn. These statements are often called **learning outcomes** or objectives. A learning outcome is a statement of what a learner is expected to know, understand and / or be able to do at the end of a period of learning. Learning outcomes might be drawn from a detailed curriculum (FE) or from more general descriptions of the level of education expected (HE). In either case the framing and articulation of these learning outcomes is usually an iterative process that includes the other succeeding steps in the design and development process that include assessment design, teaching design and evaluation.

2.2.2. Generating Useful Reference Information and Structures

The process of clearly specifying learning outcomes and design of assessment and teaching strategies to support the outcomes, readily lends itself to making reusable learning materials. Producing clear descriptions of what is to be learnt becomes the basis for structuring the course into its component parts and describing them accurately. On this foundation the teaching strategy can be developed to produce clear descriptions

of what is to be taught in each part of the course and to what level of performance in relation to the assessment criteria.

This structured and systematic approach to course design provides a wealth of useful reference information that can be used by others to search and to find reusable pieces of teaching and learning material. Here is an outline of the types of reference information that can be made available using this approach.

2.2.3. Outputs from the Specification of Learning that can support reuse

- *Title*
- *Discipline /Field*
- *General description / overview of area to be studied*
- *Introduction*
- *Who the course is aimed at and benefits to the students*
- *Educational Level of the course*
- *Duration*
- *Study time required in hours and minutes with weekly guidelines*
- *Attendance*
- *Modes of study*
- *Prerequisites, what previous education and courses are needed to complete this course*
- *Structure, main sections and sub sections with titles and short descriptions*
- *Schedule, the order in which the main sections are studied*
- *Methods of Assessment*
- *Lesson structure*
- *Lesson components*
- *Lesson objectives*
- *Order of lesson activities*

2.3 *Structured Writing*

We need to continue on the theme of designing reusable learning materials by dropping down to a more detailed level in the design and development process.

This section describes some simple techniques for producing learning materials that breaks them up into reusable ‘chunks’. The resulting structures are a great aid to searching and navigating your way through the material.

This kind of approach is needed because:

- *Creating and maintaining learning materials (especially on the web) is increasingly a team activity*
- *It is a conceptual design aid*
- *It enables effective archiving*
- *It helps in the re-use of instructional materials*
- *It makes the costly and time-consuming process of creating and maintaining learning materials more efficient*

2.3.1. Structured Writing - What is it?

It is simply writing and formatting materials in such a way that the inner structure of the material is obvious to the other members of the team (and of course the students!) and especially to the person who has to split the materials up to put them into an online format. It is very similar to the techniques used in 'traditional' correspondence courses.

This document is an example of structured writing. Take a moment to refer back to the contents list and see if the document structure is apparent in it. As you can see by dividing the material into hierarchical 'chunks' as depicted in the contents list, the structure of the material becomes obvious to someone creating web pages. For this it is essential that the relevant heading and sub-headings appear in the body text of the study material as well.

Here are some important points to note:

- *This structuring can be created before, during or after the material is written - thus allowing creative freedom in the writing process*
- *You can choose your own structuring schema - but be consistent*
- *The structuring that the team uses might not be what the student sees (larger 'chunks' may be created)*
- *This facilitates the creation of a hierarchical overview of the whole course*
- *Representing the structure in this way can be a conceptual writing tool to help you see the "larger picture"*
- *It often helps to bounce ideas off someone else*
- *If you intend to place illustrations, or multimedia elements in the text , be clear about where they are coming from and what formats they are in (talk to the designer)*
- *If you intend to place active hyperlinks in the text, remember that hyperlinks can fragment the reading process and hinder understanding (but not always!). Instead, consider referencing them and putting them in one section.*

Structuring your materials in this way makes it very easy for students to navigate and helps them perceive the inner structure of the material – both of which are powerful learning aids. But from the point of view of reusability, it helps others to identify and reuse suitable pieces of teaching and learning materials.

