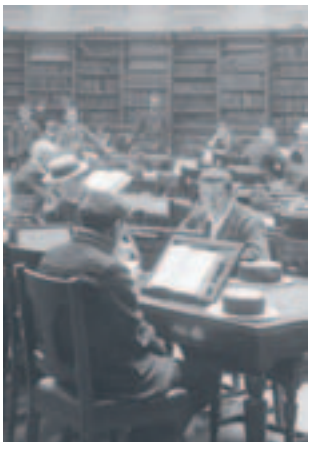
DigiCULT

Learning Objects from Cultural and Scientific Heritage Resources



Thematic Issue 4

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Information Society Technologies

Learning Objects from Cultural and Scientific Heritage Resources

Thematic Issue 4

Content

Introduction and Overview

By Guntram Geser

Function and focus

DigiCULT, as a support measure within the Information Society Technologies (IST) Programme, provides a technology watch mechanism for the cultural and scientific heritage sector. Backed by a network of peer experts, the project monitors, discusses and analyses existing and emerging technologies likely to bring benefits to the sector.

To promote the results and encourage early take-up of relevant technologies, DigiCULT has put in place a rigorous publication agenda of seven Thematic Issues, three in-depth Technology Watch Reports, as well as the DigiCULT.Info e-journal, pushed to a growing database of interested persons and organisations on a regular basis. All DigiCULT products can be downloaded from the project Website http://www.digicult.info as they become available. The opportunity to subscribe to DigiCULT.Info is also found here.

While the DigiCULT Technology Watch Reports address primarily technological issues, the Thematic Issues focus more on the organisational, policy and economic aspects of the technologies under consideration. They are based on the expert round tables organised by the DigiCULT Forum secretariat. In addition to the Forum discussion, they provide opinions of other experts in the form of articles and interviews, case studies, short descriptions of related projects, together with a selection of relevant literature.

Topic and challenge

This fourth Thematic Issue concentrates on the question of how the heritage sector might benefit from engaging in the production and provision of a new breed of learning material, called *Learning Objects*. Such objects are highly interoperable and reusable modular building blocks for e-learning content based on widely shared specifications or already accredited standards (e.g. for metadata and content packaging). It is also important to note that learning objects are not only 'chunks' of content (e.g. digitised images with descriptive metadata), but may also include interactive elements such as simulations, tools, communicative components, and assessments.[1]

There are different levels at which heritage institutions might engage in the development of e-learning opportunities based on the concept of learning objects. They can supply resources for learning objects (e.g. digitised artefacts from their collections), develop the objects themselves in the framework of a learning programme, or even run a virtual learning environment with a stock of learning objects, perhaps shared with other institutions. However, one of the major obstacles to achieving a stronger involvement of heritage institutions in the provision of learning objects is that they traditionally concentrate on informal learning styles. Some ideas related to the concept of learning objects might be rather alien to them, such as, for example, that such objects should be designed to achieve a certain narrow learning object, and may also contain an assessment mechanism to determine success against that objective.

This may also in part explain the fact that, although extensive efforts have been put into both strengthening e-learning and fostering access to digital heritage, these efforts remain somewhat isolated from each other.[2] As part of their mission, heritage institutions usually have the goal of supporting educational activities through providing access to their resources. However, these resources are most often presented only as *collection objects*, deemed to be useful for 'informal' learning in some way or other (i.e. usually not further specified). In order to become the high-quality, standardised *learning objects* necessary in education and life-long

[1] cf. Iconex Learning Objects Repository, http://www.iconex.hull.ac.uk

[2] One indicator for this is the very limited involvement of heritage institutions in the Fifth RTD Framework Programme's projects in the area of technology enhanced learning. An overview of these 90-odd projects is provided in European Commission (2003): Technology enhanced learning – Project fact sheets. Third updated and enlarged edition, http://www.cordis.lu/ist/ka3/eat/training_publ.htm

learning, a strong collaboration between the heritage and e-learning sectors is needed. This collaboration should focus on the enhancement of the heritage sector's e-learning interoperability, both in terms of technical standards and in terms of appropriate forms of learning. DigiCULT regards such collaboration as crucial to unlocking the richness and diversity of Europe's cultural and scientific heritage for e-learning within the knowledge-based society.

Overview

Setting the context for this Thematic Issue, the position paper by DigiCULT Steering Committee Member Bruce Royan highlights the many ways in which heritage organisations might profit from ensuring that their products and services are compliant with the standard expectations of the e-learning user community. He points out that the case for the heritage sector adopting Learning Objects is threefold: a progressive, a technological and a business case.

Four interviews provide different perspectives on the topic:

Lorna Campbell (CETIS, UK) states that heritage institutions should not be satisfied with providing 'raw materials' which are of little value for teaching and learning, but should make use of specifications such as IMS Learning Design to provide rich learning experiences with contextualised resources.

Miguel Rodriguez Artacho (UNED University, Spain) adds to this the importance of taking into account the different uses teachers and learners make or, rather, would like to make of e-learning objects. To allow for re-using such objects they should be accessible in different ways and with different teaching and learning aims in mind.

Patrick Towell (Simulacra, UK) highlights the fact that many heritage institutions may not be equipped for developing their own e-learning chan-nels, but they should think about their possible roles as intermediaries in the value chain for digital learning content, which builds on many 'wrap-around services'.

Henri Hudrisier (University of Paris 8, France) reports on the decision of the ISO's Standard Committee 36 to support the development of a future metadata standard, called Metadata for Learning Resources (MLR). This standard should be capable of accommodating various 'styles' of e-learning (e.g. instructional vs self-directed) and, thereby, be more comprehensive than the recently approved IEEE's Learning Object Metadata (LOM) standard.

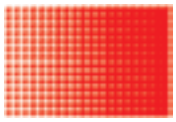
Michael Steemson's summary of the Den Haag Forum provides an overview of the many insights, lessons learnt, and recommendations given by the experts in their discussion of various 'tricky questions' in the creation and provision of new e-learning opportunities that make use of heritage resources.

A novelty in our series of Thematic Issues, standardisation expert Mike Collett (Schemeta, UK) compiled an additional Forum summary, an annotated list of 20 challenges facing the heritage sector in the use of learning objects. He also gives some recommendations for decision-makers and highlights important action points.

Chris Jackson and Adam Cooper (FD Learning, UK) provide a critical assessment of current interpretations of Learning Objects which sometimes stem more from technological issues than pedagogical considerations, and point out how these may work against the goal of achieving a wider range of reusable high quality learning material. They propose a more open approach and give some recommendations for content producers and vendors of learning management systems.

Fabrizio Giorgini and Fabrizio Cardinali (Giunti Interactive Labs, Italy) in their article address the need for virtual learning environments that foster e-learning uptake within the heritage sector, and suggest developing an e-Learning Standards Application Profile for Cultural Heritage. The authors point out the importance of using internationally agreed specifications, but also their current limitations in achieving higher levels of content personalisation and adaptation as well as in dealing with more and more complex learning objects. As an illustrative example they present results from the SCULPTEUR project which involves the creation and management of 3D virtual learning environments with cultural learning objects.

Finally, we would like to thank the National Library of Ireland and the Alinari Archives, Florence, for their kind permission to use selected images from their collections of digitised historical photographs. They have allowed us to create a 'filmstrip' of learning situations dating back to the first decades of the 20th century.



Learning Objects for the Cultural and Scientific Heritage Sector: A Position Paper

By Bruce Royan

It is only in comparatively recent years that the cultural and scientific heritage sector has awoken to the need for reciprocal access and inter-operability among its curatorial domains. Whether for collections management, bibliographic access or inventory control, archives, libraries and museums have followed similar but often mutually incompatible standards of description for the resources in their collections. As more and more of these descriptions, and indeed in many cases actual resources, have been made available on the Internet, it has become clear that the end-user is not interested in the historic, scientific or political reasons why the stuff they are seeking may only be disclosed via one or other resource description format: they simply want seamless access to the stuff itself. This realisation has led to the development of standards and protocols for cross-domain resource discovery, and in particular to the widespread adoption of the Dublin Core set of metadata elements.

During the same time period the educational technology community has been working to develop models for the delivery of content for learning in the digital age. The concept of the Virtual Learning Environment (VLE) has arisen, which exists to deliver, in a seamless fashion, learning material and communication in digital form. Managed Learning Environments (MLEs) extend that concept to encompass some of the administrative aspects of a course, such as registration, progress monitoring, examinations, etc. The content for delivery through both of these concepts is increasingly defined in terms of Learning Objects, and the community has come to use a mnemonic, 'RAID', for the attributes such learning objects should possess: they should be Reusable (able to be modified and used in many different learning situations), Accessible (able to be indexed and found as needed), Interoperable (operable across a wide variety of hardware, delivery environments and tools), and Durable (continuing despite changes in versions of system software, players and plug-ins).

The attributes of Learning Objects so closely match the attributes generally believed to be desirable for digital cultural content that it would seem sensible for managers in the cultural heritage field to be aware of these developments.

Specifications, Standards and a Reference Model

The newcomer to the educational technology field will be confronted by a veritable 'alphabet soup' of acronyms and initialisms. For the purpose of this position paper, we need only consider three: IMS, IEEE LOM, and SCORM.

IMS takes its acronym from the phrase 'instructional management system', but this is no longer spelt out, since IMS has come to be involved in a range of learning contexts from Computer Based Training to integrated Learning Environments. With an initial base in Higher Education, it also now has active stakeholders in corporate and government training, schooling, and continuing education. The IMS Global Learning Consortium includes all the major technology suppliers and educational publishers. Its purpose is to define a range of specifications, which will allow suppliers to develop learning products and services that are interoperable. Although widely influential in the educational technology community, IMS is not in itself a standards-making body.

The Institute of Electrical and Electronic Engineers has the status to develop and establish international standards, and has taken the role of publishing standards in this field. The first standard to be published is the Learning Object Metadata standard, *IEEE LOM*, which is in effect a standard for the location of materials.

Another key body in this field is the Advanced Distributed Learning (ADL) Initiative, sponsored by the US military, which has a vested interest in establishing ways to 'use advanced communications and learning technologies to transform how we will educate, train and provide performance support to the U.S. Military Services'. The underpinning of the ADL Initiative is 'a collaborative effort between the public and private sectors to develop the common standards, tools and learning content that are central to the future learning environment'. The chief vehicle for this is the definition of a reference model, known as the Sharable Content Object Reference Model (*SCORM*). SCORM indicates which of the emerging standards and which of the specifications could work together to enable this idea of delivering learning in a managed environment, by enabling learning objects to be identified and retrieved and packaged in various ways.

Why Learning Objects for the Heritage Sector?

The case for the heritage sector adopting Learning Objects is threefold: a progressive, a technological and a business case.

The March of Convergence

Although the heritage sector has not so far been directly involved in the development of the standards for Learning Objects, it is not accidental that those involved in LOM have chosen to base their work on an extended version of the Dublin Core. Just as the original Dublin Core initiative had its origins in a desire for seamless interoperability between archive, library and museum domains in the service of the end-user, so the Dublin Core set of metadata elements turned out to provide a sound basis for interoperability work within the educational technology sector. It is likely that this trend towards convergence of historically disparate sectors, at least at the level of resource description, will continue into the future, particularly in the context of national and international eGovernment interoperability frameworks. The cultural heritage sector, once the initiator of such convergence, needs to remain in the forefront

of interoperability standards-making and adoption. It is now a truism to say that, for the majority of users, if a resource cannot be discovered on the Internet, it might as well not exist.

A Technological Imperative

The concept of developing digital resources, not in a monolithic way, but as an aggregation of reusable interoperable components, is a compelling one for the heritage sector. We are all aware of heritage CD-ROM publications that deliver a pre-defined experience in a completely closed environment, which have been developed at a cost of enormous amounts of money, and which are now sitting on someone's shelf, no longer used, because some of the content is out of date or the treatment is no longer fashionable or because of their reliance on obsolescent technology. If only the Learning Object approach had been available when these products were built, their individual components would still be available for updating and re-use.

Learning is our Business

In considering digitisation projects in the cultural heritage arena, the watchword is 'sustainability'. It may not currently be too difficult to obtain capital grant aid for a good quality digitisation project, but securing an income stream to support the maintenance of the resulting resource delivery service into the future is an altogether different proposition. Advertising and sponsorship are, with some high-profile exceptions, unlikely to be available to fund the majority of services, and the revenue from commercial sales has been proved historically to be much less than might have one time been expected. The one market sector that continues to be both fairly well funded and actively interested in resources from the cultural and scientific heritage sector is education. If cultural institutions define education as the main source of their revenue, it does make sense that they should work to ensure that their products and services are compliant with the standard expectations of their user community.

For example, in the UK the Department for Education and Skills is developing a reasonably well-defined set of specifications for learning objects, with which any electronic learning publications hoping to sell into the English schools sector will be expected to comply. Compliant products will be 'kite-marked'. To ensure take-up, DfES are actually providing electronic credits to each school, totalling millions of pounds sterling, which can only be spent on learning objects kite-marked according to this set of standards. Cultural institutions and organisations are being actively encouraged to participate in this initiative.

