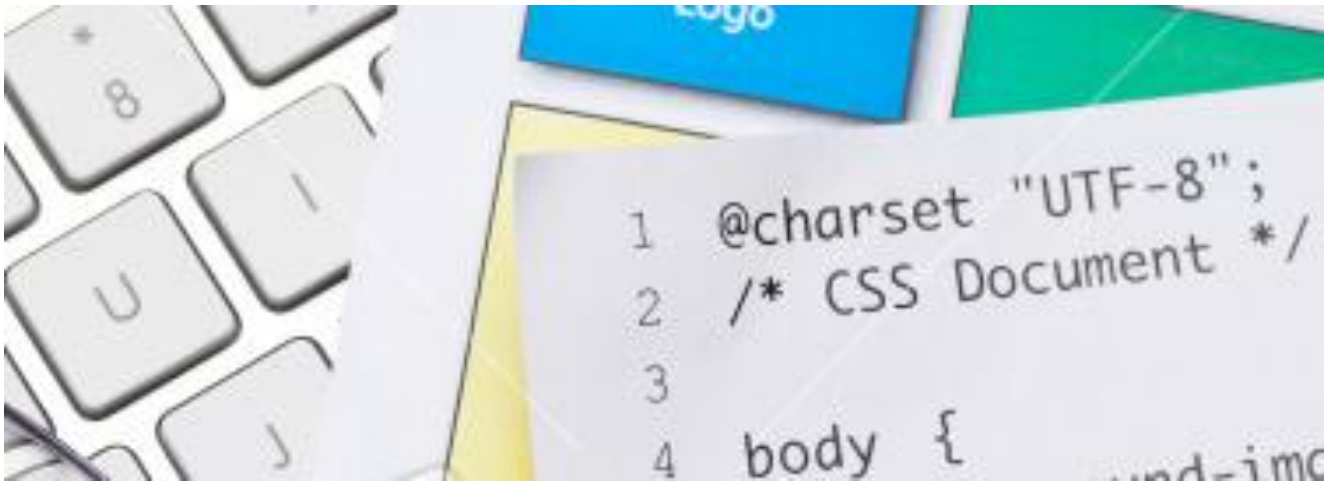
Responsive template design for dynamic learning personalization

From single source/multiple channel to responsive content template design for dynamic learning personalization



Summary

Until now, producing effective learning content has required the right pedagogical approach, a high level of creativity, effective production methodologies and an appropriate set of tools.

Today's learning content authoring community is going even further.

Instructional designers want to be able to turn learning content into a live and ever evolving learning experience that can attract users and keep them engaged whilst adapting to their users' skills, devices and context of use.

They need content to hook into users' workflow status, delivering the right piece of learning wherever and whenever the user needs it, adapting to his or her skills and tasks to be accomplished, detecting devices and location of use.

In a nutshell learning content must be personalized and localized so as to be available in a "*context responsive*" way, just in time and just as much as needed.

Achieving this with the instructional tools and solutions authors have had to date has been challenging if not impossible.

In recent years in the eLearning authoring market, XML template-based production has emerged as the primary solution to the problem of producing smart content independent of delivery devices. Now templates are becoming even more responsive, in the quest to achieve learning personalization and adaptation to user needs, by profiling users at run time.

This paper highlights both the advantages of adopting an object oriented, XML and template based approach to your instructional design. It also describes the immediate future, when next generation Learning Content Management systems will understand the many variables of a proper learning

experience and personalize users' content on the fly, whilst detecting the delivery context.

The last part of the paper describes how the new version 10 of eXact learning LCMS enters into responsive template design with an innovative solution named XPRE, ***XML based Processing Run time Engine***, expanding traditional template-based single source / multiple channel content batch publishing with live content adaptation capabilities at run time.

XML: the secret ingredient

Markup languages emerged as an attempt to standardize data representation so that data could be interpreted in the same way by different software programs. They were, in other words, a form of universally known meta-language aimed at assuring interoperability among different software applications. Generic markup languages, such as SGML (Standard Generalized Markup Language) were created as part of the solution to these problems.

An introduction to XML language

XML (eXtensible Markup Language) was born as an application profile of ISO standard SGML in the mid-1990s, and became a W3C Recommendation in 1998. Indeed, though SGML was universally judged as a capable standard for editing and structuring documentation, the original goal of having SGML documents thoroughly processed and interpreted by software applications and database structures had made SGML language way too rigorous for the needs of the emerging "World Wide Web".

For this reason, a task force of eleven researchers, supported by an external Interest Group of approximately 150 members, gave birth in a few months to the first release of the XML specification (the XML specification is 26 pages long whereas the SGML specification is 500). Thanks to the rigorous work of the XML working group (which, interestingly enough, never met face-to-face, accomplishing all of the design through a combination of email exchange and regular teleconferences), in less than two years XML 1.0 had become a W3C Recommendation and, only a few years later, a de facto standard for web-based content structuring, software configuration and web-mediated communication.

Advantages of XML

The key advantages of XML, compared to other markup languages such as its cousin "HTML" (HyperText Markup Language) are mainly:

- the separation of logical and physical structures (or, in other words, the separation between elements of document structure and the entities - text, media or, more generally, data)
- the separation of data and metadata (or, the separation between content and descriptions about the content itself, such as a quotation and the author and date of the quotation itself)
- the ability to virtually embed in a document any sort of source document as an external resource
- the separation of document semantics from its representation (meaning: content does not change, whatever presentation style and technology is used to show it to the end user)

But the real value of XML is the ability to adapt to the specific needs of any publication requirement and describe, in a virtual way, any sort of document structure.

XML rapidly became the ideal technology to support major content-related requirements including searching and retrieving, document re-purposing and component re-use, and information and data interchange across different systems and technologies.

The real value of XML

It is critical to emphasize that each organization should only evaluate data formats based on the issues that are important to them. For instance, if "Distributing Page Image Representations" is the ONLY issue that is important, the PDF file format is a very good option (the best option, for some), but we may question whether it is the best format to support content distribution to eBook readers (there is a strong debate on the advantages of the different formats available, especially DocBook and ePub, but we'll touch on this later on in this document).

When it comes to describing content in a structured and semantic way - keeping content separate from its presentation style and layout - XML is generally considered a very good (if not the best) fit.

Indeed, it benefits from all (or almost all) the advantages of its predecessor SGML, but has the key value of being extensible as well as much simpler to write and process (only the features important for web delivery have been retained).

On the other hand, keeping a complete separation of content from its representation (which, in turn, is not supposed to be described in XML), the XML language is often combined with other technologies (typically XSL (eXtensible Stylesheet Language) and XSLT (XSL Transformation), but also Flash, C#, PHP and more). In particular, with the advent of Ajax technology, XML has become the real core of web and mobile web applications.

The need for XML schemas

If we highlight just one value of adopting an XML-based documentation format, we can point to its flexibility, the ability to represent almost any sort of documentation. XML tags (meta descriptions of content fragments and information units) may be defined to support specific needs. Indeed you may easily define your own XML structure to archive your DVDs, such as the one in the following example:

```
<movie>
  <title>2001: A Space Odyssey
(1968)</title>
  <director>Stanley Kubrick</director>
  <year>1968</year>
</movie>
```

And then extend it to host the location of your DVD copy in your own archive, indicating that the movie can be found in the dark bookshelf of your living room, third shelf, position 4:

```
<movie>
  <title>2001: A Space Odyssey
(1968)</title>
  <director>Stanley Kubrick</director>
  <year>1968</year>
  <location>
    <room>Living room</room>
    <bookshelf>Dark bookshelf on the
left</bookshelf>
    <shelf>3</shelf>
    <position>4</position>
</movie>
```

Now, this is clearly a personal XML "schema", matching the personal organisation structure of the DVD owner, and we can imagine that different people would define different XML schemas to say the same thing.
Unfortunately, machines are not as flexible as the human mind, and for a software program to understand the location of your DVD, you will have to choose one of the available XML formats, whether it is a de jure or de facto standard (to be honest, no XML schema really exists for the sake of DVD filing, but here [http://en.wikipedia.org/wiki/List_of_XML_markup_languages] you can find an extensive list of available XML schemas).

So, for a software program to interpret and process an XML document, the document should follow a known grammar (or schema) which differs depending on the context for which the XML schema was developed. Among the existing standards, this document will only mention a few standards produced by the publishing and educational market - expecially DITA (Darwinian Information Typing Architecture), DocBook (a markup language for technical documentation), EPUB (Elecronic Publication, an open e-book standard) and SCORM (an XML-based content packaging format XML for web-based eLearning). Other formats are important nowadays for web content design and mashup, such as syndication standards (among these, RSS and ATOM are the most well known) and data exchange among different systems and components (messages exchanged across Web Services are mostly in XML format).

A template-based learning approach to content production

Structuring a document according to a schema does not merely ensure that the document can be processed by a software application. In reality, structuring a document according to a common grammar (or, in XML terms, a shared schema) ensures consistency of the content and makes life much easier for editors.

Structured vs visual authoring

XML-based authoring allows writers to make seamless use of multiple output formats. Transforming a document into different representations for web delivery (e.g. a blog article), mobile consumption, a printed newspaper and/or magazine makes structured authoring ideal for today's web-based world.

Moreover, XML allows technical writers to focus on content without having to worry about its visual representation (paragraphs exceeding page margin, images not well aligned, block quotes not well distinguished from the rest of the text etc). Through visual editing (such as authoring modalities provided by WYSIWYG - What You See Is What You Get - authoring tools), structured authoring forces a writer to maintain an organized approach when writing because of the nature of XML itself.

Structured content authoring tools often offer an in-between solution. They provide structured content authoring facilities integrated with quick preview functions. This allows the author to preview how each document is likely to appear to the end user in a variety of target formats and devices.