2.3.2. Making material transferable

A very common error made when writing instructional materials is contextualising general concepts, which makes the reuse of the material impossible in other contexts. A classic example of this is the study of statistics in higher education where general statistical theories and tools are taught by means of highly contextualised examples in different subject areas. What is really needed is one general statistics course with contextual modules that can 'bolted on' to a common core of materials. Try to adopt this approach in any part of your teaching where general theories or techniques are being used. Finally, as far as possible, avoid internal references in your materials (e.g. "see week 4") to ensure maximum reusability.

3. Storing and Finding Appropriate Materials

3.1 Introduction

If you have authored re-usable resources yourself, you probably have some kind of cataloguing system to enable you to find them the next time you need them. Perhaps you file them by the date you made them, or perhaps by the module where you last used them, (or maybe by depth in the pile on your desk!). Chances are though, that you could probably find them again quite quickly just by a rummage. How about if someone else wanted to find them...or you wanted to find something done by someone else... where would you look?... what would you look for?

3.2 Where are materials stored?

For most people such a search would begin on a web directory like Yahoo, or a similar search engine such as Google, however this can be very labour intensive and time consuming. People have already produced web directories of resources (a bit like Yahoo but just for educational web-based resources), such as <http://www.topmarks.co.uk>. This site, and many others, is very broad based, so it can still be difficult to find what you are after. For more precisely targeted resources, many of the LTSN subject centres maintain a list of useful teaching materials. Although the LTSN and other directories are very useful, they are disadvantaged in that they generally only classify online resources by their subject content. This can make searching for a precise resource, say a simulation on the earth revolving around the sun, very difficult.

This problem is being overcome by plans to create special digital libraries of educational resources, called [digital repositories](#). The advantage of these digital repositories over conventional web directories is that, like a library catalogue, they hold much more reference information (called [metadata](#)) on each of the resources, which means that searches can be more precisely targeted, saving time and effort. Furthermore digital repositories encourage their contributors to submit elements in the smallest possible chunks (called [granules](#)) a 'chunky' form. The aim is to be able to identify the smallest educationally viable unit separately, so that more than one granule can be retrieved and put together with others to form a larger resource which meets the precise needs of the user.

If you wanted to make your re-useable resource available in a digital repository, you would be asked to provide key reference information about it such as what kind of resource it is; who authored it; what subject area it addresses - this becomes the metadata for the material. You would also be required to ensure that the granule that you upload contains all of the files necessary for it to be used as an independent entity.

3.3 What would you look for?

In a web search engine (such as Google), normally you would put in search terms and hope for the best. With a web directory structure (such as Yahoo), you can find at least the subject area you are interested in. But in a [digital repository](#), because authors are asked for much more detail about their submissions, you have many more choices to search enabling you to pinpoint appropriate materials quickly and

effectively. Furthermore as each granule is stored separately, it is much easier to find a small element than when it is buried under a mound of other associated materials.

The [metadata](#) (information about the resource) that will be available will vary from repository to repository, however many people are now looking at ways of standardising the metadata for teaching and learning materials. One promising set of international metadata standards that many people are working on towards agreement are described by the Instructional Management System Global Learning Consortium (IMS) standards for teaching and learning materials. The IMS standards cover the general area of managing and distributing educational materials including educational metadata and ways of storing and distributing educational materials.

An example of the kind of metadata about a teaching and learning resource that a digital repository might contain might be:

- *what kind of material it is {worksheet, simulation, lecture notes, example}*
- *who the resource was produced by {author's name}*
- *what content area the resource addresses {modern languages, history, physics}*
- *time the resource would take to use {in minutes}*

4. Editability – adapting materials to your needs

4.1 Introduction

Sometimes the precise material for which you are looking is simply not available, although developing a completely new element is beyond your time and or budget. This highlights the importance of making sure that all re-useable resources are constructed in a format which makes them as editable as possible. Often the delivery version of a resource will not be editable such as an Acrobat Portable Document 'PDF' file. This means the author should provide an editable version of the materials alongside the finished delivery version. For instance, text could be provided a Rich Text 'RTF' file.