Even if a cultural institution does not rely on subscription or other income from the educational sector for its future survival, it is likely that education and learning will be part of its core mission. Such an institution would benefit from a framework within which both to discover and procure useful digital resources for its own purposes and to disclose its resources for re-use in external learning environments.

Finally, cultural institutions, in particular museums, see themselves as learning institutions and some of the products that they are currently building in that role could well benefit from the standards and frameworks of the educational technology community. In the final analysis, a virtual cultural environment is not so very different from a virtual learning environment.

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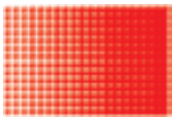


Cultural Heritage Institutions Can Provide More than Raw Material

An Interview with Lorna Campbell, Centre for Educational Technology Interoperability Standards (CETIS), UK

By Joost van Kasteren

An interesting concept that has recently emerged in relation to e-learning is the learning object economy. The primary commodity of this economy is the learning object, a learning resource that can be used in a wide variety of learning scenarios. In this object economy, the cultural heritage institutions can be seen as providers of the raw material for this commodity. Other organisations, publishers for instance, will then process the raw material into re-usable, interoperable learning objects. This is one scenario. 'The other one is that the cultural heritage institutions themselves process their raw materials into learning resources', says Lorna Campbell, assistant director of CETIS, the UK's Centre for Educational Technology Interoperability Standards. 'This scenario might be more appealing, because for many cultural heritage institutions educating the public is part of their mission.'

The first step to fulfilling that assignment is to expose the collection to teachers and learners. Although several initiatives have been taken (Campbell mentions SCRAN, the Scottish Cultural Resources Access Network, as an outstanding example), it is still difficult for teachers and learners to find out what resources are available. If the accessibility of collections improves, these resources could be used as learning material for both formal learning (courses) and informal and lifelong learning.

However, the problem is that many teachers and learners do not have the skill to use the raw resources for learning. Campbell: 'My own background is in archaeology. At university level lecturers and students are capable of using raw assets from museum collections to facilitate teaching and learning. If the same resources are to be used in school classes they will require some degree of contextualisation to provide a meaningful learning experience for the pupils. Cultural heritage institutions can help by making their resources available in a variety of formats, such as raw assets, learning objects and contextualised learning activities.' For example, SCRAN offers educational context through 'pathfinders', navigators and teaching packs.

Providing an educational context is not easy. Apart from the necessary investments, there is a lot of discussion about appropriate standards for e-learning. One problem is the inbuilt paradox of a learning object. To be re-usable and customisable the content of a learning object should be separated from its context. The paradox is that learning is not only about content but also about context, i.e. the pedagogical framework. Without context there is no learning experience.

Campbell: 'There has been some concern in the past that learning objects and electronic learning resources cannot be used to facilitate more diverse forms of teaching and learning. To some extent this criticism is justified as until recently most learning technology interoperability standards were primarily geared towards the production of efficient and effective training resources.'

However, recently the IMS Global Learning Consortium has published its Learning Design

specification. According to Campbell this is an important step towards the development of richer, more varied learning experiences, because it promises to be a comprehensive and powerful way to design online learning activities. The IMS Learning Design specification differs from models such as SCORM in the sense that it can support many different pedagogical perspectives, while still facilitating the re-use of units of learning.

IMS Learning Design is based on the Educational Modelling Language developed by the Open University of the Netherlands. To support many pedagogical approaches, the researchers from the Open University looked at a large number of pedagogical models to see what they had in common. These rather abstract commonalities form the basic conceptual elements of IMS Learning Design.

IMS Learning Design is a very new specification. As yet only a few implementations and tools have been developed. Campbell expects that when more become available they will give rise to a wide range of new learning experiences, many of which may be unexpected and unfamiliar within our current educational paradigm.

Both teachers and learners will use these pedagogically rich implementations and tools to create their own learning experiences. Campbell: 'In my opinion cultural heritage institutions have to stay in touch with these new developments in the field of learning technology standards. They could work in isolation, but it might be better to co-operate with other communities of practice within the educational sector, to leverage the full potential of these new opportunities.'

Centre for Educational Technology Interoperability Standards
http://www.cetis.ac.uk

Bridging the Gap between Catalogue and Course

An Interview with Miguel Rodriguez Artacho, Universidad Nacional de Educación a Distancia (UNED), Spain

By Joost van Kasteren

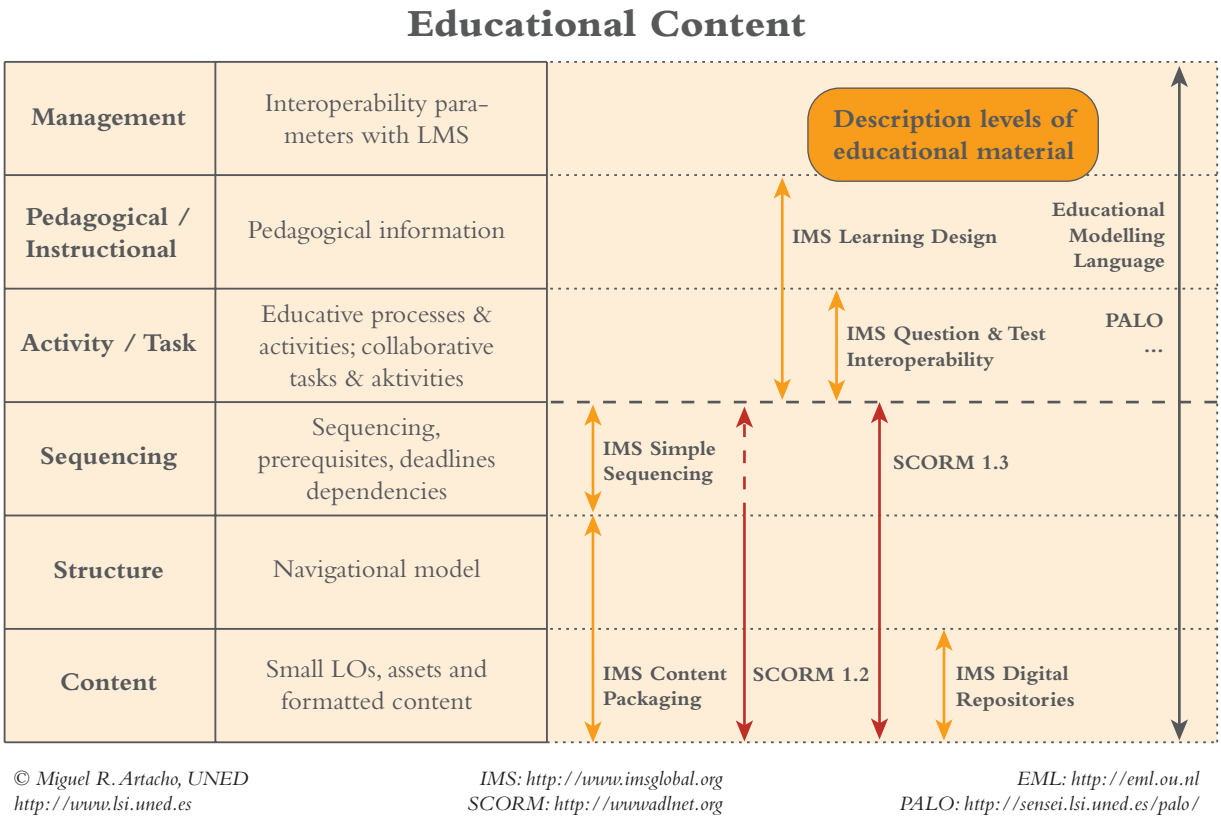
Cultural heritage institutions are a repository for objects that could be used as learning objects. To turn the material in museums and libraries into something that can be used for education it has to be structured in a certain way. I think we need very skilled persons to do that in such a way that teachers can use the learning objects to develop their own lessons and courses', says Miguel Rodriguez Artacho. He is assistant professor at UNED, the Universidad Nacional de Educación a Distancia (University for Distance Learning) and does research on learning material specifications to model individual and collaborative learning processes, resources and tools.

'A figure that is often overlooked in e-learning and distance learning is the teacher. When developing learning material you should not only think of the end-user, the student, but also of the teacher. Learning is a process between teacher and students, and teachers tend to have their own view of learning and the way they use learning materials in class. I think it is important that the learning materials give teachers the opportunity to use their pedagogical skills instead of prescribing to them how to use the material. You should not provide them with predefined courses, because they probably will not use them.'

On the other hand, the content of cultural heritage institutions is not readily accessible for teachers. Artacho: 'They can of course look at a painting or go through a catalogue, but even if you have the necessary background it takes a lot of effort to structure these objects as building blocks for a lesson or a course. A painting for instance carries the weight of its own history and that of the period in which it has been painted. Then there is the relation of the painting with other paintings done in the same period or before or after. For example, on Rembrandt's *Night Watch* a lot of books have been written from different perspectives. For a teacher it is scarcely possible to translate these mountains of information into a 50-minute lesson.'

To be able to use and re-use the information it has to be structured in such a way that teachers can access it in different ways and with different (learning) motives of their students in mind. By 'structuring' Artacho means that historical facts and objects are linked together and placed in their context. 'A kind of ontology, a story or a concept, which explains the how and why of the relations between the objects and/or facts. These ontologies, which link different objects and concepts, should be made by experts to help teachers navigate through the content.'

In order to help educators to re-use learning objects in different frameworks and scenarios, Artacho has been involved in the development of the educational modelling language PALO. For this language, he prepared a set of levels, which looks a bit like the OSI seven-layer model for telecommunications (see diagram). 'At the bottom level we find elements and objects as they are catalogued by



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http://www.lsi.uned.es

IMS: http://www.imsglobal.org
SCORM: http://www.adlnet.org

EML: http://eml.ou.nl
PALO: http://sensei.lsi.uned.es/palo/

cultural heritage institutions. These elements can be linked and placed in a context by subject-matter experts using ontologies or substructures.'

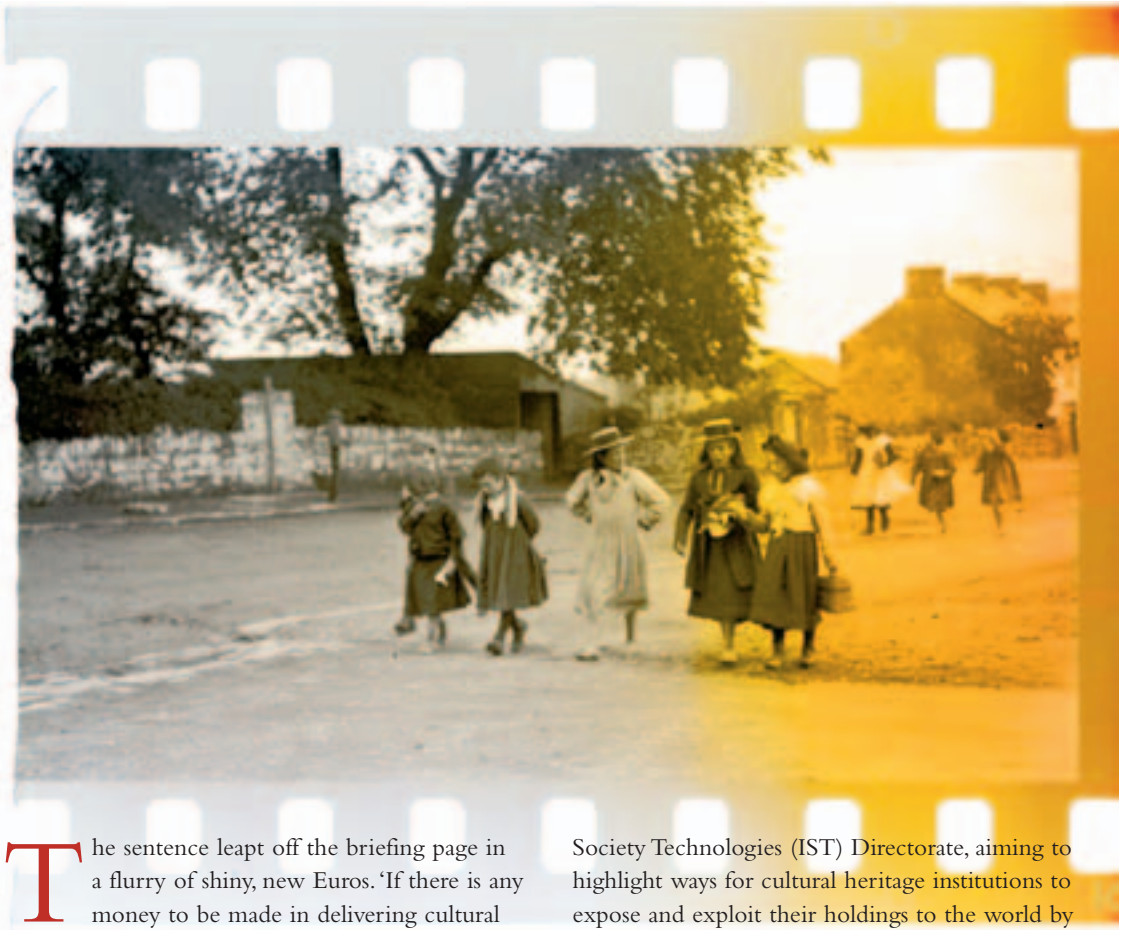
Artacho continues: 'From these substructures, which are still very much content-oriented, a teacher should be able to build a course by sequencing the substructures. It is a bit like using scissors and glue to personalise and re-arrange printed material. On the next level educative processes and activities can be defined as well as tasks that students have to perform. So you go from elements to substructures and then to full courses. On top of that you have another two layers: one containing the pedagogical information – for example, the objectives of the learning process, and the other containing the management information.'