"RIAD", more than just an acronym

In reality, what makes a learning content design successful is:

- The appropriate level of granularity, which helps maximise the reusability of the same learning object (learning unit, learning component) in a variety of contexts
- The minimum compliance of the learning object with interoperability standards, which ensures the ability to use it under different delivery conditions (different LMSs, different browsers, different devices)
- Its accessibility level or, even better, the ability to access it from all required learning contexts
- The durability of content objects, which, in more general terms, we may define as "scalability of content", meaning its ability to maintain, if not improve, its effectiveness and performance as the number of users and contexts in which it is used are increased and diversified.

The ability of an object to respect the required level of "RIAD" (Reusability, Interoperability, Accessibility, Durability) strongly depends on two main components:

- Its design - meaning the instructional methodology upon which the learning effectiveness of the learning object has been built
- The technological component, such as its output format or the authoring tools adopted to create it.

Learning design, which embodies all the instructional approach adopted, and rendering technology, which takes care of user experience and content interactivity, are two key drivers of a successful approach to learning content production. This is where a template-based approach to learning content production makes all the difference.

From learning theory to learning content

Learning is mainly about knowledge acquisition. Instructional Design (also known as Instructional Systems Design - ISD) is the art of creating instructional experiences that contribute to the acquisition of knowledge and skills, making it more efficient, effective, and appealing. Though different instructional theories and practices may be put in place for a specific learning program, the whole learning process usually starts from the definition of the current state and needs of the learner, defining the actual learning objectives (the goal), and designing a learning experience that will leverage the existing knowledge and skills in each learner to transfer more knowledge and more skills.

The outcome of this process must be observable and measurable, though often intermediate steps are not monitored and measured but, rather, kept hidden and assumed.

There are many instructional design models. Some are based on the ADDIE 5 steps model. Others have a more constructivist approach.

LCMSs and authoring tools help authors create and tune course activities. Nonetheless, an effective instructional design environment should also give course authors visibility over the training needs of the target population and help them design effective and appealing learning experiences, applying their own

preferred learning and instructional theories and methodologies.

The real advantages of a template-based authoring tool

Learning Object templates are the core component of innovative learning content authoring and management solutions.

Templates can be as simple as a sequence of screens with placeholders for text and media or as rich and effective as a pedagogical structure filled with a variety of learning activities, from basic knowledge presentation to rich and dynamic learning paths including interactive assessments and remediation components.

In general terms, templates can be considered conceptual and visual models for specific learning units. In terms of interface and functionalities, they define what will appear on learners' screens (or in a printed page, an eBook screen and so forth) based on the learning objectives to be conveyed.

Among the benefits of a template-based content production process it's worth mentioning:

- The separation of the logical, abstract content structure from its visual representation, which will favor the ability to create different outputs from a single content structure, as shown in Figure 1
- Fast implementation of a standard

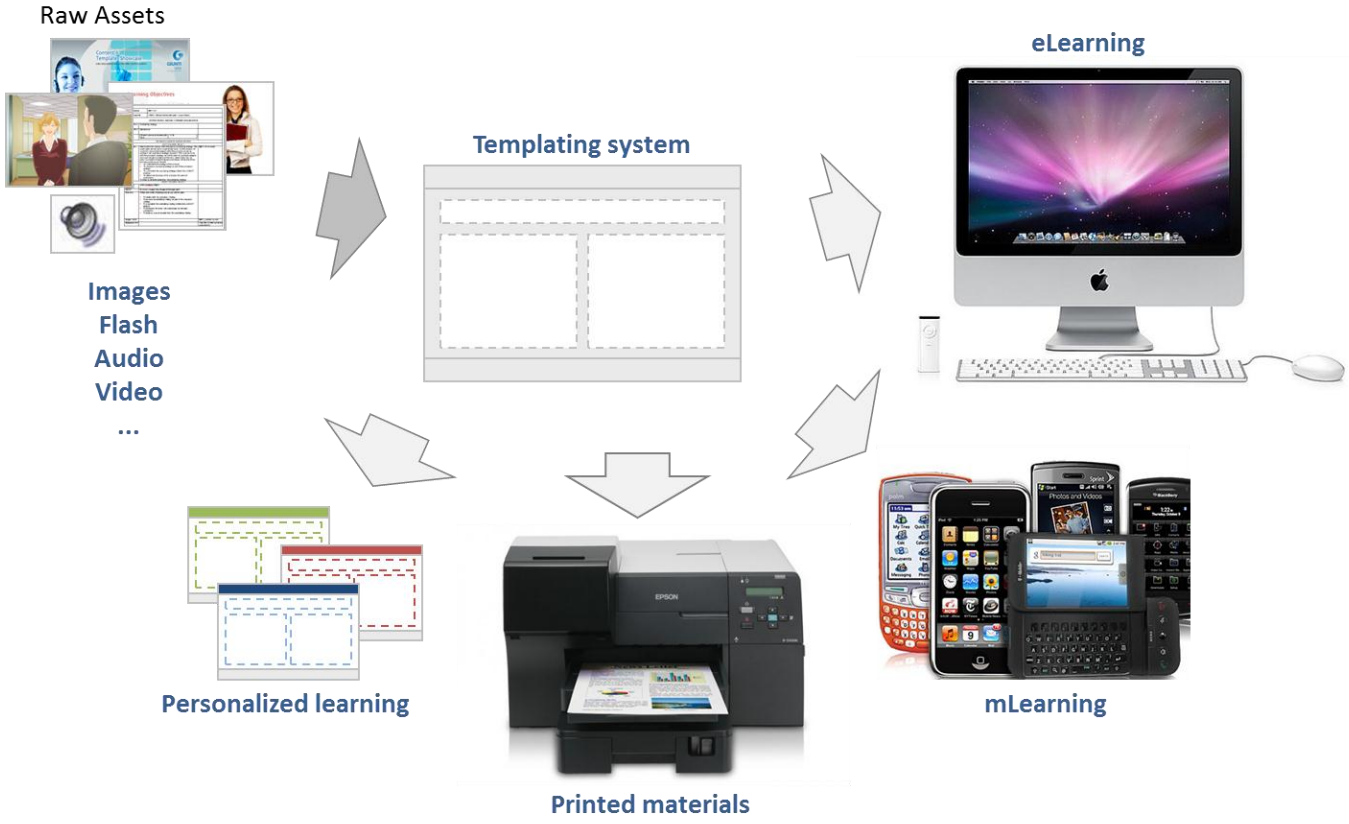


Figure 1: Templates allow aggregating raw assets into effective, multichannel eLearning

learning unit by combining pre-existing or tailor-made raw assets.
- Easy production of highly interactive learning content by dropping resource files into placeholders; final screens are automatically generated and embedded in a visual shell with no need for programming skills
- Consistency of final results; all screens and screen components are represented according to template layout properties

In a more general sense, templates support the overall content design and production process since every action is guided by the pedagogical structure embedded in the template. Indeed, storyboards are often created taking into consideration the available templates and media are produced following guidelines that can be easily defined as part of the template design.

In short, a template-based approach to content production is a good fit to maximize reusability of content, reduce content production cost and time (thus, lowering time to market and increasing the competitiveness of your organization.

XML-based template structures

A template structure consists of a schema of meaningful learning object components that can be collated to create pedagogically sound, user friendly, attractive learning content. Given the nature of learning content and the often recurring pedagogical schema driving the implementation of most learning units, XML technology is a good fit to describe a template structure, its components (screens, pages, exercises, questions) and how they are supposed to relate to each other.

To better understand what a XML-based template structure is, let us start with a simple example. We will see richer and more real-world examples in the case studies in the following section of this document.

We can see a simple learning object template structure comprising the following items (for the sake of simplicity we will use as an example a traditional WBT course):

- A welcome screen, introducing the learning unit with no special content (unit title, some metadata such as expected duration, indications of whether the object makes use of audio, video or interactive components, maybe some background music and a picture)
- A screen summarizing topics and learning objectives addressed in the Learning Object
- A sequence of learning activities (some of which are expositive, while others are more interactive) aiming at the presentation of the topics addressed in the learning object. Learning activities may be organized into sections (chapters, paragraphs, and so on).
- At the end of the learning object (or after each section) a final test assesses the learner's achievements. The assessments might be more or less strict, and contain remediation paths - suggesting the learner should return to specific screens or sections of the learning object, review the topics there and try to answer the same questions again. Assessments may also provide learners with a variety of intermediate and final feedback messages (those may be per question, per test bank, per learning object section).

- The learning experience might finish with a screen summarizing the learning outcomes that the learner is now expected to have reached, and the suggested readings or follow-up activities for those who want to know more.
- At the very end of the learning object, a credits screen might indicate the contributors to the learning unit and request feedback to the editors about the quality perceived by the learner as well as how the learning object may be further improved.

The learning object structure described above, besides its likelihood or pedagogical value, is a typical example of a structured document with educational purposes, regardless of the format in which the document is distributed (WBT, eBook, printed material, live speech or interactive seminar). Again, in order to simplify our explanations within the scope of this document, let us assume the document structure described above is meant to be distributed in the form of a standard WBT unit or, in more general terms, as a web-based "learning object".

Now, to produce several learning objects all sharing the same pedagogical structure depicted above, it is a good idea to adopt a template-based authoring solution that will guide our distributed team of editors and instructional designers in the production of the whole learning object set (if not, as in most cases, an entire eLearning catalogue).

In order to define a template supporting the production of a set of learning objects similar to the one described above, we might start from the definition of a common content structure. This might look like the following example:

- One welcome screen summarizing overall learning object properties
- One screen summarizing topics addressed and learning objectives
- Any number of learning object sections, each containing multiple screens. Each screen may be:
  - A linear or flat representation of a concept, with no special interactivity (the user is mainly passive)
  - An explorative screen requesting the user to interact with the content to access all the knowledge contained in it
  - An interactive exercise challenging the user in showing how much knowledge has already been acquired
- An assessment section including any number of questions that the user should answer in order to successfully complete the learning activity. The assessment section may optionally include a screen about test results, displaying to the user how s/he performed. This same information would be stored in learner's gradebook and would contribute to her/his learning achievements.
- A screen summarizing the learning outcomes (similar to the one introducing the learning objectives at the beginning of the learning object)
- A credits screen listing all relevant contributions for the learning object and any special copyright notice on attached materials (if needed).