4.2 Making efficient use of time

Creating and finding appropriate reusable resources is time consuming, however it can pay off in the long run. Make sure that any resources that you create are designed for re-use from the start, so that if you need to adapt them for curricular or time related reasons they can be easily updated. Making full use of [metadata](#) can ensure an efficient filing system that will not only find resources which precisely address the topic that you wish to cover, but also find related resources that can be adapted or amended. Getting to know and use digital repositories can also cut down search time once you become a proficient user.

Although all this can be time-consuming to get to grips with; the time savings overall can be significant. By re-depositing any resource to which you have made significant changes, back in the repository you can help it to grow and become a more useful place. This is particularly true of resources which are very time-consuming to construct, such as multimedia files. Adapting re-usable versions of these can significantly cut down on development time.

4.3 Minor Customisation of resources

It is unlikely that you will ever find precisely the resource that you are looking for, authored by someone else. Everyone has their own style of teaching and their own manner of approach. Making resources editable means that minor customisations can be incorporated into the material relatively simply, thus making the material up-to-date or relevant for your particular group of students. Once you have retrieved the material for reuse you can ensure that your materials have a clear course identity by providing templates for your course which makes all course materials look similar (same formatting; logo; title etc) no matter where their origin.

To make sure that this customised re-use is made as easy as possible, some guidelines should be followed,

- *style should be separated from content*
(e.g. Non-relevant logos should be taken off material before entering it into the repository)
- *absolute rather than relative references should be given to other material*
(e.g. see Colombs Law simulation at <http://www.any.com/collawsim>, rather than see next simulation)

- *use should be made of web standards* (e.g. HTML 4.0; XML 1.0, CSS2)
- *use should be made of standard 'open' file formats, to ensure materials are available in the long term* (e.g. RTF, PDF, JPEG, GIF, MPEG etc)
- *proprietary software should be used only where essential with clear references to requirements* (e.g. requires ChemDraw plug-in - available at <http://www.cambridgesoft.com/support/filesa.cfm>)

4.4 *Major customisation of resources*

Sometimes, however, it is not possible to find the resource that you are looking for. But for time-consuming materials it can be better to adapt something that is already available rather than to create something new entirely. Sometimes this may mean changing the fundamental purpose of the resource. An example might be a simulation showing water pressure as it flows through a pipe allowing students to experiment by changing the dimensions of the pipe. This could be adapted into a simulation showing the flow of electrons along a wire and allowing the student to investigate the current. This change would not really be difficult to make if the original resource had been authored in an editable fashion. This makes the creation of a totally new resource possible which, out of courtesy, should be added to the repository; new metadata should be entered along with it to reflect that change. Obviously the guidelines covering the creation of editable reusable resources should be adhered to so that others may benefit in the same way.

5. Bringing it all together - creating learning objects

So far we have discussed how to design and write reusable resources and how we might use and adapt other peoples resources. When we deposit our teaching and learning materials with their accompanying metadata in a digital repository we create what are known as [learning objects](#).

A learning object is any resource or content object that is supplied to a learner by a provider with the intention of meeting the learner's learning objective(s)...and is used by the learner to meet that learning objective(s)

A learning object can be as small as a single image (high [granularity](#)) or as large as an entire syllabus (low [granularity](#)). When several learning objects are packaged together and deposited into the repository (eg a worksheet comprising an image, a piece of text and an assessment question), we create a combined learning object called an [aggregated learning object](#). An aggregated learning object is one that can be broken down into smaller constituent parts, with each capable of being used separately.

When a learning object is very small, the possibilities for its use are very broad - a single image can be used in a variety of ways. The use to which it is put is entirely up to the student or the teacher. As a learning object becomes larger or is aggregated, its uses become more limited, and increasingly the emphasis is on the designer to provide a coherent route through the material by recording the teaching design.

6. Moving from Teaching to Teaching Design

6.1 Introduction

In this section we look at how adopting a [teaching design](#) approach to writing teaching and learning materials can help to make them more reusable, and produce very useful metadata to assist searches for reusable resources.

6.2 What is Teaching Design?

Teaching design is the name we give to the design of teaching and learning materials and activities, it might sound like a strange concept but in the area of distance learning course designers do it all the time. In North America and elsewhere the term used to describe this process is "Instructional Design" - often referred to as "ID".