The layered model for educational content can be used to bridge the gap between the 'raw material' from the repositories of the cultural heritage sector and the teacher and learner, says Artacho. 'Cultural heritage institutions do not have to make lessons or courses themselves. They can leave that to intermediates, the content experts and the teachers.'

UNED, LSI Department
http://www.lsi.uned.es

DigiCULT's Learning Object Lessons for the Heritage Sector

By Michael Steemson



The sentence leapt off the briefing page in a flurry of shiny, new Euros. 'If there is any money to be made in delivering cultural objects for re-use it may well be in the educational publishing field,' it said. After that, the document hardly needed to add clinching clauses like: 'So, there is an economic imperative for cultural heritage to adopt the Learning Objects approach.'

Learning Object? The DigiCULT Forum knew about that. The 14 experts sat in round table conference in the *Koninklijke Bibliotheek* (National Library of the Netherlands), The Hague, to find the means of making that briefing promise a reality. They didn't find all the answers but they came up with a tidy parcel of signposts pointing the way to those '*Eu-riches*' for Europe's museums, libraries, galleries and archives. Their signposts said: This way to the *dot.edu* gravy train.

The July 2003 forum was the fourth of seven debates for the European Commission's Information Society Technologies (IST) Directorate, aiming to highlight ways for cultural heritage institutions to expose and exploit their holdings to the world by digitisation. Previous DigiCULT Forums have discussed and recommended actions on Digital Asset Management, the Semantic Web and Digital Integrity and Authenticity.

This time DigiCULT wanted to focus attention on those mysterious 'learning objects', otherwise described as 'any digital resource that can be reused to support learning'[1] and, even, 'any entity, digital or non-digital, that may be used for learning, education or training'.[2]

The subject of Learning Objects has spawned a vast array of published material from online books like *The Instructional Use of Learning Objects*, edited by Dr David Wiley, assistant professor at the Utah State University, to papers such as University of Arizona Learning Technology Center author Pithamber R. Polsani's *Use and Abuse of Reusable Learning Objects*,[3]

[1] Wiley, D.A. (2000): Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In: The Instructional Use of Learning Objects, D. A. Wiley (Ed.), http://reusability.org/read/chapters/wiley.doc

[2] IEEE Learning Technology Standards Committee: Standard for Information Technology - Education and Training Systems - Learning Objects and Metadata, 1484.12.1 – 2002, p. 6, http://ltsc.ieee.org/doc/wg12/LOM_1484_12_1_v1_Final_Draft.pdf

[3] Polsani, Pithamber R.: Use and Abuse of Reusable Learning Objects. In: Journal of Digital Information, volume 3, issue 4, http://jodi.ecs.soton.ac.uk/Articles/v03/i04/Polsani/

and University of British Columbia Office of Learning Technology Project Coordinator Brian Lamb's amusing *Oh no! Yet another learning objects presentation* and review of a UBC Distance Education & Technology Workshop on Reusable Media.[4]

Learning Objects can be as small as a 'chunk' of information designed to achieve a narrow learning objective or as large as a chapter in a textbook, a case study, or an interactive study course. Each object should allow re-use and repackaging to suit all users, teachers, learners or publishers, and may contain an assessment mechanism to determine its success. It needs to conform to metadata standards to assist access and interoperability.

Much technical work has been done developing standards and procedures on the subject but, as the DigiCULT Forum briefing paper briskly declared: 'The cultural heritage sector has not yet been involved.' It wouldn't be very difficult to get up to speed, the paper said, because the virtual cultural environment was not too different from the virtual learning environment. Now the need was for:

- CH metadata compliant and convergent with the virtual learning environment; and
- CH digital objects built with the standards of learning environments.

This was the challenge, but what was the answer? The Hague group, 13 men and one woman from universities, software developers and the heritage sector in the United Kingdom, France, Spain, Italy and France, began with a teach-in from industry.

Italian technologist **Fabrizio Cardinali** is CEO of Genoa's Giunti Interactive Labs,[5] one of Europe's leading e-learning research and development companies. It specialises in standardisation services, content brokerage and management, and Web services. The DigiCULT 14, sitting in the spacious conference suite of the *Koninklijke Bibliotheek*, heard the dapper chief executive describe the three 'fundamental jump-shifts' in media and publishing technologies, bringing new levels of interactivity, collaboration and personalisation to education and communications since the 1970s.

The first was the introduction of the personal computer into households, then the booming Internet technologies and, finally, the availability of 'distributed Web services, standard digital content and mobile, ambient intelligence'.

He spoke of the multi-level efforts needed for establishing an e-learning standard, starting with a perceived need of the sector, and first tentative solutions suggested by independent research and development centres and associations like the Belgians' Ariadne Foundation.[6]

Then came the secondary level where bodies such as the IMS Global Learning Consortium[7] provided detailed documentation to test and pilot the specification. This was done, for example, in plug-fests or co-labs of the US Department of Defense's Advanced Distributed Learning (ADL) programme before inclusion of the specification in their SCORM[8] (Sharable Content Objects Reusable Model).

Finally, standardisation institutions like the US Institute of Electrical and Electronics Engineers (IEEE),[9] the European CEN/ISSS,[10] or the International Standards Organisation (ISO)[11] needed to review the specification and take it through an open, consensus-based process to produce a working draft that may in due course become an accredited standard.

Today, after much specification effort had been spent over some seven years, a new generation of e-learning was 'chunking up' platforms of set parts and services with standardised interfaces shifting standard data, Cardinali said. It was creating what he called 'ambient learning spaces' and services such as user profiling, content brokerage, and personalisation. It was giving birth to what publishers had always asked for, RAID content – 'Re-usable, Accessible, Interoperable, Durable'.

He went on: 'Which means that you can actually publish one book for multiple devices and multiple delivery means and multiple personalisation issues. So, we can de-chunk your content and personalise it on-the-fly, with different indices and different learning paths or just publish the paths relating to the user profile.'

The Tricky Questions

It was all exciting stuff. Cardinali recommended adoption of the 'second level' of available standards to create what he called the first CHAPTER (Cultural Heritage Application Profile for Technologies in Educational Re-usability). Chapter One was about convergence and consensus building. Chapter Two would be about extending into Web services, which he said was 'a much more tricky issue to address'. With more than 25 active research and development projects on e-learning, Cardinali knows a tricky issue when he comes across one.

That was not the only tricky question, by a long shot.

4 Lamb, Brian: Oh no! Yet another learning objects presentation, University of British Columbia Office of Learning Technology, http://www.learningobjects.ubc.ca/CADE.html

5 Giunti Interactive Labs, http://www.giuntilabs.com

6 Ariadne Foundation, http://www.ariadne-eu.org

7 IMS, http://www.imsglobal.org

8 ADL's SCORM programme, http://www.adlnet.org

9 IEEE, http://www.ieee.org

10 CEN/ISSS, http://www.cenorm.be/isss/

11 International Standards Organisation (ISO), http://www.iso.ch

Seamus Ross is an educationalist, Director of Glasgow University's Humanities Advanced Technology and Information Institute (HATII),[12] and he asked: 'Do you envisage an environment with heritage institutions owning digital objects and their administration and discovery metadata with corporate enterprises independently owning learning object metadata, withdrawing a digital object from a repository and delivering it as part of a learning package?'

The Italian expert said there were many different approaches to such 'content brokerage', with technical and system architecture implications. The first requirement was an XML-based metadata process to link with the Learning Object Metadata (LOM) standard. Then came links to the physical resource. Later concerns would be about digital rights management, watermarking and indexing. He said: 'We say start indexing at the very fine grade level with tagging systems which can automatically generate metadata and then aggregate a learning object. Because if tomorrow I want to drag and drop an image from your learning object I can be tracked.'

The Learning Object Metadata standard,[13] sponsored by the Learning Technology Standards Committee (LTSC) of the US Institute of Electrical and Electronics Engineers, is in its final draft and was approved in 2002 as an operational standard. Its purpose is 'to facilitate search, evaluation, acquisition, and use of learning objects, for instance, by learners, instructors or automated software processes', the standard's 'Purpose' chapter states.

It continues: 'This multi-part standard also facilitates the sharing and exchange of learning objects, by enabling the development of catalogs and inventories while taking into account the diversity of cultural and lingual contexts in which the learning objects and their metadata are reused. By specifying a common conceptual data schema, this (standard) ensures that bindings of Learning Object Metadata have a high degree of semantic interoperability. As a result, transformations between bindings will be straightforward.'

At the Hague Forum, another educationalist, University of Paris 8[14] researcher **Henri Hudrisier**, wondered how cultural heritage could be structured for learning functions. This was an important question for universities, he said, asking: 'What is the education model to ensure interoperability between cultural heritage tagging and learning?'

Cardinali said: 'There is no standard definition of what a learning object is at the intra-learning object level, so what you put in is actually left to your authoring pedagogical approach. Then you start putting metadata tags on what that is. So, first thing (and this is where 90 per cent of the work, effort and budget usually is) is deciding if those tags are enough and if the vocabularies are right.'

James Ayre, a partner in the UK management consultancy Multimedia Ventures,[15] took another angle. He has been involved with the EU's European Schoolnet[16] since 1998 and is part of the organisation's CELEBRATE (Context e-learning with broadband technologies) project,[17] a Euro 7 million initiative investigating how different types of learning objects and learning content management systems (LCMS) impact upon learning processes. He challenged the Forum's assumption that institutions were themselves creating the content.

'I would like to take a step back from that,' he said, 'because technologies also give scenarios where you can unlock digital repositories and the assets within them for a wide range of people, including students, to actually create the content based on those assets.'

[12] HATII, University of Glasgow, http://www.hatii.arts.gla.ac.uk

[13] IEEE LTSC: Standard for Information Technology - Education and Training Systems - Learning Objects and Metadata, 1484.12.1 – 2002, http://ltsc.ieee.org/wg12/ files/LOM_1484_12_1_v1_Final_Draft.pdf

[14] University of Paris 8, Department of Documentation and Hypermedia, http://www.univ-paris8.fr

[15] Multimedia Ventures, http://www.multimediaventures.com

[16] European Schoolnet (EUN), http://www.eun.org

[17] EUN CELEBRATE project, http://celebrate.eun.org

Mangle Board Metadata

The Forum's senior cultural heritage voice, **Jon Birger Østby**, the Director General of Norway's newly created Archive, Library and Museum Authority *ABM Utvikling*,[18] provided a wonderful example of the gap between cultural and pedagogic thinking - digitisation based on curators' needs rather than education - in an exhibition at the National Copenhagen Museum of Greenland's Inuit people.

He recalled: 'They thought they had fantastic digitised material in the museum catalogues but the museum discovered very soon that the answers to the public's questions were only in the heads of the curators, not in the records.'

'Another example: the Norwegian folk museum has 1650 mangle boards, devices to press clothes. The curators knew that they had a digital film and an excellent article about these boards but you will not find anything about how to use them in any of these 1650 records. For the education sector it is very important to merge these different types of materials. And then you need a standard for how to find it.'

That struck a chord with the Forum's sole Scotswoman, Assistant Director of the UK Centre for Educational Technology Interoperability Standards (CETIS),[19] **Lorna M. Campbell**. Her recent focus has been the development of a UK Common Metadata Framework, an application profile of the LOM standard.

'Providing good quality metadata is going to be fundamental', she said. 'We have to consider not only what kind of metadata we need in terms of: technical metadata, cataloguing, digital rights management (which I think is going to be crucial in this field) and learning objects, but who creates it. We need to think about what peoples' roles are or are going to be. We are already seeking this in the higher education sector. What do librarians do? What do academics do? There is a parallel here. What does the cultural heritage sector do and what does the educational sector do?'

Fabrizio Cardinali had detected the shift in higher education over the last five years. 'We have seen a drift in universities which have begun to market their content abroad, but we have still not seen this drift in the cultural heritage managers. It needs to be a high-level commitment.'

The VLE Value Chain

Patrick Towell was sceptical. Chief executive of the UK's Simulacra Media[20] consultancy, he has worked with the UK Department for Education and Skills (DfES) Curriculum Online[21] programme, the NetGAIN[22] Web portal and the Countryside Agency's[23] Local Heritage Initiative, among other similar projects in cultural heritage institutions. 'I think one of the big cultural changes (excuse the pun) will be a more business-like approach to this,' he said. 'This is expensive and people in the UK in these sectors do not think in a business-like fashion. If you talk to them about making money with their assets they tend to look away.'