Such document structure may be easily formalized in the XML language. Depending on the tools adopted for content authoring,

different XML notations are possible. The one suggested below is only an example of XML-based document structure to drive the production of simple learning objects. For the sake of simplicity, we will consider the term "learning object" as a synonym of "course".

```
<course>
      <screen type="welcome">
            ...
      </screen>
      <screen type="objectives">
            ...
      </screen>
      <section>
            <name>...</name>
            <screen type="standard">
                  ...
            </screen>
            <screen type="standard">
                  ...
            </screen>
            <screen type="video">
                  ...
            </screen>
            <screen type="simulation">
                  ...
            </screen>
            <screen type="..." />
      </section>
      <test>
            <question type="radio">
                  ...
            </question>
            <question type="checkbox">
                  ...
            </question>
            <question type="blanks">
                  ...
            </question>
            <question type="..." />
      </test>
      <screen type="summary">
            ...
      </screen>
      <screen type="credits">
            ...
      </screen>
</course>
```

As you may have noticed, the above XML structure tries to simplify the number of different item types constituting a "course" (or "learning object"). This is achieved by using a single "screen" component (tag) and giving it a different behavior through a "type" attribute. This way, any screen in the learning object will be represented as an extensible entity which may take different formats (welcome, standard presentation, video, simulation and so on).

So, to dive one level down in the XML representation, we may expand the "welcome screen" as in the following example:

```
      <screen type="welcome">
            <title>
                  Course title
            </title>
            <description>
                  Course description
            </description>
            <duration>
                  20 minutes
            </duration>
            ...
      </screen>
```

Some more attributes might indicate whether the learning object contains media elements or has other special requirements, as in the following example:

```
      <screen
            type="welcome"
            audio="yes"
            video="no">
            <title>
                  Course title
            </title>
            <description>
                  Course description
            </description>
            <duration>
                  20 minutes
            </duration>
            ...
      </screen>
```

You could claim that some of the information listed above is not properly part of the welcome screen semantics. Indeed, we said they are likely to be shown on the welcome screen, but course title, description and duration, as well as the indication of media elements contained in the course, are properties of the course itself.

This would also apply to other elements in the learning object structure. Indeed, learning objectives (tentatively shown on the second screen), learning outcomes and credits are also global information related to the course. There is no reason to represent them within dedicated "screen" tags which would, otherwise, contain information about content presentation (how the content will be presented to the end user) rather than the content itself.

For this reason, a more correct notation for the course sample described above would look like:

```
<course
      audio="yes"
      video="no"
      duration="20 minutes">
      <objectives>
            ...
      </objectives>
      <outcomes>
            ...
      </outcomes>
      <credits>
            ...
      </credits>
      <section>
            ...
      </section>
      <test>
            ...
      </test>
</course>
```

In this notation, four "screen" tags were removed since they do not really provide semantic information (welcome, objectives, outcomes, credits) and only those elements that describe the content structure remain.

One final consideration about the XML notation proposed above might be that the "screen" concept may well fit the nature of a WBT (Web-Based Training) unit, but it is inappropriate when considering alternative ways in which the same content structure might be presented (e.g. in the form of a printout or textbook).

So we will replace the "concept" of "screen" with something more meaningful, such as "learning activity" or, simply, "activity".

Here, then, is our learning object representation in XML notation:

```
<course
      audio="yes"
      video="no"
      duration="20 minutes">
      <objectives>
            ...
      </objectives>
      <outcomes>
            ...
      </outcomes>
      <credits>
            ...
      </credits>
      <section>
            <activity type="..." />
            <activity type="..." />
            <activity ... />
      </section>
      <test>
            <question type="..." />
            <question type="..." />
            <question ... />
      </test>
</course>
```

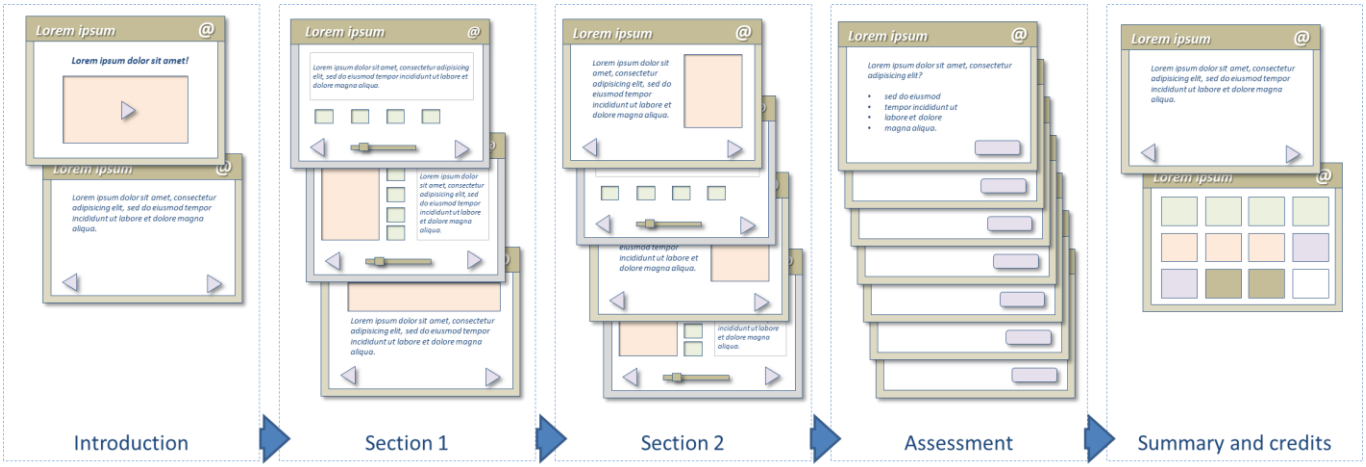


Figure 2: Wireframe representing the screens of a traditional Learning Object

Granularity, nesting and reuse

Structuring contents according to a defined template schema is a good investment because it helps writers produce learning materials which are consistent with each other and match a given pedagogical approach.

Considering the time and effort spent by experts to create effective educational content, reusing content is an important ROI source for learning organizations. Indeed, although each eLearning project is usually covered by a dedicated budget allocation, there is usually a great benefit in reusing the output of such investment for further initiatives related to training, knowledge distribution, marketing.

Maximizing the reusability of a document or learning object means, among other things, being able to structure it in single, independent, small-enough pieces of content. From a pedagogical and publishing perspective, this may go from the "learning unit"(or "learning object") level down to the single components of that same learning object (interactive screens, external resources, articles, quotations and more).

Adopting a template schema as part of the authoring and publishing infrastructure also significantly enhances the reusability of content fragments and document chunks across multimodal, multifaceted publishing processes. Looking at the example above, we may consider that what we called "learning activity" (or simply "activity") may, in principle, consist of any content fragment that, as long as it consistently addresses a given learning objective, may exist on its own and be repurposed in a variety of content and learning structures. So, for instance, an activity where learners can listen to a conversation in a foreign language and should understand a list of key topics addressed in the conversation is an activity that may be repurposed in a variety of language courses.

A similar concept applies to other components of learning units or, more generally, digital documents such as learning tools, knowledge bases, additional resources and so on.

Extending the template infrastructure to easily and seamlessly nest learning activities, learning tools (glossaries, bibliographies, webographies), external resources (articles, papers, wikis, blogs), question banks and more into different documents and document sections is a good way to improve the reusability of learning components developed by a publishing team or community.

A template-aware Learning Content Management System should support the storage and sharing of learning and content fragments at the required level of granularity in order to maximize the return on investment of the publishing processes taking place within the organization. Authors should be able to explore (browse, search or otherwise scan) the available learning resources in the shared digital repository and, where appropriate, opt for reusing existing materials instead of developing them from scratch every time. This potentially applies to any component of the learning objects, from learning activities (or, depending on the nomenclature adopted, pages, sections, screens, paragraphs, chapters) to learning tools (glossaries and glossary items, reading lists and book references) and re-occurring components (such as the credits screen in all learning Objects of a course catalogue).

Single source, multiple output

A natural extension of the reusability concept, particularly when talking about a template-based authoring environment empowered by XML technology, is the concept of "multiple output". This is the ability of an authoring or learning content management solution to produce multiple output materials from a single set of source documentation, through a single publishing process. Those familiar with XML technology will immediately appreciate the advantages that such technology offers to multi-output scenarios.

Defining a learning object structure and all content through an extensible, single source, granular template-based engine enables content editors and instructional designers to design their contents in a way that the same learning object may be delivered, seamlessly and according to the actual learning and knowledge demand, in different output formats and through a variety of delivery channels.

When talking about web-based learning content, the term RWD ("Responsive Web Design") is currently trending in the media community. Adaptive responsiveness of contents is a good fit for many single source scenarios, including the delivery of digital and eLearning contents to mobile devices with different OS/browser requirements (iOS, Android, Windows) as well as screen size (smartphone, tablet) and orientation. There are clear advantages in approaching multi-output requirements with a responsive approach, particularly that a single content package can be distributed to all target devices for offline browsing, without the need to make different packages for different target populations.

At the same time, a similar approach does not cover all the needs related to the distribution of multiple content variations. Limitations of a multi-output approach only based on RWD include the fact that it produces heavier packages (for instance, the same video file might be needed in multiple formats such as FLV for desktop use and one or more mp4, or similar formats, for target mobile devices.