Teaching design involves thinking about how your students will learn from your teaching or instruction in conjunction with the materials you provide and what you ask them to do. In distance learning you are not there to teach your students all the time so your course materials have to embody your teaching strategy - this means making your teaching strategy explicit. Whereas in a classroom setting the teaching strategy you employ is usually implicit and deeply embedded in the context of the department, institution and curriculum.

Teaching design is about standing back from your day-to-day teaching work and being objective about your teaching practice and making your teaching strategy for particular tasks explicit both to yourself and others. Access to specialist support staff to help devise teaching designs greatly speeds up this process. Once you have done this you have a clear plan onto which you can bolt your learning materials. The teaching design is important and represents the underlying foundation that the course is built upon. It will be derived from the learning objectives we discussed earlier but requires knowledge about how we think people can learn and our experience of designing and using learning materials previously. It will also be influenced by institutional cultures and values.

The teaching design determines the design of the materials and activities associated with them, the order of instructional events and the details of the types of assessment involved. This in turn can provide very useful metadata to both enable the searches for resources and guide the reuse of those resources. The teaching design information can typically be more detailed and capable of being written at a lower level (lesson and sub-lesson) than those of the learning objectives. It is important to understand that the process of writing and recording the teaching design is not going to be prescriptive for others using the material. Rather it provides useful information about how the materials were intended to be used.

6.3 Example Outputs from Teaching Design that can Support Reuse

Here are some examples of the metadata that can be produced from the teaching design

<ul style="list-style-type: none">• <i>the types of knowledge that are intended to be acquired in conjunction with the learning materials (e.g. declarative, procedural, organisational, activation of prior knowledge etc)</i>

<ul style="list-style-type: none">• <i>the types of student learning activity intended to occur in conjunction with the learning materials, (comparison, experimentation, analysis, recall, description, synthesis, repetition etc)</i>

- *type of interactivity supported by the material*
(Delivery of material i.e. Exposition, such as reading or watching a video or Active, such as manipulating a simulation)
- *the type of learning resource the material represents*
(e.g. Exercise, Index, Question, Reading etc)
- *the educational level*
(e.g. primary school year 6, Undergraduate final year etc)
- *the level of difficulty of the material for the typical target audience*
(e.g. easy, medium, hard)
- *age range of users*
(e.g. children over 7, adults)
- *description of how the material is to be used by a teacher*
(tutor notes and guidelines etc)
- *the typical time it takes to work through the material*
(usually in hours and minutes)
- *the user or consumer of the material*
(e.g. Teacher, Student, Administrator)
- *relationship to other learning materials*
(e.g. is preceded by, is a part of)
- *what the tutor or 'agent' is supposed to be doing in the context of the learning materials and the student,*
(e.g. explaining, demonstrating, providing feedback, evaluation, linking etc)
- *what the student is supposed to be doing*
(e.g. Reading, discussing, writing an essay, answering questions, carrying out exercises)
- *how the materials are supposed to support the learning*
- *a hierarchical classification of what subject areas are covered*
(e.g. Physics/Acoustics/Instruments/Decibel Meter)

7. Summary

7.1 Overview

In this guide we have described the need for reusability of educational materials and the typical problems connected with reuse. We have stressed the central importance of using the educational design process to generate the necessary metadata to support effective search strategies for identifying reusable materials. We have also indicated how recently agreed international standards might help in the future.

7.2 Glossary

Aggregated learning object – a resource which is comprised of more than one learning objects and is capable of being broken down into its constituent parts

Digital Repository – a database of learning materials together with detailed information about them

Granule – The smallest educationally viable unit which is capable of achieving a learning objective

Granularity – the size of a learning resource. The smaller the resource, the higher the level of granularity **Learning Object** – a resource which helps a learner achieve a particular learning objective

Learning outcome – a statement of what a learner is expected to know, understand and/or be able to do at the end of a period of learning

Metadata – Information about a resource

Teaching Design – the design of teaching materials and activities