He recommended the DfES paper *The Value Chain for Digital Learning Content in England*[24] as a framework for a policy on business models and decisions rather than information science ones.

Norwegian museologist Jon Birger Østby was more prescriptive. What was needed, he said, were examples of how museums can earn money. He went on:

'We could take a look at the International Council of Museums.[25] It declares that the museum is in the service of society and of its development. It acquires, conserves, researches, communicates and exhibits for purpose of study, education and enjoyment material evidence of people and their environment. It is a fundamental task to transmit knowledge, cultural experiences and enjoyment to the public and traditionally in the museum domain this has been done through exhibitions. The rest of the knowledge source has been kept for their own use... Times have changed. We have to raise acceptance among the museum decision-makers that they must open their

[18] ABM Utvikling, http://www.abm-utvikling.no
[19] CETIS, http://www.cetis.ac.uk
[20] Simulacra Media, http://www.simulacramedia.com
[21] Curriculum Online, http://www.curriculumonline.gov.uk
[22] NetGAIN Consortium, http://www.netgain.org
[23] The Countryside Agency, http://www.countryside.gov.uk
[24] Department for Education and Skills, DfES, The Value Chain for Digital Learning Content in England, http://www.simulacramedia.com/html/what/pdfs/valuechain.pdf (July 2003).
[25] International Council of Museums (ICOM), http://icom.museum

sources. The public is no longer satisfied just to see the items stored and shown in exhibits.'

So, how were they to get users interested? What were the risks and opportunities?

Finding E-learning Excitement

UK consultant Jim Ayre could see a hazard in the constant technology talk. 'It is going to be very difficult to excite small content developers about learning objects while the discussion is just on application profiles, metadata and interoperability, and teachers and pupils,' he said. 'Publishers that we are working with on the CELEBRATE project are very experienced in the learning field. But new ones are not terribly excited about learning objects, yet. I wonder why and I think it is because a lot of the discussion is still on the standards and technologies, not on what it is you actually get from the learning experience. We need to get a feel for what teachers and educators really want from this... what they get excited about.'

Lorna Campbell had a neat way of putting it: 'They do not need to know what metadata is running under the bonnet. It's our job to make it work.'

Ian Huckvale, an analyst in e-government and e-learning at Simulacra Media, had one way around it. He had the 'unenviable task' of explaining technologies to educational publishers. He told the Forum: 'One of the analogies that we came up with was describing content packaging, sequencing, aggregation and dis-aggregation as being the virtual equivalent of using scissors, glue and a photocopier to put worksheets together. That was something they seemed to be able to grasp.'

It took a teacher to put it into the pedagogic nutshell. **Miguel Rodriguez Artacho** is an assistant professor and Director of Information System Planning in the Vice-rectorate of New Technologies in Madrid's UNED (*Universidad Nacional de Educación a Distancia*).[26] He put it this way:

'Teachers are people who like to do things by themselves, they like to change everything that comes to them. They want to rearrange and reshape. So if we provide learning objects as a black box they will not use them. You need to give the teacher the freedom to build personalised learning environments.'

The Hague's long, sinuous tramcars looped quietly by outside the conference room windows on their elevated tracks as the DigiCULT 14 talked of digital rights, costings, quality assurance, semantics, legacy data, fitness for purpose, qualitative metadata, slippage of meaning, and life-long learning.

Forum Moderator **Bruce Royan**, a visiting professor of Edinburgh's Napier University[27] and for six years the man in charge of SCRAN (Scottish Cultural Resources Access Network),[28] had set these topics out as challenges for Forum focus.

Remembering Metadata Rights

At this point, Mike Collett, chairman of Europe's CEN/ISSS[29] (Comité Européen de Normalisation Information Society Standardisation System) Learning Technology Group and the UK representative on the ISO/IEC learning technology sub-committee, SC36, set another bunch of targets:

'Persistence, relationships management (I think this is one of the biggest challenges), multi-linguality, multi-culturality and special needs.' He was also concerned over metadata rights. He explained:

'A use case is: SCRAN has some photos on the Web for which they have created some metadata. The French want to translate it because it is also relevant to their history and their slant on why such and such a castle was there. But, their concept of victory or loss in a battle could be very different... So, the French want to translate that metadata, translate it literally. But they want to create their own metadata too – publish it and point it to the SCRAN material. Understanding the rights of metadata tends to be forgotten because we talk about the rights of the object.'

The Forum had not thus far heard much from Mr Collett. He had, perhaps, been saving himself for the grand finale. As the discussion later eased down to its 5.30pm conclusion, the British expert was to present a succinct, off-the-cuff précis of cultural heritage issues for 'everyone to follow'. His summation encapsulated the Forum's thoughts neatly and is reproduced on pages 20-21 of this Thematic Issue.

Meanwhile, Forum members identified further challenges for the sector. Patrick Towell highlighted the 'lack of leadership and vision by EU member

[26] UNED, http://www.uned.es
[27] Napier University, http://www.napier.ac.uk
[28] SCRAN, http://www.scran.ac.uk
[29] CEN/ISSS, http://www.cenorm.be/isss

states, and business changes'. Ian Huckvale thought 'much funding for technology projects was time limited'. Seamus Ross was concerned that no-one knew the cost of maintaining learning programmes long-term.

And the Forum turned to a collation of its recommendations to curators and e-learning functionaries.

Mr Huckvale suggested: 'We need international standards from which they can create their own application profile. Then we need guidance on things like creating bindings, cross-walks and mappings to allow interoperability. One of the things DigiCULT could do in the future is expand on something like that to advise people how to map out of proprietary collection management metadata systems.'

Mr Towell thought: 'Policy-makers need to be aware that there is a step in projects that is called creating application profiles; they do not need to know anything about it but they need to make sure that it goes into their funding programme. And they need to allocate someone to be responsible for it – not a solutions provider contractor. It is usually against the interests of commercial contractors to implement standards. They take a long time to create an application profile and are expensive to implement. That is a mistake that is being made over and over again.'

He suggested recommending 'key performance indicators to measure impact rather than output', but other members warned that this was very difficult. Mr Ayre even called it 'very dangerous', saying that studies of ICT impact on schools were causing policy-makers to rethink their programmes in terms of 'return on investment'.

The Forum agreed, though, that the cultural heritage sector needed an application reference profile, perhaps sponsored by the European Union. Lorna Campbell was enthusiastic but warned: 'To do that is a massive job. Someone would have to put up funding for it.'

The Forum Wish List

Finally, quiet-spoken and bespectacled director of the Norwegian ALM Authority, Jon Birger Østby, came up with a list of recommendations for his academic and industry fellows to work on.

'If I should focus on some development strategies, risks and opportunities I would point out the following aspects:

- 'Making the educational authorities aware of the ALM institution's resources and possibilities relevant to learning and teaching.

- 'Promoting cross-sectoral standards within Archives, Libraries and Museums and co-ordinating these with the educational ones.'

These were an important basis for the use of sources from the different sectors, Mr Østby said.

He went on: 'In education, it is interesting to use different types of material that are connected thematically or geographically. It is important to make it possible to search in this material across various types of sources and sectors. It is also essential to develop better systems of linking different sources to geographical maps.'

The education and cultural heritage sectors could usefully open up more sources across country barriers such as Roman antiquities or Picasso paintings. With Picasso and other forms of modern culture, there was a copyright problem but that was not only an economic question. It was often difficult to find all the actors involved for the necessary permissions. That tended to lead to a fall-back on older, free material.

The ALM Authority director realised that, in a European context, the language differences were obvious obstacles to the common use of digitised resources. It was a challenge that would have to be met. He went on with a set of very concrete actions that should be taken:

- 'We need programmes to educate personnel in the cultural heritage sector in the use of electronic technology, especially on how to use this technology for educational purposes.

- 'If we are to provide educational resources, we also have to study the educational programmes concerning relevant subjects and teaching levels... a prerequisite for co-operation in the development of learning tools adapted to the needs and wishes of the educational institutions.

- 'Likewise, if it wants to make use of the learning object metadata standard, the cultural heritage sector has to pay attention to what is happening in the area and play an active role in co-ordinating this standard with the ones used in cultural institutions.'

Overall, Mr Østby recommended, 'that we develop a strategy for better co-operation between the educational and the cultural heritage sectors.'

And so the Forum's wish list came together. The DigiCULT 14 was putting the cultural heritage and education sectors on notice: *If you want to set your tills ringing with those e-learning Euros, you have got quite a lot of learning to do yourselves*.

Time will tell if any of those curators, museologists or pedagogues were listening.

Challenges Facing the Heritage Sector

By Mike Collett
schemeta, UK

Introduction

This is a summary of the main challenges or issues facing the European cultural and scientific heritage sector in the use of learning objects. It is based on discussions held at the DigiCULT Forum expert round table on Learning Objects. The issues are in no particular order of importance and only highlight the main areas considered. Notes are added to expand on some of the points.

Some assumptions are that:

- learning objects can be almost anything used to support learning;
- archivists and others do not need to provide the links to curricula - these may be provided by educators;
- some information, metadata, will be associated with each object and this may exist separately from the object;
- there may be many metadata records, from multiple sources, associated with a single object.

Recommendations and Actions

Some general recommendations for decision-makers

- Select open standards and specifications
- Understand the creation of application profiles and interoperability
- Identify where they have interactions
- Develop models for a channel strategy, partnerships, scope, value chains, competencies
- Identify key performance indicators and impact
- Change management

Some actions

- Provide some models and use cases
- Clarify how others (educators) can add metadata (educational value) to resources
- Provide free tagging tools
- Produce a Learning Object Metadata profile for cultural heritage
- Establish a community of practice

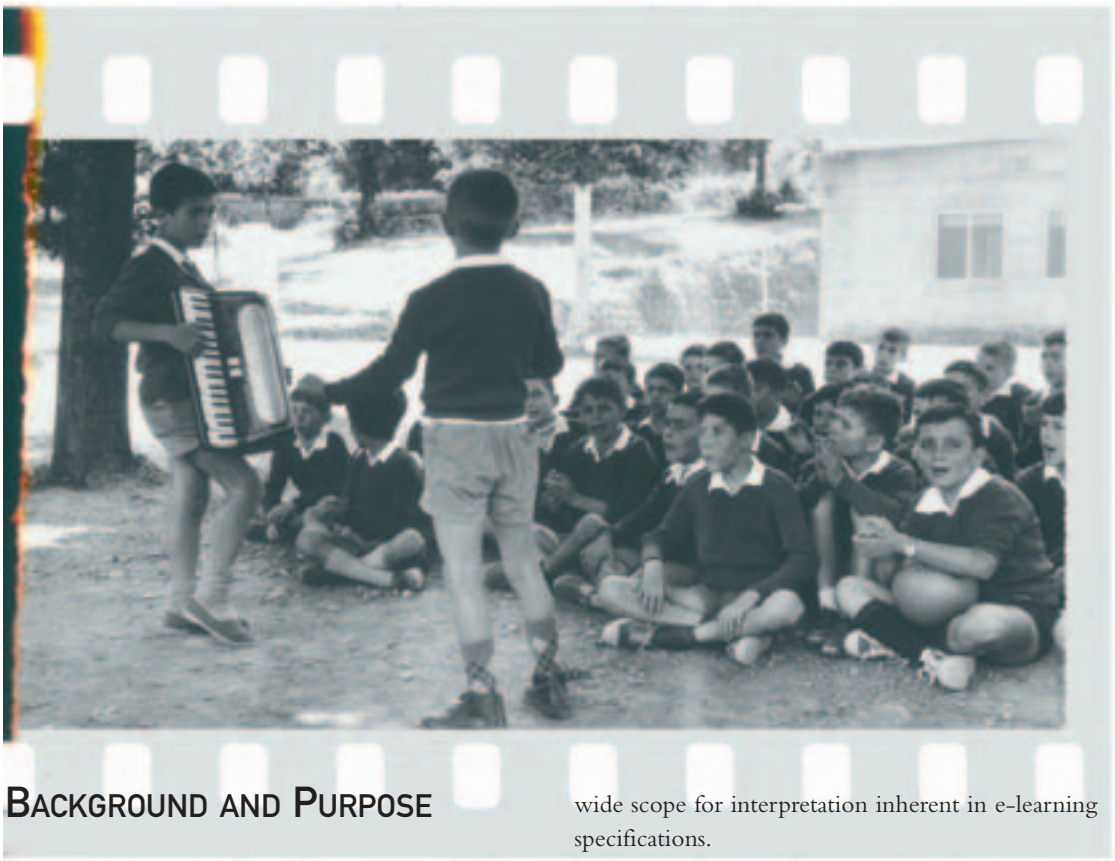
IN THE USE OF LEARNING OBJECTS

CHALLENGES

N	Challenge	Notes
1	Authenticity and uniqueness	How will things be identified and authenticated? Will some identifier need to be used?
2	Rights management	A complex issue, especially for digital objects and metadata that can be easily fragmented, combined and distributed.
3	Enabling participation	The audience should be engaged and provided with access to information and learning experiences.
4	Quality assurance	This refers to both the object and the metadata. It will be based upon a level of 'trust'.
5	Semantics and diversity	There may be different understandings of the same information in different domains. There is considerable cultural diversity and there may be 'meaning slip'.
6	Secondary usage	How the object came about is important, not just the object itself. How is this captured, both subjective and objective information?
7	Legacy data	Most organisations have large amounts of information already. How will this be integrated into new systems?
8	Persistence	This will include things such as version control, persistence of the metadata and location, such as using Digital Object Identifiers.
9	Relationships	An object and its metadata will have multiple relationships and versions.
10	User profiles	In order to tailor the learning experiences, some information can be communicated about the learner. Agreed formats would be useful.
11	Accessibility and accommodation	How will cultural, language and functional differences be accounted for?
12	Leadership and vision	In order to facilitate large-scale change across the sector, some clear understanding and communication plus determination will be required.
13	Metadata and objects	There may be many metadata records from different sources for a single object. Rich metadata, containing information about education use and relationships, can have value and require as much management as the object itself. Repositories may be for objects or for metadata or both together.
14	Business change and roles	Need to acquire a thorough understanding of the value chain of e-learning content.
15	Communities and collaboration	Establish collaboration with communities of best practice.
16	Assessment	Accreditation (including micro credits), formats for exchanging question and test information, competency definitions.
17	Informal learning	The cultural sector has experience of informal learning. How might this link into the more formal learning sectors?
18	Location awareness	There are emerging technologies and standards that can position or refer to the position of objects and metadata.
19	Cost	Implementation and maintenance need resources.
20	Context	How to describe the relationship of a cultural object to its context.