Again, some images may be needed in different resolutions to achieve the best results on different screens). Moreover, the need to produce contents for different technologies requires additional technologies and methodologies that can produce, as part of the publishing process and based on the publishing workflows, different versions (variations) of the same document - each in the format most suited to the expected distribution channels and target populations. This may include the production, from single source content, of a responsive web version (able to adapt itself to different web browsers and different web-capable devices including desktop PCs, tables, smartphones and smart TVs), a downloadable PDF version (most often two, with different resolutions and, thus, file size), one or more eBook-suitable formats (such as different versions of EPUB, as well as a DocBook version), and possible other formats such as a print-shop ready high resolution file.

A template-based approach is of vital importance for a multi-output publishing process not only for its ability to produce several publications out of single source documentation and one publishing process, but also because it makes content maintenance processes easier and more cost-effective, thus achieving the key goal of content "durability".

From single source to adaptive learning

If the effectiveness of a content production process, combined with the quality and durability of output content is a key success factor for many eLearning projects (we are, of course, not talking about rapid authoring, which follows a completely different paradigm), templates may help achieve a further level of effectiveness for eLearning in knowledge organizations. Indeed, a template set may leverage the advantages of dynamic learning activity structures combined with responsive output design to produce highly adaptive learning objects that instructors may combine to produce immersive learning activities with effective assessment mechanisms and measurable results.

Examples from the market

This chapter collects some examples of content production projects leveraging a template-based approach. The examples come from different domains, in particular a soft skills eLearning catalogue for vocational training, academic learning materials for high end masters education and, finally, an experience of medical education based on the concept of "virtual practice".

Cegos eLearning catalogue

Cegos' catalogue provides more than 200 modules in nine languages with options for using these in the context of blended learning, serving around 200,000 learners worldwide. This means that the Cegos catalogue represents Europe's largest initiative in soft skills eLearning catalogue development. The Cegos materials are sold online and internationally by Cegos subsidiaries. Cegos' consultants visit Fortune 500 corporate clients worldwide.

A template-based catalogue production

The eLearning catalogue by Cegos (http://www.elearning-cegos.com/) is a good example of well-designed eLearning content. Cegos started building its Soft Skills eLearning catalogue some years ago. The project started with a thorough analysis of the learning needs of target population and a

careful design of the user experience (UX). Cegos' direct experience in classroom-based training was of great help in transferring effective training strategies to the design of eLearning modules.

Once learning design was completed and the first Learning Object prototypes ready, the actual templates were designed and produced. The design of the templates was driven by the twofold objective of producing effective eLearning modules implementing a successful pedagogical (or rather "andragogical") methodology into eLearning for target trainees, as well as providing content editors and instructional designers with an authoring environment that could help them implement what they needed to produce.

Among Cegos' key requirements are:

- Learning Objects should reflect the pedagogical approach and UX metaphor that Cegos had developed across years of experience in the field
- Learning Objects should extensively support content localization, and provide instant access to the same Learning Object in up to eight languages (including non-western languages)
- The interactivity level of learning activities should be relatively high, with predominant use of video-scenarios and interactive exercises or simulations (such as writing an email, arranging a business meeting or conducting an interview)
- All Learning Objects constituting the Soft Skills catalogue should be highly consistent with each other and match the overall business needs of the blended learning offering (classroom-based training and eLearning catalogue)
- Single Learning Objects, as well as the whole eLearning catalogue, should be easy to rebrand, in order to match the branding and layout guidelines of the organizations that will acquire it for their own long term training projects
- Templates should be jointly produced by a cross-disciplinary team involving Cegos' educators and media developers as well as external eLearning and technology consultants
- Templates should be easy to maintain and extend in house, without the need for external consultants or developers

Self-consistent, highly interactive learning modules

The outcome of this project was an impressive eLearning library housing over 1000 hours of eLearning programs, with 38 collections available in eight languages, where each eLearning module lasts between 30 and 40 minutes.

Each Learning Object follows the same content schema. A Learning Object comprises four or five "pedagogical situations" (a sort of problem-based learning activity), represented in the user interface according to a special metaphor (situations may be represented by the rooms of a building floor, the areas of an island or simply the sub-component of a geometric shape, such as a cube).

Pedagogical situations comprise a variable number of pedagogical activities (presentations, simulations, scenarios or other exercises) and are supported by external resources as well as other learning materials (attachments, syllabus, a note-taking tool).

Learners can freely browse the different pedagogical situations (or "sections") of each module, although it is possible for instructional designers to set preconditions and force navigation rules (such as "learner cannot access the question until the video scenario is completed", or "learner must go through a test bank sequentially and answer each question before accessing the next one).

Screen types supported in Cegos templates include:

- Sequence introduction and conclusion (opening and closing a Pedagogical Situation)
- Various combinations of text and media elements
- Dynamic animation, synching images and labels with a background movie or audio file
- Single and multiple choice questions (including true/false checklist)
- Different versions of Fill-in-the-blanks exercises
- Various matching exercises
- Sorting and ranking exercises
- Reveal content (image and list explorations)
- Open text question
- Tabbed screen (each tab hosting any combination of the screen types mentioned above).

Figure 3 shows an example of Cegos eLearning module content structure as seen by content authors and reviewers within the authoring tool. Figure 4presents a similar eLearning module as seen by the learner (focus is on the table of contents).

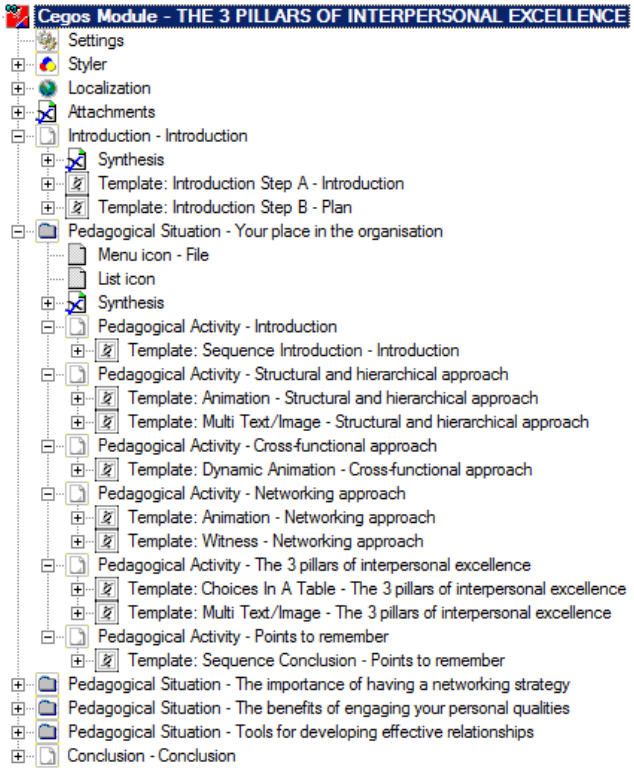


Figure 3: Structure of an eLearning module as seen within the authoring tool

In the above structure, most components are reusable templates. This means that they can easily be authored both separately and within their context of use (e.g. an interactive exercise can be produced as a separate object, then nested into the structure of one or more eLearning modules, or directly created within the structure of the module in which it is being embedded).

In particular, we can highlight three types of reusable components in the above structure:

- Containers, i.e. elements in the structure which are mainly meant to represent aggregations of other sub-items. Containers include:
  - the "Module", which is the "root" element of the structure and can contain any number of "Pedagogical situations" (usually 4)
  - The "Pedagogical situations" (main sections of the eLearning module)
  - "Pedagogical activities", which are the main components of the above mentioned "situations"
  - Tabbed screen template (allowing to create an aggregation of interactive screens that learners can browse by clicking on tab-like labels
- Screen templates (such as the ones listed in the previous paragraph), which constitute the actual learning activities and exercises accessed by the learners
- Learning tools and resources (such as the attachments)
- A set of technical components and tools to support interface adaptation (color schemes, fonts, and so on) and localization (see below for more details on the localization of Cegos modules).

One module, 10+ languages

Cegos modules are designed for localization. Multi-language eLearning offerings at Cegos go far beyond standard content translation. Indeed, given the highly immersive learning

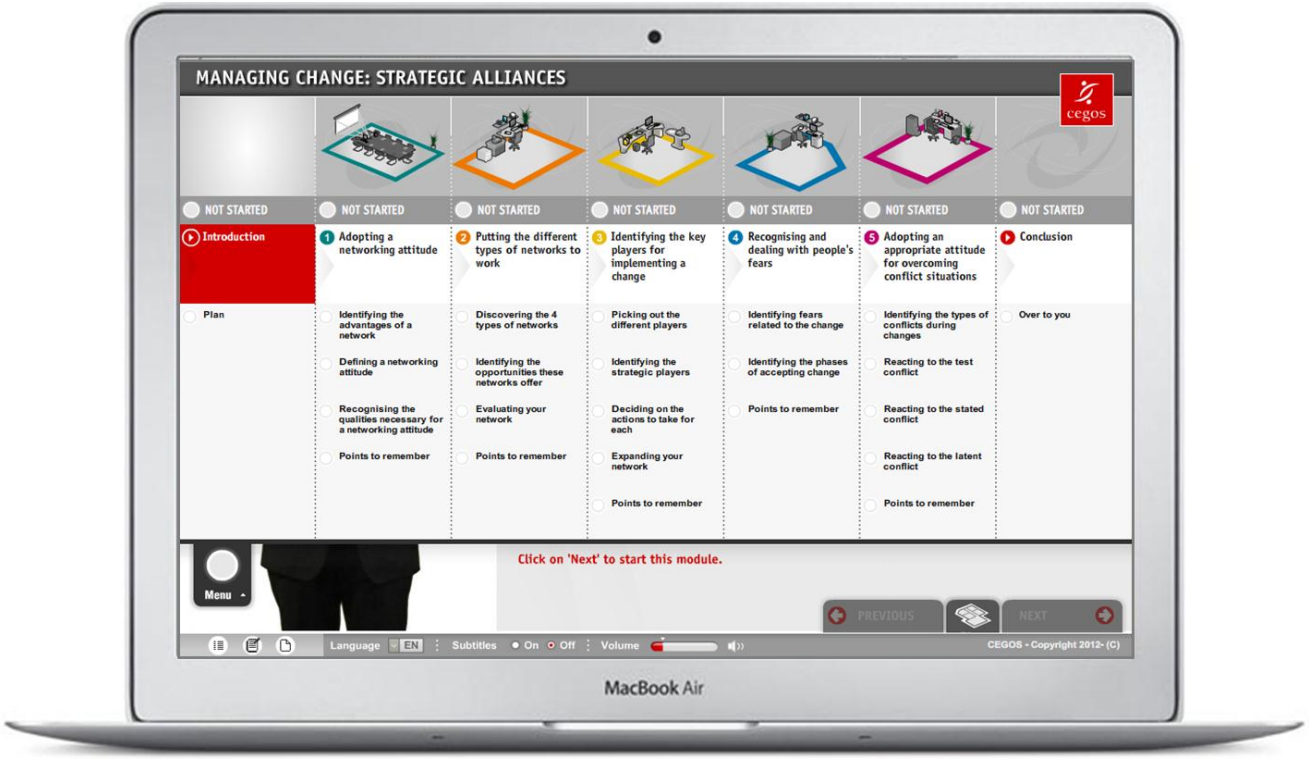


Figure 4: An example of multiple outputs leveraging Flash technology for best user experience on desktop.

scenarios constituting most parts of eLearning modules, the adaptation to specific markets is performed by the local operations of Cegos and requires a proper localization of content. This goes from the adoption of the appropriate speaker to the realization of appropriate video scenarios and navigation interfaces.

The outcome of multilingual eLearning content production is a learning unit which addresses the same learning objectives through similar learning activities but presents knowledge to learners, adapting it to the local culture and in a way that the learning process may be effective for each specific context of use of the eLearning catalogue.

The advantage of adopting a template-based content production process mainly resides in the ability to separate the production process from the localization activities that are performed by different teams at different times. eLearning modules may be delivered to organizations when only part of the localized versions are available. Thanks to separation of content from its presentation (or "rendering engine"), additional languages may be added to each module when they have been completed and passed the required review and sign-off phases. Adding a new language to an existing module is a matter of minutes and involves coupling the new language with the master module (which includes at least the English and French version) and running an automated process that merges the contents in the new language to those already available, in order to provide a single output module including n+1 languages at every step.

Repurposing learning objects for new media and devices

In Figure 4 we can see an example of a Cegos module with its feature-rich Flash-based user interface.

Given the success of the eLearning catalogue, which still sets the benchmark for soft skills eLearning, Cegos is considering extending its blended offer from classroom-based and eLearning to also include a mobile learning offering. Though a precise definition of next generation blended learning scenarios has not been produced at Cegos and the actual mobile offering is yet to be defined, some experiments have been done to extend current templates capabilities to cover mobile learning scenarios.

Under such circumstances, it would be possible to adopt a new adaptive template design to produce mobile-ready learning objects which would adapt its rendering technology (e.g. HTML5 in place of Flash) and style (an adaptive design would be required for course delivery on a Smartphone) to deliver an adapted learning experience on a variety of new target devices. In Figure 5, we can see an example of a learning unit originally designed for desktop learners, then adapted for smartphone access. This sample includes video and audio synchronization, highly interactive menu and exercises, instant feedback on the progress of the learner across the different pedagogical situations included in the learning unit.

About Cegos

Cegos Group, established in 1926 is the European leader in professional education and one of the major global players. Its consultants have expertise across all subject areas in management and developing competencies: human resources, management and leadership, performance and organizational skills, individual and team performance, marketing and commercial, project management, deployment of large training systems in France and internationally. With some 30 local offices around Europe and Asia, Cegos employs 1,200 consultants and works in 30 countries across the globe.

For more information:
http://www.cegos.com/

U21Global Graduate School training materials

U21Global Graduate School has a long lasting experience in e-content production, which has given rise to a set of online courses in the framework of Business Administration and Information Systems Management. U21Global has produced more than a thousand hours of e-content delivered worldwide to a selected range of target users.

U21Global Graduate School subjects are designed to develop practical, problem-solving skills. The use of case studies within subjects helps students develop solutions to real-world issues. Students may work in teams to solve such problems that are integrated into the design of the subjects.

Active communication among students is encouraged through the use of email, chat, discussion forums, public folders, threaded discussions and other Web-based communications tools. Where appropriate, students are also encouraged to incorporate their professional and social experiences into their learning process.

A clear focus on standards

In order to create large volumes of durable and interoperable contents, compliant with most well established e-learning and accessibility standards (content is packed and tracked according to SCORM 1.2, and will thus be deliverable on any standard-compliant LMS and conformant to WCAG 1.0, level 1), U21Global Graduate School adopted a centralized LCMS solution through which all stakeholders of the content production and review cycle can contribute to the highly distributed and controlled publishing process.

Figure 5: An example of a mobile learning pill developed with a template-based approach. This sample was not produced by Cegos but is mentioned here as a relevant example of responsive eLearning design.

Improving an effective content strategy

Starting from successful content samples, the result of years of experience in e-content production, U21Global decided to adopt an XML-based Learning Object Modeling approach to authoring. This produces a centralized, controlled and effective content production process following the quality, tracking and accessibility criteria that make U21Global products a successful example of well-established high quality eLearning content. By adopting this approach to eLearning, U21Global produces interactive contents in a controlled and effective way, and re-purposes pre-existing static content into a new durable format. Adopting a template-driven LCMS environment, U21Global could bridge the gap between producing traditional high cost e-content and bulk-producing high quality, reusable learning content.

Ensuring consistency

When U21Global first started its transition to XML-powered Learning Object templates, learning content production was assigned to five vendors, each adopting a different authoring technology and coding style to produce objects with basically same look, feel and pedagogical approach.

The main aims of U21Global were twofold. On the one hand, learning objects should have the same content structure and user experience paradigm as the existing legacy content - while increasing the granularity of the learning modules so as to improve the reusability of single learning object components (such as animations, exercises, stimuli for discussion, glossary items and so forth). On the other hand, the new XML-based learning object structures should allow for easier and effective multi-delivery output of

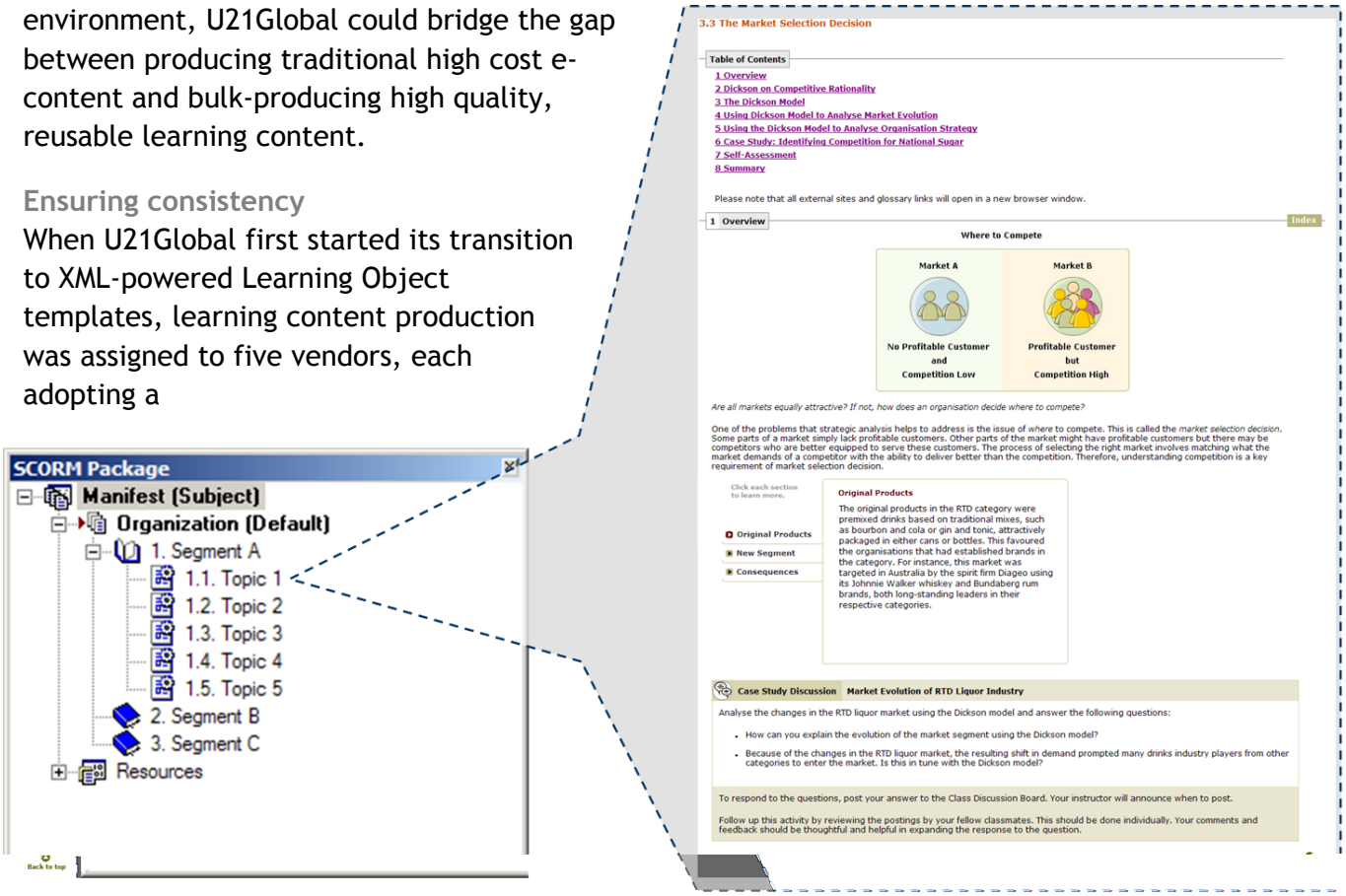


Figure 6: Content breakdown of U21Global subjects, from SCORM Packaging down to Learning Object templates and sub-templates

the same e-content to different formats (including extensive support for accessibility guidelines and screen reader requirements and devices.