Learning Object Structure – A Critical Assessment

By Chris Jackson and Adam Cooper
FD Learning, UK



Background and Purpose

The definition, size and structure of learning objects have been the subject of much debate and some confusion, with varying views and positions. This area is one that FD Learning is very familiar with, having researched and developed e-learning solutions with education sector colleagues since 1995. This paper reviews various approaches to learning objects and the implementation of specifications. Its purpose is to stimulate and foster debate, so that the views of technologists and educationalists can be heard and balanced.

The main contentions of this paper are twofold:

First, that an open approach to content design is advisable in order to ensure good quality, re-usable content that is able to exploit emerging e-learning standards. This can sometimes be undermined by the wide scope for interpretation inherent in e-learning specifications.

Secondly, that the prerogative of defining the structure of learning objects should largely reside with educationalists and instructional designers, rather than with technologists. Whilst producers need to be challenged to adjust their thinking towards much smaller chunks of learning, they also need the freedom to determine the approach to learning, which may limit the ability of the resulting content to conform to specific technical limitations.

This paper:

- briefly reviews some of the interpretations of 'learning objects' and relates them to IMS Content Packaging items and SCORM Shareable Content Objects (SCOs);
- indicates how interpretations can sometimes stem more from technological issues than pedagogic considerations, leading to restrictive practice in

content design which can ultimately lead to difficulties in making content, content repositories and Learning Management Systems (LMSs) comply to e-learning specifications;
- discusses how some restrictions rather than making available a wider range of reusable high quality learning materials may achieve exactly the opposite effect;
- proposes a more open approach to the issue and outlines the implications to content suppliers, as well as content repository and LMS vendors.

This paper is based on one originally written by us in the summer of 2002, in the specific context of the UK education sector. There have been developments since then in the IMS Simple Sequencing specification. These may result in a greater ability in future to address the problems of appropriate navigation within a delivery system rather than within content. This revised paper does not attempt to review the impact of such changes in detail; however, we believe that the basic contentions of our original paper still stand.

Learning Object Structure

Learning Object Interpretations

The main objective of creating learning objects is to achieve the goal of maximum reusability, leveraging the high cost of production of quality materials without sacrificing the learning meaning. For the benefits to be available outside the publishing community, learning objects need to be able to be individually broken out and delivered in a wide variety of systems, rather than being delivered as part of fully constructed courses via proprietary systems.

The meaning and precise definition of learning objects has been the subject of much debate which it is not the intention of this document to repeat. Stereotyping viewpoints somewhat:
- at one extreme is the 'publisher' view in which an object is little more than an asset to be incorporated in a larger piece of material;
- at the other extreme are practitioners who insist that a single learning object should completely address a specific learning objective, by delivering the learning AND assessing whether it has been achieved;
- in-between are a range of views that often take a pragmatic stance based on the size of the learning object and its practical ability to be reused in other contexts.

Some argue that 'all of the above' are valid learning objects – which is a philosophically generous approach, but does not provide content producers or LMS implementers with any help as to what they are supposed to be building and supporting.

Views on the ideal size and length of learning objects vary with the proponents' position in the debate above, but the consensus appears to be around a range of 1-15 minutes. More flexible delivery systems allow existing assets such as documents and presentations to be included 'as-is' and there will inevitably be simple content based on typed text, but content developers are encouraged to avoid 'page-turner' content where the material is basically pages of a book replicated as Web pages, with interaction being limited to 'turning the page'.

Learning Objects and e-Learning Specifications

Given that there is a range of interpretations of 'learning object', specifications groups have tended to avoid the term, in favour of other terms with definitions that can be agreed by producers and implementers.

SCORM SCOs

The Advanced Distributed Learning Network's SCORM specification (ADL SCORM) defines a 'Sharable Content Object' as follows:

A Sharable Content Object (SCO) represents a collection of one or more Assets that include a specific launchable asset that utilizes the SCORM Run-Time Environment to communicate with Learning Management Systems (LMS). A SCO represents the lowest level of granularity of learning resources that can be tracked by an LMS using the SCORM Run-Time Environment. (SCORM V1.2 Content Aggregation Model, October 2001).

SCORM defines a Run-Time Environment which allows content to exchange data with the delivery environment. This includes launch parameters, interim data such as bookmarks (saved when the SCO is suspended and retrieved when the SCO is re-launched), feedback to the LMS of objectives achieved, and an assessment score and maximum score which can be compared with a pre-defined mastery score. The API and its data model only operate within a single SCO, i.e. one cannot begin a SCORM interaction within one SCO and complete it within another. A SCO's use of the run-time API can theoretically be limited to a simple 'initialise call' followed by a 'complete' call. Except in this trivial case, the need to complete an interaction within the SCO can limit its minimum size.

IMS Content Packaging

Content packaging and structuring specifications allow a content producer to group together a number of content items which may themselves be made up of multiple assets. Depending on interpretation, they may indicate commercial limitations (such as licence restrictions on reuse) or an implied delivery structure or navigation order.

IMS Content Packaging is primarily a way of bundling up the assets into items with metadata. It offers a hierarchical 'table-of-contents-like' structure, but does not itself specify any navigation, though the organization structure (of which there can be several in one package) is envisaged as being extensible to other structures and navigation. The basic structure is for content producers and LMSs to interpret. Some LMSs exploit the structure, for example presenting contents as units and sub-units or in e-book style. Others interpret the structure as a simple list that should be navigated forwards and backwards, for example via built in 'next' and 'back' buttons in the LMS. None of these is 'wrong', and all are arguably 'compliant' with the specifications.

Recent SCORM releases have included the IMS Global Learning Consortium's Content Packaging specification, with a SCORM interpretation of its use, including name-spaced elements. This interpretation identifies the SCORM SCO with the IMS Item.

Simple Sequencing

If the content provider wants to control navigation or believes that non-linear navigation is required to deliver the content appropriately, usually that navigation needs to be included within the content itself. At the extreme this leads back to proprietary courses, distributed as 'items' of several hours' duration, which is undesirable.

The IMS Simple Sequencing Specification Version 1.0, released in March 2003 attempts to address aspects of this problem. Simple Sequencing enables specification of which learning activities a learner will be presented with, in what order and under what circumstances. It focuses on single user learning experiences, and supports, among other things, roll-up of scores, some flow choice within an activity tree, and the ability to suspend and resume an activity.

ADL has worked hard to produce practical recommendations and sample implementations to encourage the progress of Simple Sequencing into SCORM V1.3, which has not yet been finalised. With this support, Simple Sequencing may in due course provide a basis for some types of instructional design to be managed in the LMS rather than the content.

Despite these initiatives, it must be recognised that in terms of the majority of current commercial implementations, content that requires non-linear navigation needs to encapsulate that navigation within itself. Exciting, interactive content may always need to retain some aspects of internal navigation. It may be impossible to address some concepts within a learning object that is a single file or web page; this also implies some form of navigation if the content item is to remain meaningful.

Uses and Abuses of Specifications

IMS Content Packaging provides a framework within which implementations can be developed, but does not specify what goes within that framework. SCORM clarifies this somewhat in specifying the way in which the IMS structure is to be used to support SCOs.

When there is investment in existing content or delivery environments, vendors may simply provide an 'IMS-compatible' packaging of their existing practice, rather than modifying their practice in the spirit of the specification.

Very Large Learning Objects

Content providers may be tempted to deliver learning objects that are very large, retaining as much internal navigation as possible, regardless of whether the LMS could do just as good a job of providing the structure. They may alternatively break their content up into smaller 'items' within a package but continue to provide hyperlinks between them. This can cause failures if the package is broken up.

Such approaches to content result in a number of potential problems:

- LMSs cannot track learners' progress at a detailed enough level, reducing the effectiveness of online support from tutors or mentors.
- Reusing content becomes much more difficult. While there are still serious issues to be resolved regarding rights management, ultimately the value of content from a user's perspective will be higher if it can be reused.
- Tutors or mentors may have difficulty in including other online materials, whether commercial or locally produced, to contextualise and enhance the learner's learning.
- Moving very large objects around networks and across the Web will continue to be a real performance and usability issue for users for some time to come.

Very Small Learning Objects

LMS, content management and tool vendors may have an existing proprietary environment, including simple content creation, which can only cope with a particular approach to content. For example this might be allowing only a single file or single Web page per 'item', or insisting on a particular internal structure to items. Such content can almost always be exported as an IMS Content Package, but whether the 'items' make sense stand-alone or when imported into a different LMS is a different matter.

It is arguable that these approaches, also, do not deliver 'good content' and can undermine a standards-based approach:

- Reusability may be reduced rather than increased. For example, a content producer forced to split meaningful 'learning objects' across several small items becomes totally dependent on the packaging structure and its interpretation by an LMS to make the set of items meaningful. Hence it cannot be assumed that any package can be safely broken up, even if the first three items could belong to one learning object and the next three to a second object. While the provider may want to sell the package on an 'all or nothing' basis, it does mean that the level of granularity of reuse is actually larger, i.e. the package rather than its individual items.
- Quality of materials may also be reduced. There is a significant body of opinion that effective e-learning involves interactivity, which almost always involves choice. Choice cannot be delivered via a single linear path through a set of materials; it inevitably implies some form of navigation. At present, most LMSs cannot deliver complex navigational paths within the LMS based on choices made within the content, unless the content is proprietary to the LMS. If the content is reduced to very simple pages linked by a LMS's 'next' and 'back' buttons, the result is the classic 'page-turner', recognised as less engaging for e-learning users.
- IMS Content Packaging (CP) specifically recognises and allows for Web-based content items consisting of multiple related files or Web pages. In LMSs that do support the use and import of larger, more complex items, content that has been artificially broken down into very small elements may appear limited. If the complete list of elements is presented to the learner, the result can be infor-- mation overload. Conversely, if LMS or repository vendors believe that they only need to support a limited subset of IMS CP that suits them, purchasers of those products may be disappointed when they find that the wider range of IMS CP-based content is not available to them.
- SCORM's identification of SCOs with IMS CP items, and the limits placed by SCORM on inter-SCO interaction, can make it difficult within very small items to exploit the SCORM Run-Time Environment at anything more than the trivial level.

A good test of how truly committed a vendor is to the specifications is whether the product can meaningfully import a wide range of IMS CP structures and content, rather than simply export its own internal format in a package which is valid but makes little sense in another environment.

Finding A Balance

Of course, any vendors may find that certain approaches to content production do not import well in a particular environment. The purpose of plugfests and similar events is to allow system vendors and content producers to gain a wider understanding of the needs and limitations of each others' products.

However, to encourage availability of the greatest variety of content for users, it is our view that the majority of problems should be laid at the doors of the LMS, repository and tool vendors, not the content providers. If content providers adhere to the specifications and seek to develop their content in meaningful small chunks, then it becomes the job of the LMS and repository developers to ensure that their systems allow import of that standards-based content, whatever the source.

Some Recommendations

Having reviewed the issues above, the following approach is proposed to achieve the balance of quality, reusability and specifications-based interoperability sought by the education and cultural heritage sectors and those responsible for development of e-learning within these related sectors.

1. Content producers should be encouraged to think in terms of producing content that is broken up into small learning objects, initially delivered via a package. Rather than engage in extensive debates about the exact structure of such objects, a pragmatic approach needs to be taken. Objects that are too small may not have any learning meaning whereas objects that are too large usually result in too much embedded context to encourage reuse.

2. Content producers should be encouraged only to use internal navigation where it enhances the delivery of that learning concept in an interactive way. It should not be used simply to provide an index or table of contents, which can be done just as well by the LMS. Hyperlinking between learning objects is not desirable.