As part of the adoption of an XML-based template technology, U21Global also decided to “retrofit” most of the existing content, making it available in the same format as the new learning modules being created with the “new” approach and technology described above.

Learning Objects granularity

eLearning courses at U21Global Graduate School consist in multi-SCO SCORM packages called "Subjects". Subjects begin with a brief introductory segment with useful information and initial instructions for getting started. An introduction outlines the nature and scope of the subject and defines the subject's learning objectives in terms of competencies that the student will achieve. Subjects are then presented in a series of segments, each an intellectually coherent unit with clearly-stated objectives. Each segment is made up of topics, which are the actual units of learning (Learning Objects).

Every "Topic" is a Learning Object produced through a set of custom built templates, to ensure the required level of quality, consistency and reusability.

Topics are, themselves, split into "Sub-Topics", which embed the actual content fragments constituting the learning materials.

Unlike some eLearning contents, U21Global Topics are not built on the usual "screen sequence" user experience metaphor but, rather, each Topic is a "document" with links to more detailed information or explorative media.

In Figure 6 we can see an example of subject breakdown, where the actual topic (named "The Market Selection Decision") is made up of eight subtopics. All topics start with an "Overview" and finish with a "Self-Assessment" and a "Summary".

The rest of the topic contents are built by aggregating a number of "Subtopics" (each built through a Subtopic Learning Object template). Subtopics may host a number of content fragments, including:

- Formatted text or tables
- Static pictures or interactive animations
- Links to media files (videos or simulations)
- Links to additional information or examples
- A number of thematic boxes, each identified by a different icon and color scheme, such as "Discussion box", "Objectives box", "Reflection box", "Reading box" or "Glossary" box. Thematic boxes encourage learners to do additional study activities alone or in groups
- Additional resource files (such as attachments or explanations)

At the end of each topic, an interactive "Self-Assessment" allows learners to check their understanding and go back to remediation materials where needed.

Advantages of XML standards adoption

When U21Global Graduate School adopted a template-based authoring tool, a significant number of subjects were already distributed to students worldwide. The adoption of a template-based approach allowed U21Global to implement a more effective content

production cycle, where the already established Pedagogical Approach could be embodied into the new, reusable Learning Object templates. The adoption of a central, XML-based technology allowed the organization to gain full control over content strategies (interactivity level, layout customization etc.) and thus centrally manage a large-scale content production process.

With no need for technical development skills in the internal eLearning team and with the possibility of incrementally developing new templates to include additional learning activities within the subjects, the new authoring approach was soon extended to the repurposing of existing learning materials.

In addition to optimising eLearning Content production and quality assurance, a goal of U21Global Graduate School was the provision of SCORM tracked content, to be delivered on one or more third party Learning Management Systems. Thanks to the implementation of a natively XML-based SCORM compliant technology, the adoption of the SCORM reference model was completely transparent to content developers, as well as all the technological implications of packaging, tracking and an accessibility-safe approach. Indeed, issuing SCORM-compliant content gave the institution a warranty of durable and freely reusable contents, without the need to re-adapt pre-existing content to as-yet unidentified new delivery environments (other LMSs, mobile devices, interactive TV, and so on).

About U21Global Graduate School

Established in June 2001, U21Global is a graduate school with a unique focus of global management education. The postgraduate programs offered by U21Global maintain the high standards of quality found at traditional research-intensive universities, but are delivered through an innovative, collaborative online model by a global faculty of qualified professors. This provides the students, who are working professionals from around the world, with a unique learning experience.

For more information:
http://www.u21global.edu.sg/

Continuous Professional Development in medicine

The third case in this paper is related to CPD (Continuous Professional Development) in medicine. The project, involving a global consortium of medical schools and universities whose name cannot be disclosed in this document, aimed at developing a “Virtual Practice” concept as a repository of interactive virtual patients that could be compiled and edited for a range of learning strategies including guided learning and problem-based learning. The "Virtual Practice" is an interoperable, internationally adopted teaching tool for sharing virtual clinical experience. The creation of a shared information model for virtual patients is a first significant step towards the development of interoperability standards for this innovative teaching approach. Virtual patients are, within the framework of this project, interactive learning contents created within the consortium and its extended medical community. The learning contents are fully IMS and SCORM compliant and ready to set the standards for a marketplace of CPD training packages to be exchanged with external communities and medical institutions. Among other things, the adoption of standard packaged content allows a transparent and

immediate integration with the leading LMS systems in the eLearning market.

The Virtual Patient concept

Virtual Practices are an interoperable, internationally adopted teaching tool for sharing virtual clinical experience. The project aims to create a library of Virtual Patients as a Problem-based, Holistic and Vocational approach to Medical Education. Under this framework, each Virtual Patient takes the form of a Reusable Learning Object (RLO). Every Patient is produced through a dedicated library of Learning Object templates and packaged as a SCORM package with fine-grained tracking abilities.

Each Virtual Practice collects real data from real medical cases, adapting them to the context of each patient and converting sensitive information (such as patient name, age, family status) into anonymous details consistent with the overall case presentation.

Figure 7: Home page of a Virtual Patient RLO

The layout of each Virtual Patient is inspired by the metaphor of a medical record, very similar to those produced and stored in real hospitals). Each patient record includes, among other things:

- Patient details (name, gender, age, marital status, ethnicity, occupation, education, social education, as well as a photo)
- A brief introduction to the patient, describing her/his current conditions and a short clinical summary
- Clinical reports related to current situation and recent screenings (including blood pressure values, blood analysis report, echocardiogram or doppler reports, X-rays, MRI or CT scans and such)
- A series of medical lists and charts showing the history of the patient and how her/his medical conditions have evolved over time

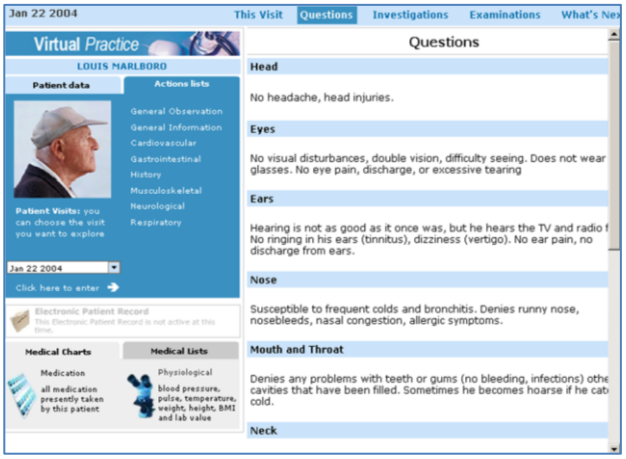


Figure 8: Layout of the initial page of each visit

The core part of each Virtual Practice is then structured into "visits", where each visit collects information from each doctor's visit to the patient. Visits are sorted by date (in descending order). They collect information about:

- Anamnesis (list of questions answered by the patient during the initial phase of the

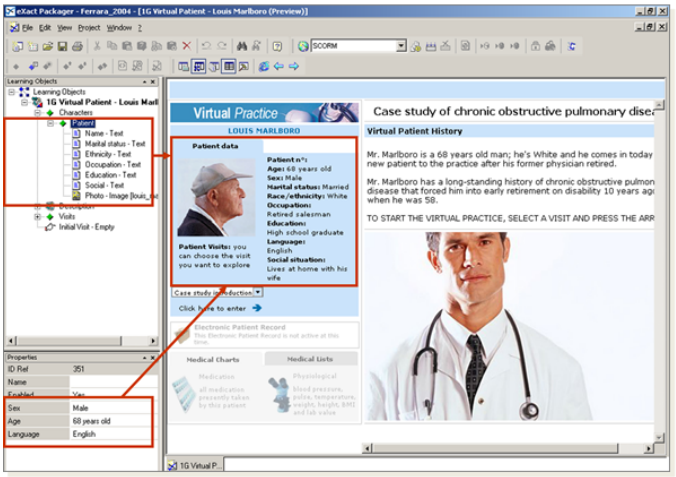
visit, mainly focussing on current symptoms and the patient's history)

- Investigations and Examinations (list of documents collected by the patient since s/he last visited, and reporting data from relevant investigations)
- Next steps (indications that the patient received from the doctor, which could contribute to a correct diagnosis, as well as suggestions for the medical trainee about what to study or consider before moving on to browsing the next visit)

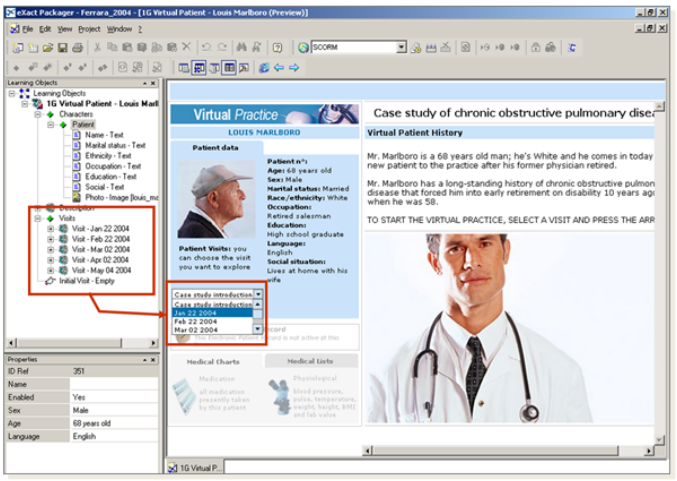
Reusability of patient components

Every Patient is the result of combining of real or real-life clinical information and a library of reusable Learning Object templates, each addressing a specific component of the Virtual Practice structure. In order to facilitate the exchange of medical details among different authors when producing the overall patients' library, each element in the breakdown of patient history was

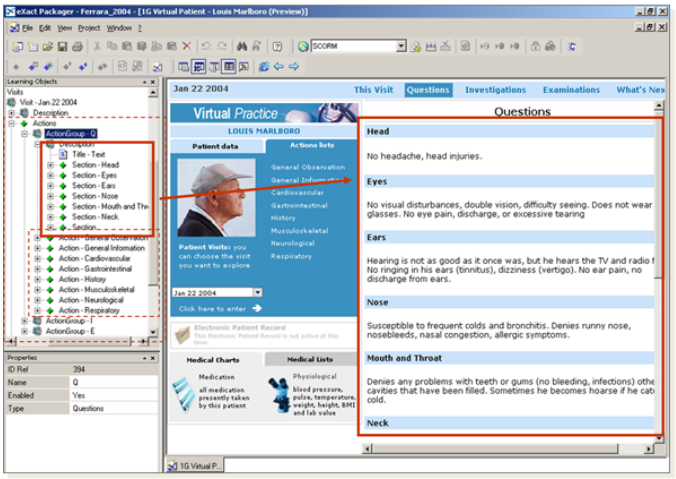
PATIENT DETAILS



VISITS LIST



SECTIONS OF ANAMNESIS TAB



ACTIONS LIST

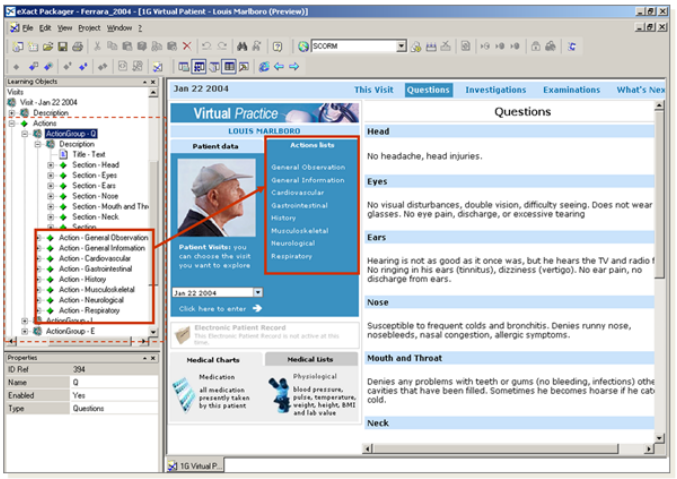


Figure 9: Breakdown of Virtual Practice Learning Object schema

implemented as a separate template. So every visit, as well as every visit component (anamnesis, diagnosis, prognosis) can be stored singularly in the central repository of cases and authors can pick and choose those components that might fit or improve the specific patient they were about to build or update.

As described in Figure 9, each visit, each "tab" in the clinical record and each fragment of information presented in the tab (questions, investigations, examinations etc.) correspond to a dedicated template with a pre-defined content structure (or, in technical terms, schema).

Defining virtual practice as a proprietary schema

The scenario described above highlights the effort of the medical community to build a Repository of interactive Virtual Patients that can be compiled and edited for a range of learning strategies including guided learning and problem-based learning.

This was achieved by implementing a content-centric approach to Continuous Professional Development in medicine, and relied on the adoption of a template-based authoring solution that could be extended to enable a large-scale, template-based production of Virtual Patients to be shared across the medical training community.

The creation of a shared information model for Virtual Patients was the first significant step towards the development of interoperability standards in the domain of medical education.

A robust and shared definition of an XML-based Virtual Patient schema was the first step towards a truly semantic interoperability within the medical community. RLO (Reusable Learning Object) Templates developed within this project fully supported this first step.

Benchmarked against current good practices in the international medical community, the Virtual Patient schema that emerged from the project has been further assessed in real training scenarios with the overall aim of achieving a common schema for Virtual Practice in medical education.

Several researchers and organizations are currently working on the definition of a shared schema for Virtual Practices.

Dynamic XML templating and rendering in exact learning LCMS 10

eXact learning LCMS is the industry reference Learning Content Management System that supports organization-wide, digital content production infrastructure relating to learning, knowledge dissemination and performance support. It maximizes existing content investment while empowering the learning content strategies that fit with and improve your key business processes.

eXact learning LCMS supports the management of learning content creation and delivery for organizations that require a scalable, extendable modular system to meet high-volume, professional and consistent learning output demand. The combination of rapid authoring capabilities and model-based automation of content production enables unrivaled levels of high-volume, professional and consistent learning output.

eXact learning LCMS version 10 contains a brand new Dynamic Learning Object

templating framework which extends the already powerful and flexible single source - multiple channel publishing capabilities offered by the overall eXact learning suite.

eXact learning LCMS 10 provides its authoring community with all the benefits of previous versions, including:

- Its template-based content production approach
- A common template framework for both offline (professional) and online (immediate and easy to use) authoring tools
- The Learning Object modeling framework, supported by off-the-shelf template libraries with high levels of granularity and reusability of Learning Object components and configurations
- The ability to plug user-friendly authoring interfaces into each template set and enable different user profiles in the production process, depending on the overall authoring scenario
- The ability for software and web developers to extend template capabilities through the set of APIs (Application Programming Interfaces) available in the off-the-shelf templates set
- The connection between Learning Object templates breakdown and the core content linking and version control engines

In addition, as a main point of innovation, eXact learning LCMS 10 introduces the new XPRE Technology (**X**ML based **P**rocessing **R**un time **E**ngine) supporting real-time Learning Object rendering, with the ability to attach multiple rendering engines, content format, layout style and device coverage at the very end of the publishing process. This enables the use of unforeseen scenarios of learning content adaptivity to specific learner preferences or alternative user profiling strategies.

For those requiring integration with a third party LMS or delivery portal, eXact learning LCMS 10 will provide both the abilty to render adaptive learning content on the fly and consolidate the same content objects in different standalone packages (e.g. a SCORM version, offline HTML version, iPhone or Android version, PDF printout etc) for further download, handover to LMS or alternative use.

Template-based authoring

The core templating technology is a unique feature of eXact learning LCMS, which often sets the baseline for eLearning publishing requirements, along with learning content strategy definition and implementation.

The templating approach adopted in eXact learning LCMS and its embedded authoring tools (Packager and Online Editor) combines the power of XML-based content modeling with the ease of use of semantic structuring and the flexibility of responsive web design technologies such as HTML5.

More details on the benefits of adopting eXact learning LCMS 10 and its template-based authoring features are provided in the following paragraphs.

Template-based content production

A common template framework for eLearning professionals and Subject Matter Experts

Fast-paced organizations often need to meet high-volume, professional and consistent learning output demand.

eXact learning LCMS 10 supports them by providing both rapid authoring capabilities and model-based automation of content production in different languages that can be delivered on different channels and platforms. Authors in eXact learning LCMS 10 can count on ready-to-use, open and extensible sets of Learning Object templates for online authoring as well as desktop authoring.

eXact learning LCMS provides a seamlessly integrated solution to support distributed, multi-disciplinary content production teams through the combination of Packager and Online Editor modules, together with the extensible set of Learning Object templates. This provides content and knowledge production teams with:

- An effective authoring capability and automation of content production in fast-paced environments
- A single, distributed template-based environment
- A seamless working environment for simple and advanced authoring tasks
- The ability to ingest pre-existing assets and convert them into multi-delivery packages
- The ability to be easily extended and customized to adapt to pre-existing content strategies and templates

Online Editor's templates are based on the same XML technology employed by eXact learning LCMS's professional desktop authoring tool, eXact learning Packager. Both tools enable controlled content production with remote users working on- and offline, with various levels of functionalities, through various access-controlled user profiles.

The seamless adoption of the same template set in both Packager and Online Editor makes eLearning publishing much more future proof and increases the overall ROI for learning organizations. Indeed, unlike other authoring and LCMS solutions available on the market, authors can seamlessly work in eXact learning LCMS 10 on high end learning content projects and more extemporary rapid authoring initiatives using the same set of tools and templates. In addition they can move from one approach to the other without the need to restart a production activity from scratch.

Tailor-made authoring interfaces

In addition, eXact learning LCMS 10 features the ability to plug user-friendly authoring interfaces to any Learning Object template, as well as define different interfaces for novice and experienced users. This enables different user profiles across the overall authoring process, depending on the actual needs of the organization, and scales the authoring community by delivering the appropriate authoring tool and interface configuration to each of the project stakeholders.

The combination of "WYSIAWYG" (What You See Is Almost What You Get) and instant multi-device preview makes the lives of authors, reviewers and subject matter experts much easier than in the past.