3. LMS vendors whose product cannot cope with multi-file objects or internal navigation should be encouraged to develop support for importing such content. Without this, they cannot really claim to support IMS Content Packaging.

4. LMS vendors whose products do not cope well with a larger number of smaller learning objects should be encouraged to develop their products so that a collection of such objects can be handled well via their interface.

5. Vendors claiming to offer repositories or content packaging tools which support IMS Content Packaging should be able to demonstrate that their products support the full breadth of the specifications. Otherwise, these systems constrain the ability to engage properly in specifications-based interoperability.

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Knowledge On Demand: An Approach to Personalized Learning in a Learning Object Economy (Adam Cooper 2002), http://www.fdlearning.com/html/company/papers/KOD_Approach.pdf

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IMS Global Learning Consortium (See especially the Current Specifications section), http://www.imsproject.org

Content is Useless Without a Wrapping

An Interview with Patrick Towell, CEO, Simulacra, UK

By Joost van Kasteren

Before anyone can use a learning object he or she must be able to find it. This is obvious of course but the problem is that people in the culture and heritage sector and else-where tend to forget it. They focus on the content but forget about the wrapping', says Patrick Towell, CEO of Simulacra and very much involved in the British Government's Curriculum Online Programme. 'I am not saying the museums and libraries should develop their own channels to the learner. They are probably not equipped for that. But the least they can do is to think about their role in the value chain for digital learning content.'

To demonstrate his point, Towell talks about an average visitor on the Internet with a rather vague objective, for instance to learn more about castles in France. 'That person needs support to clarify his own needs. To assist him in formulating his learning objective you have to show him samples. Generally people do not systematically search the Internet; it is more like a discovery trip. They wander around a particular domain before they focus on a particular piece of content. And then, once they are focused, their need has to be quickly fulfilled. They don't want to wait for a CD-ROM in the mail nor do they want to subscribe to a specific learning platform.'

According to Towell there is a large demand for (informal) learning. This includes information about public records, for instance, but also about art, history and science. 'It is not just a matter of offering content to fulfil that demand. You need many wrapped-around services to make the content useful for the learner. You could compare it with a filmed documentary. Before it is on television it has gone through the hands of the production company, the post-production polishing, the distributor, the broadcaster. A whole chain is needed to make content available and accessible.'

In the traditional value chain for learning, cultural heritage institutions would make their collections accessible through catalogues, exhibitions and monographs. These were then used by authors of textbooks and published and distributed by publishing houses. The value chain for digital learning needs new players. Towell: 'The relation between providers of content and vendors of learning systems is rather weak. There is a role to play for an intermediary for delivering digital content. Another role yet to be fulfilled is the closing of the gap between the subject-matter expert, often within the institution, and the learning system. These are just two examples of where value can be added by intermediaries.'

The value chain has several links that, according to Towell, can be either public institutions, not-for-profit organisations or private companies. 'Thanks to a combination of market forces, regulation pressures, funding and a bit of luck, all building blocks will fall into place to create new channels and reach new customers. It is still an embryonic market so roles haven't been established yet.'

Standards are needed to help define the content or, better, the wrap-around services, but Towell adds that formulating standards is not enough. 'It is not that you specify standards and then everybody starts using them. You will have to put a lot of effort into adoption, because a poorly implemented standard is of no more use than no standard at all.

The problem is that the work on standards is often viewed as the work of 'geeks'. It has a low status inside the boardrooms of companies and institutions. What these CEOs don't realise is that – adopted – standards are a prerequisite to realising the strategic goal to achieve high usage of learning objects. For instance, without interoperability, a concept that relies heavily on standards, you can forget about the strategic goal of high usage.'

Simulacra
http://www.simulacramedia.com

New Metadata for Learning Will Benefit Cultural Heritage Sector

An interview with Henri Hudrisier, University of Paris 8, France

By Joost van Kasteren

The standard for Learning Object Metadata (LOM), which was developed by the Institute of Electrical and Electronics Engineers (IEEE), is good for training and procedural learning, but it falls short when learning becomes education. For distance learning in art history or philosophy you need a more sophisticated kind of learning model and the accompanying standard. I think the new Metadata for Learning Resources (MLR), the development of which has now been accepted by the ISO SC36, will provide us with a standard that can accommodate different modes of distance learning.'

Henri Hudrisier is glad that the Standard Committee 36 of the International Standards Organisation (ISO) did not choose the fast track when discussing standards for distance learning. This fast track was solely based on the Learning Object Metadata (LOM) from the IEEE and the Sharable Content Object Reference Model (SCORM) developed by the Advanced Distance Learning group from the US Department of Defense. Hudrisier: 'LOM and SCORM are based on a very straightforward learning model. It is either 1 or 0, right or wrong. That figures because LOM and SCORM were developed for the army and for the aviation industry. Still, people thought that they could be extended to include other types of learning. There was a lot of pressure to use LOM and SCORM as the basis for distance learning standards, but we were not very happy with this fast-track approach.'

In 2002, an inventory was drawn up of the necessary modifications and in September of that year the SC36 decided to abolish the fast track to standardised metadata and choose a more complex road, called Metadata for Learning Resources (MLR). Hudrisier: 'More complex maybe, but also doing more justice to different types of learning than LOM. You can compare it with the standard for colour television. In the United States a rather straightforward standard was chosen (NTSC). As this is based on technology of the sixties it is very difficult to incorporate new technological developments. In Europe, the development of colour television took place at a later stage, so we could choose a more sophisticated standard (PAL), which can incorporate new developments.'

Metadata for Learning Resources (MLR) is supposed to be the PAL for distance learning in the sense that it can accommodate all types of learning. In March 2003, at the plenary meeting of SC36 in Paris it was decided that France and China together will edit the future MLR standard, with Yolaine Bourda from the French Ecole Supérieure d'Electricité as project leader. The work is done within working group 4 of SC36 of which Hudrisier is a member. 'We hope to develop a model for distance learning within the next five years. Or rather a set of learning models, somewhat comparable to the concept of styles in MS Word. Every style will have its own combination of metadata for resources, for evaluation and for interaction and collaboration. But the metadata themselves will be constant, like the letters in the alphabet. It is a more abstract approach than LOM and SCORM, but it will be the more comprehensive because of that.'

According to Hudrisier the cultural heritage sector will benefit more from MLR because it gives the possibility for 'learning on a higher level', as he puts it. Furthermore, the MLR standard will be compatible with existing and future developments in the area of imaging and transport like MPEG7 and MPEG 21 for e-commerce and e-exchange. Also a standard of terminology is being developed in accordance with future standards.

Hudrisier acknowledges that this will take more time, but that should not be too much of an issue. 'It took us over 50 years to build the railway system in Europe', he says. 'We are not taking that much time, but in my opinion it is more important to build a standard that can accommodate existing and future developments than rushing to a standard which will be obsolete in five years' time.'

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From Cultural Learning Objects to Virtual Learning Environments for Cultural Heritage Education: The Importance of Using Standards

By Fabrizio Giorgini and Fabrizio Cardinali
Giunti Interactive Labs, Italy

Introduction

In recent years, there has been an increased interest by the Cultural Heritage sector in reusable multimedia components for learning, also referred to as Cultural Learning Objects (CLOs). The use of cultural learning objects promises to increase the effectiveness of learning by making cultural content more readily available, by reducing the cost and effort of producing quality content, by allowing virtual artefacts to be more easily shared, and by addressing the need for significantly greater adaptability of learning objects to fit the unique needs of individuals or groups and to enable greater flexibility for mass customisation and ultimately personalisation of learning.

However, the development and deployment of Cultural Learning Objects also presents new challenges to designers of instructional materials and technologies alike.

Figure 1 summarises the historical development of educational technologies over the last 30 years by mapping them according to educational objectives and models, thus demonstrating how some technologies have better helped to achieve quantum leaps in the possible implementation of new educational strategies and models. From Figure 1 it should be evident that educational technologies point to an increasingly higher level of interactivity and collaboration.

Nowadays, the need for tools to improve collaboration and interactivity in the educational process is favouring the spread of virtual learning environments (VLEs) dedicated to specific application fields. A VLE is a set of teaching and learning tools designed to enhance a student's learning experience by including computers and the Internet in the learning process. Virtual Learning Environments manage and deliver learning content (specifically called Learning Objects, LOs) and administer communication, both internal (between students and tutors) and external (between different systems). The main components of a VLE are:

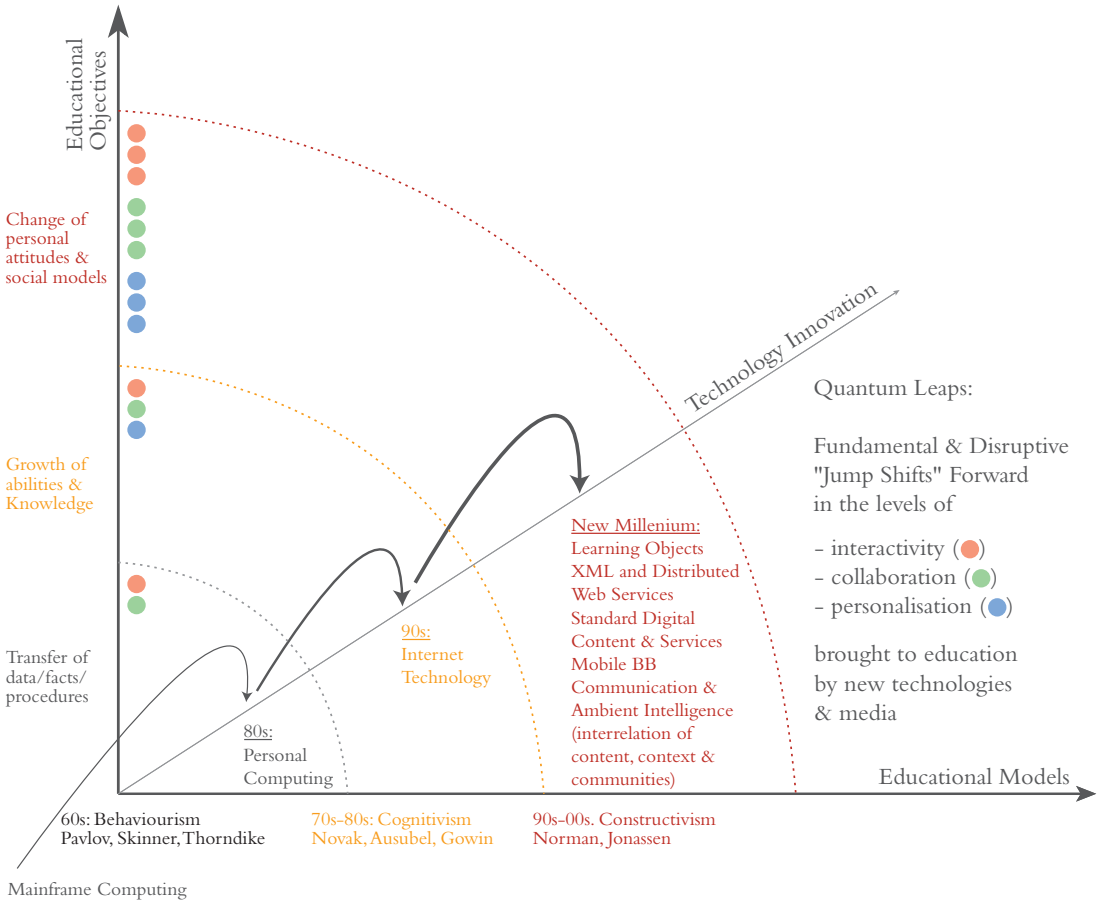


Figure 1: Today's Big Picture: A quantum leap in educational technologies

- mapping of the curriculum into courses that can be assessed and recorded;
- tracking of student activity and achievement against pre-fixed objectives;
- support of online learning, including access to learning resources, assessment and guidance;
- online tutor support;
- peer group support;
- general communications, including e-mail, group discussion and Web access;
- communication and interchange of content with other systems, both in-house and external.

There are many ways of using a VLE, ranging from simple applications of a limited range of tools, to support for face-to-face courses, through to online courses that make sophisticated use of a wide range of the VLE's facilities. Figure 2 gives some examples of how VLEs can be used, and shows the possible range in their levels of sophistication.[1] These uses can of course be combined in as many ways as appropriate to local needs. There are a number of commercial VLE software packages available, including Lotus LearningSpace,[2] COSE[3] and Learn eXact.[4]

[1] Cook, J.: Virtual Learning Environments: Making the Web easy to use for teachers and learners. LTSS, University of Bristol (1999) available from http://www.ltss.bris.ac.uk/VLEintro_1.htm

[2] Lotus LearningSpace, http://www.lotus.com/home.nsf/welcome/learnspace

[3] COSE, http://www.staffs.ac.uk/COSE/

[4] Learn eXact, http://www.learnexact.com

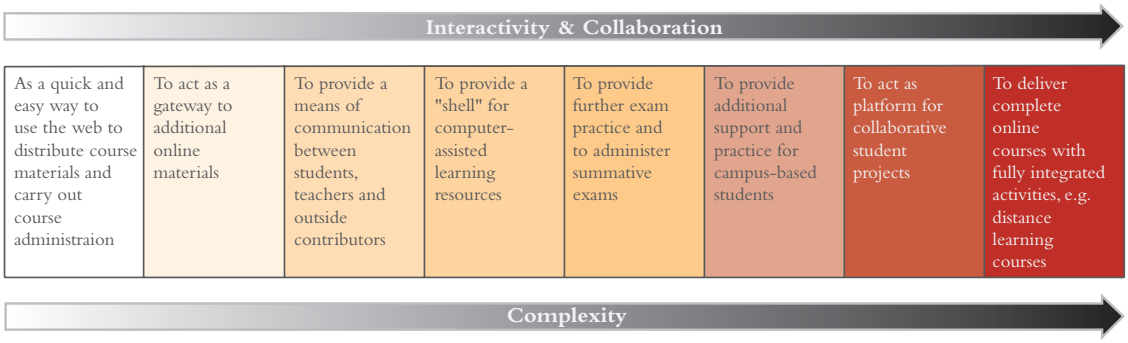


Figure 2: How VLEs can be used, and related levels of complexity, interactivity and collaboration

However, interactivity and collaboration will actually be granted if content providers adopt internationally agreed specifications for content tagging, packaging and tracking. What's more, the massive adoption of new generation interoperability standards will underpin higher performance levels and enable content owners to free their content and solutions from proprietary solutions.

Key bodies like IEEE,[5] IMS[6] and AICC[7] are working on the development of e-learning specifications (some of which are standards at the moment) for the delivery of electronic learning materials. Other bodies like the ADL[8] and OKI[9] use these specifications to propose application profiles, which are interpreted subsets of mandatory regulations, vocabularies and services targeting specific sectors (Department of Defense and Ministry of Labor of USA in the case of ADL and US Higher Education Framework in the case of OKI).

Sometimes these specifications are sufficient to create and describe cultural learning objects to be used within a VLE; sometimes they are not. This explains why the educational technology community and some R&D projects are working towards improving current specifications in order to propose new standards capable of addressing the needs of the new paradigms of education.

This paper focuses on the need and market potential for conceiving and proposing specific VLE platforms that foster e-learning uptake within the cultural heritage educational sector, and proposes a specific standards Application Profile for assuring e-learning technologies & content interoperability and reusability.

The paper introduces CHAPTER®, the Cultural Heritage Application Profile for Technologies in Education Reusability, the approach to cultural heritage e-learning standardisation promoted by European e-learning R&D and standardisation actor Giunti Interactive Labs[10] together with results from one of the main R&D projects co-ordinated by Giunti Interactive Labs within this framework, called SCULPTEUR (Semantic and Content-based Multimedia Exploitation for European Benefit).[11]

The importance of using standards

As we mentioned above, the adoption of standards allows different applications to define their content, so that data can be exchanged. This is particularly important in the CH sector, where content can be distributed on the Internet and represented in different formats, making it difficult to find, access, present and maintain.

Some organisations are well known for their direct involvement in the development of learning object standards, theory, models or repositories. While a number of e-learning organisations are also working in the realm of learning objects, those listed below have learning objects as their core focus, and as a major component of their mission, or are of such influence that their inclusion here is mandatory:

- Advanced Distributed Learning Initiative (ADL);
- Educational Object Economy Foundation (EOE);[12]
- Instructional Management System Global Learning Consortium (IMS);
- Learning Technology Standards Committee (LTSC).[13]

In this section the ADL-SCORM (Sharable Content Object Reference Model)[14] Application Profile is briefly examined, with the aim of describing how cultural learning content can be packaged, making it shareable and interoperable. It is important to point out that, while the SCORM Application Profile is based on a mandatory subset of IMS specifications addressing Learning Objects Indexing, Packaging and Sequencing, it has developed its own CMI (Computer Managed Instruction) tracking model to enable object tracking and possibly support adaptive and/or conditional sequencing based on user performance in content navigation.

The SCORM is a set of specifications for developing, packaging and delivering educational and training materials whenever they are needed. SCORM is a result of the US Government's initiative in Advanced Distributed Learning (ADL) which aims to provide access to high-quality materials that are easily tailored to individual learner needs.

The SCORM applies current technology developments from groups such as the IMS Global Learning Consortium, the AICC and the IEEE Learning Technology Standards Committee (LTSC) to a specific content model, in order to produce recommendations for consistent implementations by the vendor community.

[5] Institute of Electrical and Electronics Engineers, http://www.ieee.org
[6] IMS Global Learning Consortium, http://www.imsproject.org
[7] The Aviation Industry CBT (Computer-Based Training) Committee, http://www.aicc.org
[8] Advanced Distributed Learning, http://www.adlnet.org
[9] OKI, Open Knowledge Initiative, http://web.mit.edu/oki/
[10] Giunti Interactive Labs, http://www.giuntilabs.com
[11] SCULPTEUR project, http://www.sculpteurweb.org
[12] Educational Object Economy Foundation, http://www.eoe.org
[13] Learning Technology Standards Committee, http://ltsc.ieee.org/
[14] ADL-SCORM, http://www.adlnet.org/index.cfm?fuseaction=scormabt

Although choice and competition in the marketplace are generally a good thing, the rapid growth of VLE vendors has created a significant problem for content authors. Without a common specification for packaging online courses, VLE vendors often organise their content databases in any fashion they choose. As a result, each vendor is using a different format for packaging their content.

Although they are all delivered by http, or some other standard protocol, if an author tries to move a course from one VLE to another, they find that this task is very time-consuming (sometimes it requires the complete reconstruction of the course materials).

ADL is developing a set of specifications for packaging online content and courses that not only will make the transport of content or courses from one VLE to another easier, but will also achieve other desirable goals as well.

SCORM-compliant courses leverage course development investments by ensuring that compliant courses are *accessible* - so that they can be indexed and readily found; *interoperable* - so that they operate across a wide variety of hardware, operating systems and Web browsers; and *durable* - so that they can be adapted and used by many different development tools.

As shown in Figure 3, all of the specifications and guidelines contained or referenced can be viewed as separate 'books' gathered together into a growing library.

These technical 'books' are currently grouped under two main topics: *Content Aggregation Model* and *Run-time Environment*. The purpose of the SCORM Content Aggregation Model is to provide a common means for composing learning content from discoverable, reusable, shareable and interoperable sources. The model further defines how learning content can be identified and described, aggregated into a course - or portion of a course - and moved between systems that may include VLEs and repositories. The SCORM Content Aggregation Model defines the technical methods for accomplishing these processes. The model includes specifications for aggregating content and defining metadata.

The purpose of the SCORM Run-time Environment is to provide a means for interoperability between Shareable Content Object-based learning content and VLEs. A requirement of the SCORM is that learning content is interoperable across multiple VLEs, regardless of the tools used to create the content. For this to be possible, there must be a common way to start content, a common way for content to communicate with a VLE, and predefined data elements that are exchanged between a VLE and content during its execution.

Currently SCORM has achieved version 1.2,[15] while the 1.3[16] draft includes an advanced model for content sequencing also integrating the IMS Simple Sequencing specification. Simple Sequencing enables status inheritance, conditional branching sequencing and personalisation of learning objects.

[15] SCORM 1.2 Run Time Environment, http://www.adlnet.org/screens/shares/dsp_displayfile.cfm?fileid=482

[16] SCORM Version 1.3 Application Profile Working Draft Version 1.0, http://www.adlnet.org/index.cfm?fuseaction=DownFile&libid=496&bc=false

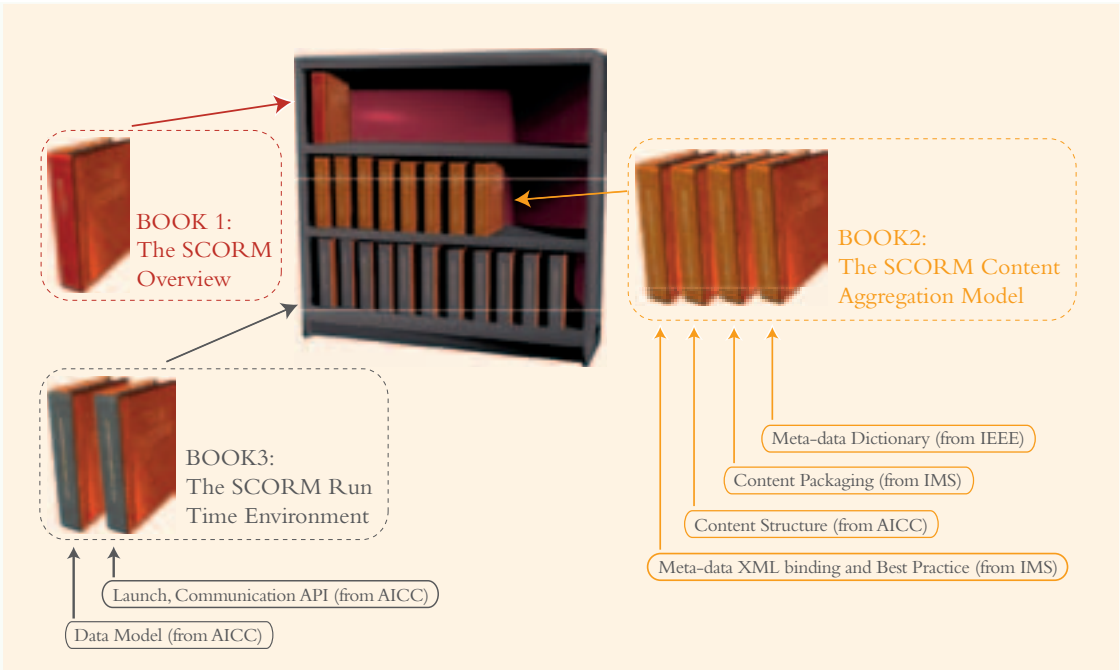


Figure 3: The SCORM as a collection of specifications

When current standards are no longer sufficient

We anticipated that some bodies like ADL (through SCORM) and OKI are collaborating with leading universities and specification and standards organisations to support innovative learning technology in specific application sectors such as military training and higher education. The results of this collaboration are application profiles for some specific sectors like the adoption of SCORM by the US Department of Defense, which specifies how the components of an educational software environment should communicate with each other.

Unfortunately, an application profile for the cultural heritage sector to take into account the specific content publishing needs and educational strategies that might be better used in sector-related scenarios is still missing. In order to address this deficiency, Giunti Interactive Labs proposes a framework of sector-related activities called CHAPTER® (Cultural Heritage Application Profile for Technologies in Education Reusability), whose aims are to extend or modify the current e-learning specifications through the results of pioneering R&D projects, co-funded by the European Commission (e.g. IMAGEN,[17] SCULPTEUR, ARCO,[18] I-MASS,[19] Mobilearn[20]), and to conceive valuable results able to follow the process from early R&D results to final adoption by the standardisation bodies. The full process is illustrated in Figure 4.

The main results of those R&D projects dealing with the cultural heritage sector (some of which are depicted in Figure 4) may be submitted to the specification bodies, mainly IMS, while the originating R&D projects continue to work on the most interesting results in order to improve their specifications. Once the specifications have reached a sufficient state of maturity, and have become of interest, a sector profiling body (like ADL) for cultural heritage e-learning could provide the consensus building and community building strength needed to pass specifications through wider uptake to the standardisation bodies such as the IEEE, International Organization for Standardization (ISO) and the World Wide Web Consortium (W3C).[21] The continuous process of feeding information back to the standards organisation will occur again and again before the documents move being from an initial R&D specification to an accredited standard.

To give an example, IMS, through the Shareable State Persistence Project Team (SSP),[22] is working on a new specification to extend the ADL SCORM in order to support the storage, retrieval and sharing of the state of a piece of learning content.

The information about the state is usually a collection of data about variables that are important for determining the learning status (for example the learners' mastery states). SCORM currently provides a rule-based 'learning strategy' that enables Shareable Content Objects (SCOs, the lowest level of granularity of learning resources that can be tracked by a VLE) to set the state of global records, called 'objectives'.

These records can store the learner's degree of mastery in the form of a score or a passed/failed state, or they may store the progress of the learner in terms of completion. A 'hook' was included in the records, which allows them to reference externally defined competencies.