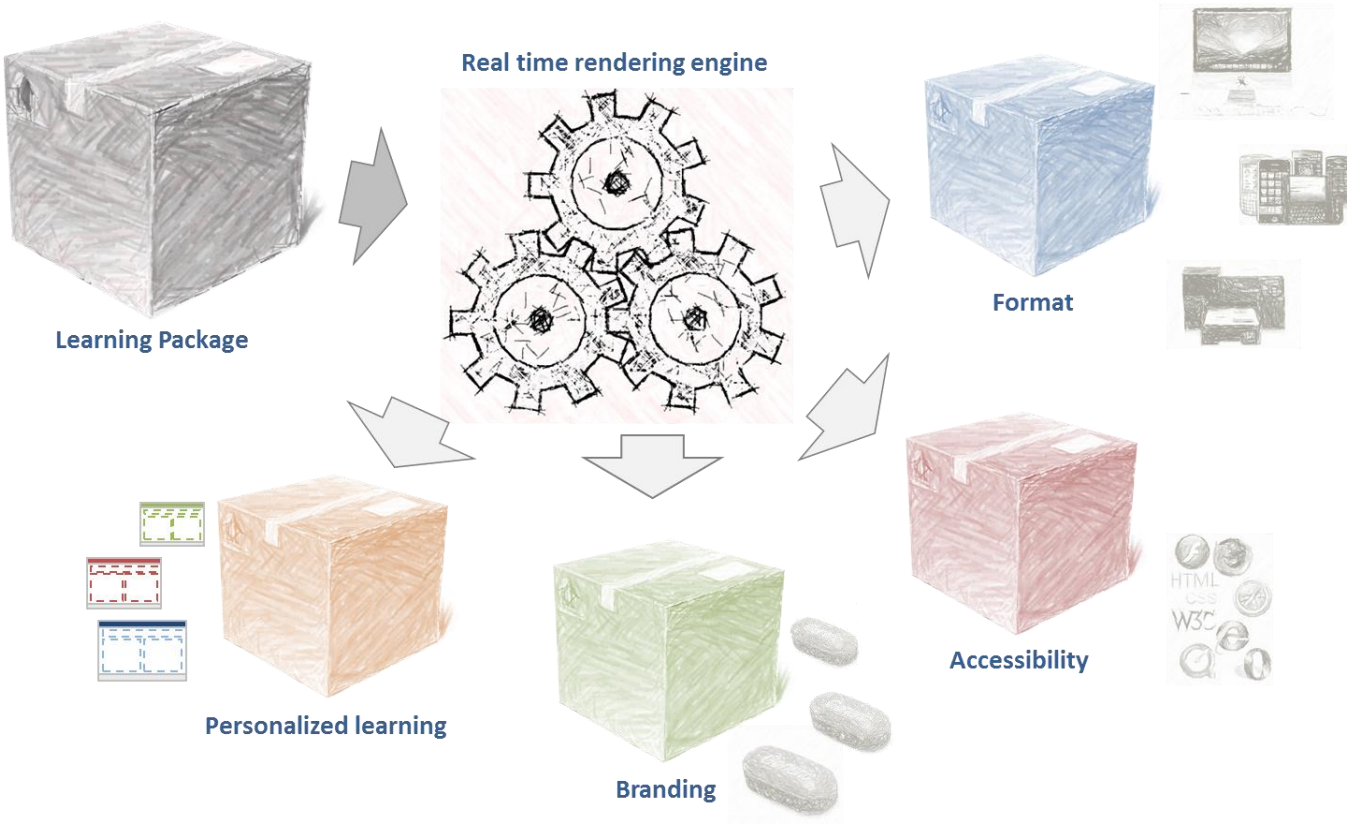


Figure 10: Overview of a multiple output real-time rendering scenario.

An open template framework

A unique value of eXact learning LCMS is its open framework which allows clients or any third party to develop and integrate their own template sets. With eXact learning LCMS 10 and the new HTML5 template library, this is extended with the introduction of template set APIs that allow any third party to extend the off-the-shelf template libraries provided by eXact learning solutions. This combines the advantages of a certified, fully maintained and supported template library with the flexibility of a powerful SDK (Software Development Kit) that gives adopting organizations full control over the authoring solution.

From productivity to adaptivity

Adopting a template-based authoring approach and flexible publishing solutions helps organizations to achieve their goals, keeping the overall costs of eLearning under control. A careful analysis of an organization's needs and the adoption of a template-based content production process and toolset is the first step towards ensuring the appropriate level of ROI for a learning organization. Indeed, this makes the whole learning content production process simpler, easier and quicker (and therefore, in most cases, cheaper). It alsosignificantly improves the organization's ability to repurpose its own existing catalogue of learning resources with limited effort.

In order to improve the productivity of learning content production scenarios, eXact learning solutions enriched its LCMS suite with a real-time rendering engine that, attached to the template framework, enables adaptive learning in a variety of cases.

How does real-time rendering work and how does it boost productivity and improve ROI?

Standard template-based authoring interfaces allow eXact learning LCMS to produce any number of learning modules (or, in eXact terms, Learning Objects).

We may assume some hundreds of thousands of learning packages were created through the process described previously, and stored in the central repository for direct delivery or future use. Indeed, Learning Objects produced in this way may be exposed to end users through the embedded learning portal or via any third party integrated LMS (including both open source and proprietary solutions).

Now, let us assume that any number of those packages were created some time ago and do not fit new learning requirements that have emerged in our organization (this may be related to pedagogical, technical, business or branding factors). These new requirements require that an update be applied to tens, if not hundreds or thousands of learning units in a relatively short time.

With traditional publishing technologies,

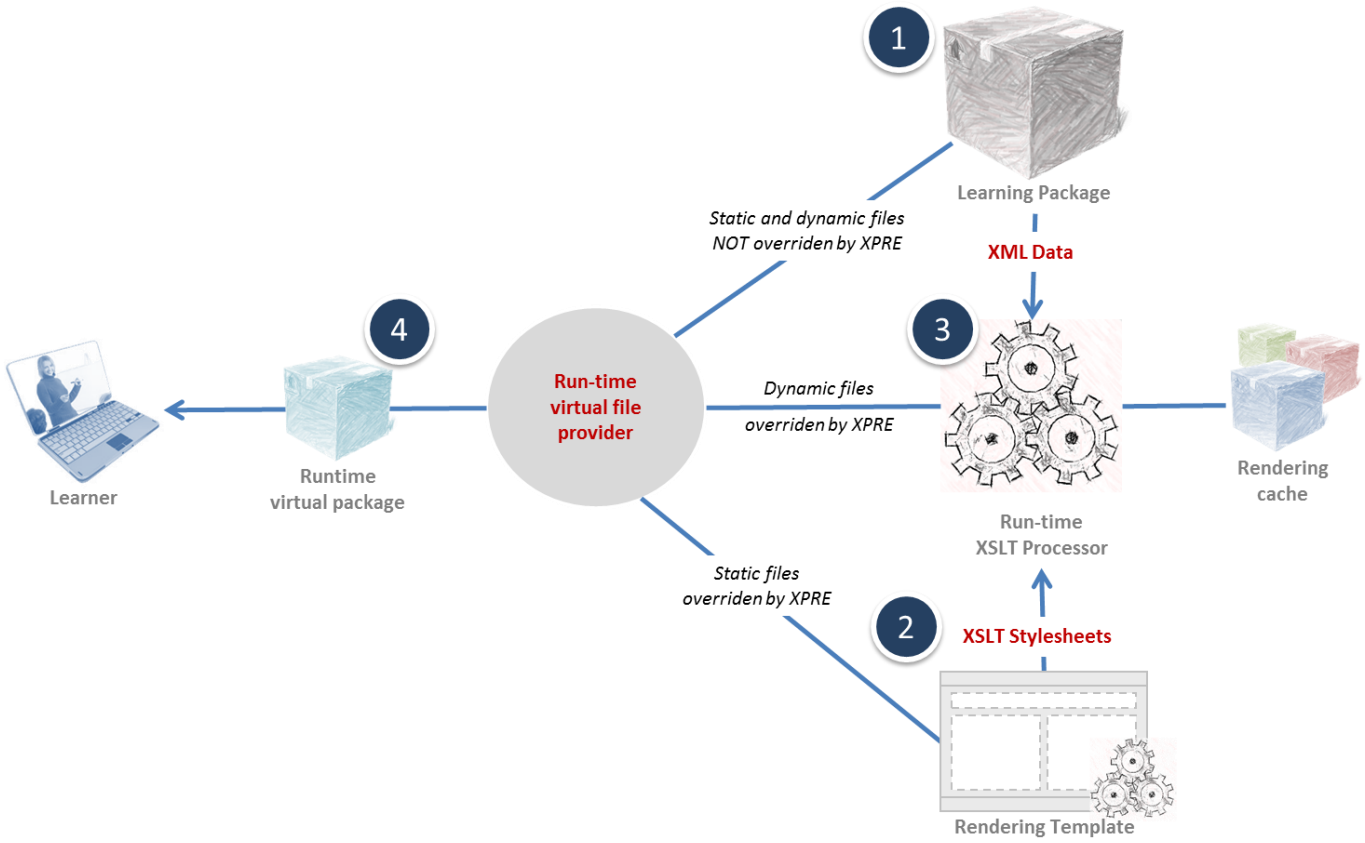


Figure 11: A simplified schema of how eXact LCMS Real-time Rendering engine works

addressing these requirements would mean opening each of those packages separately, applying the changes (either manually or through the application of an updated template set) and publishing a brand new version of each object to the repository. In many cases, one would also need to update the reference to the learning materials in each instance of the LMS portal used for learning content delivery.

Real time rendering is about applying any such change once - at the level of the core rendering engine - and have that change applied transparently and seamlessly to each package when a target user first accesses it from her/his preferred learning channel or device.

But if productivity and cost reduction is a key requirement of most of the organizations involved in learning content production and delivery, the need to produce adaptive learning content is emerging as the real trend. Adaptive learning means effectiveness of the learning process which, in turn, improves the competitiveness and time to market of your organization.

Going back to our Learning Object templates and pluggable rendering engines, we may think that an organization can produce and install multiple run-time rendering templates - each addressing a specific learning or delivery need - and use them in parallel to provide a more "focused" and user-centred learning experience. Specific user requirements may range from compliance with screen readers or accessibility guidelines, access from specific mobile devices and application of the appropriate corporate branding to, more interestingly, adaptation of the learning modules to the specific level of knowledge and skills of each learner involved in the training initiative.

This is what we call learning content adaptivity - and this is a way in which eXact learning LCMS 10 can help you achieve the required level of content personalization, providing each learner with the appropriate piece of knowledge, personalised according to her/his specific learning and content needs.

eXact learning solutions - Headquarters
Abbazia dell'Annunziata
Via Portobello - Baia del Silenzio
16039 Sestri Levante (GE) Italy

Tel +39.0185.4761
Fax +39.0185.43.347
www.exact-learning.com
info@exactls.com