As the learner is sequenced through the Shareable Content Objects, the learning system builds up a representation of the learner's mastery and progress. The objective records may be viewed as a simple

[17] IMAGEN project, http://www.imagenweb.org/
[18] ARCO project, http://www.arco-web.org
[19] I-MASS project, http://www.i-massweb.org
[20] Mobilearn project, http://www.mobilearn.org
[21] World Wide Web Consortium, W3C, http://www.w3.org/
[22] Shareable State Persistence, http://www.imsglobal.org/workinprogress.cfm

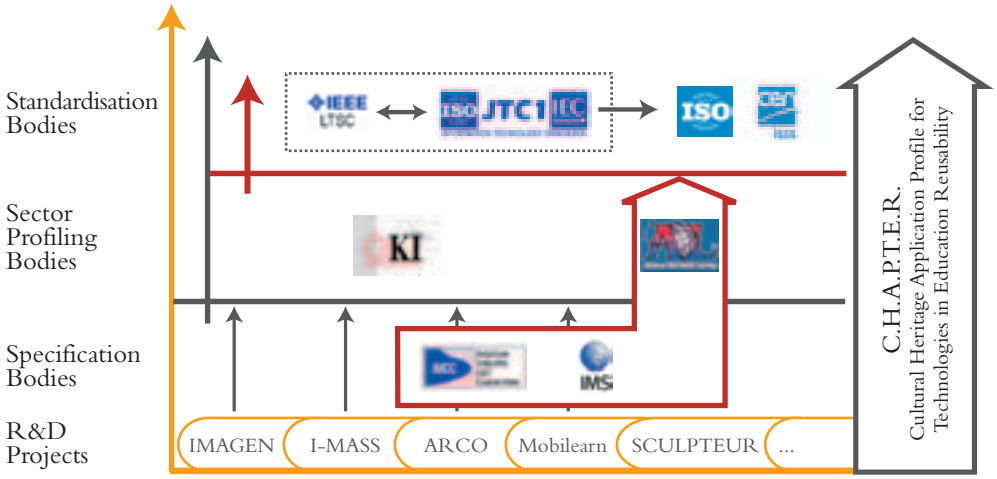


Figure 4: CHAPTER framework

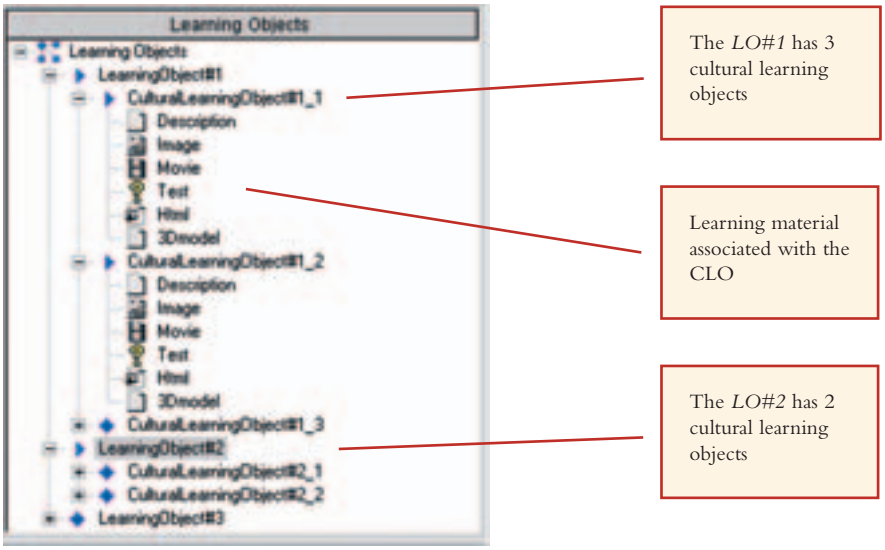


Figure 5: An example of LO structure

model of the learner's state.[23] However, a Cultural Learning Object can be arbitrarily complex: it can contain from a few to many learning resources and, when packaged in a SCORM package, the SCO state could also be very complex.

Consider the example of CLOs in Figure 5: *LO#1* is comprised of three Cultural Learning Objects; several learning materials (text, image, movie, html, 3D model) are associated with each CLO. A test session completes the asset set of the CLO.

Figure 6 describes the packaging procedure which allows the creation of the SCORM package of the defined three Learning Objects; the SCORM properties (on the right of Figure 6) define the rules for the learner to access Learning Objects according to the agreed learning strategy. If we suppose that *LO#2* can be accessed only if *LO#1* has been successfully completed, the SCORM course viewed in a VLE will look like a table of contents where only *LO#1* and its sub-sections (*CLO#1_1, CLO#1_2* and *CLO#1_3*) are available to the learner. *LO#2* will be disabled until the learner completes the learning path scheduled for him or her by the structural designer.

In this simple case, the state of an SCO could be represented by the history of learner actions (i.e., what he or she experienced) and the score of all tests. The status of the SCO associated with *LO#1* allows the VLE to understand whether *LO#2* could have been experienced or not at the given time. If we imagine an arbitrarily high number of Cultural Learning Objects per LO, the storage of the SCO

[23] Gibbons, A.S. and Fairweather, P.G. (1998): Computer Based Instruction: Design and Development. Englewood Cliffs, NJ: Macmillan Library Reference.

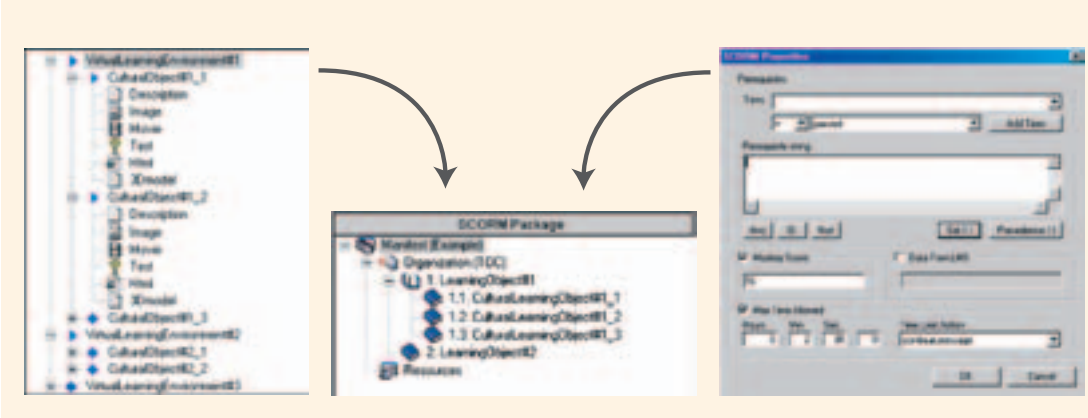


Figure 6: Cultural Learning Objects and SCORM properties define the SCORM package

state would require a high-capacity data storage and, more importantly, a dynamic data storage structure, capable of growing according to the different storage needs.

There is currently no explicit support for such a scenario in the existing SCORM runtime, API or data model. For example, although there are provisions in the SCORM application profile that can be used to load and store states such as *cmi.launch_data, cmi.suspend_data* or *cmi.core.lesson_location*, these data stores are severely limited in size and cannot be accessed by other SCOs.

The addition of sequencing in SCORM 1.3, however, provides an important building block for constructing modular SCOs composed of re-usable Cultural Learning Objects. In SCORM 1.3, the logic for determining how to proceed through these Shareable Content Objects (based on SCO status) can now be written down as sequencing rules.

What is still missing is the ability to store complex data from one SCO that can be retrieved by another, so that the Shareable Content Objects can be 'knitted' into a complete and integrated learning experience. This capability is crucial to the persistence of the complex state information that is generated by the most diverse Shareable Content Objects and is currently stored and retrieved in prop-rietary formats, and through proprietary methods. The Shareable State Persistence Project Team of IMS is working to propose extensions to e-learning runtime systems (e.g. SCORM) that enable the storage of - and shared access to - the state information. This specification will enable e-learning applications to be stopped and resumed where the learner last left off. It is expected that the work will be completed in November 2003, but the standardisation process will require more time.

A case study: The Sculpteur project

One of the projects included by Giunti Interactive Labs in the CHAPTER® Framework for developing an e-learning standards Application Profile for Cultural Heritage is SCULPTEUR.

SCULPTEUR (Semantic and Content-based Multimedia Exploitation for European Benefit) is a three-year European project which started in May 2002. Its total investment amounts to Euro 3M and it is co-funded by the European Commission within the Fifth Framework's Information Society Technologies (IST) Programme. SCULPTEUR involves ten partners from three European countries in a multi-disciplinary partnership with participants from industrial, academic, research and cultural sectors.

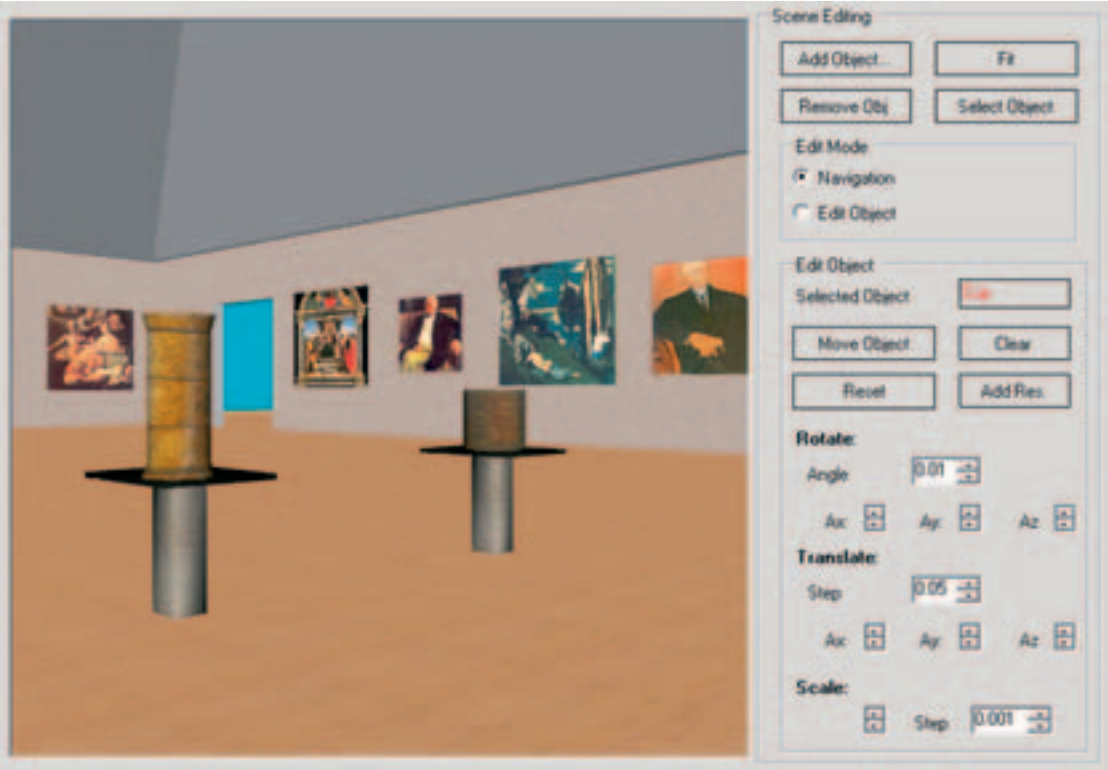


Figure 7: The GUI of the editor (alpha version) and an example of a 3D VLI created *(see p.37)*

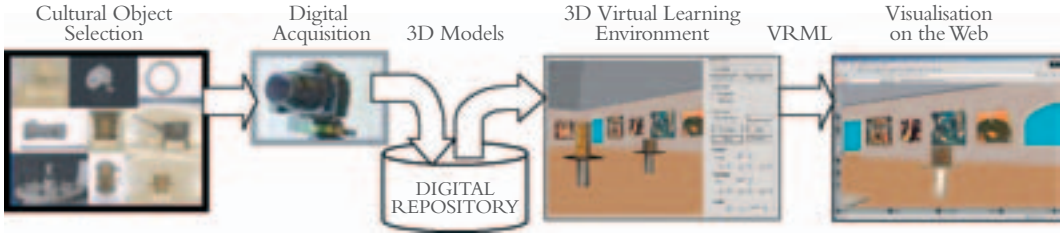


Figure 8: The workflow from digitisation to visualisation on the Web

There are many European cultural heritage archives of special scientific and cultural interest. To preserve, exhibit and study these heritage collections is a European-wide issue. At the same time, these collections need to be made available to scientists, archaeologists, curators, historians and European citizens for their research, enjoyment and learning. The vision of SCULPTEUR is to develop both the technology and the expertise to help create, manage, visualise and exploit these cultural collections.

The existing digital library technology is going to be extended to support storage and retrieval of diverse multimedia objects together with algorithms for content-based analysis of 3D models. In the project, querying and navigation of museum collections are enhanced using Semantic Web technologies to generate, structure and link together metadata within a semantic layer. SCULPTEUR is providing seamless access to distributed museum collections, by supporting and contributing to digital library standards.

SCULPTEUR is also developing technology to provide museums and educational departments with tools to create and manage 3D virtual learning environments (VLEs) of both trackable 3D models of cultural objects and related learning materials (reports, images, videos, animations). A simple-to-use graphical user interface (the alpha version is shown in Figure 7) will assist curators, museum instructional designers and educators to build their virtual exhibitions of Cultural Learning Objects and define learning rules and Shareable Content Objects.

In SCULPTEUR, generated 3D models are retrieved and imported into the virtual scene, where they are positioned, rotated or scaled according to author needs. The Cultural Learning Objects are then created by associating the imported learning material to each 3D model. Later, the run-time environment API for the communication with a VLE is automatically generated and embedded in the generated VRML file. The 3D virtual learning environment created can be saved and displayed on a Web browser with a VRML plug-in (see Figure 8).

Once the 3D virtual learning environment editor is integrated in a Content Management System (in

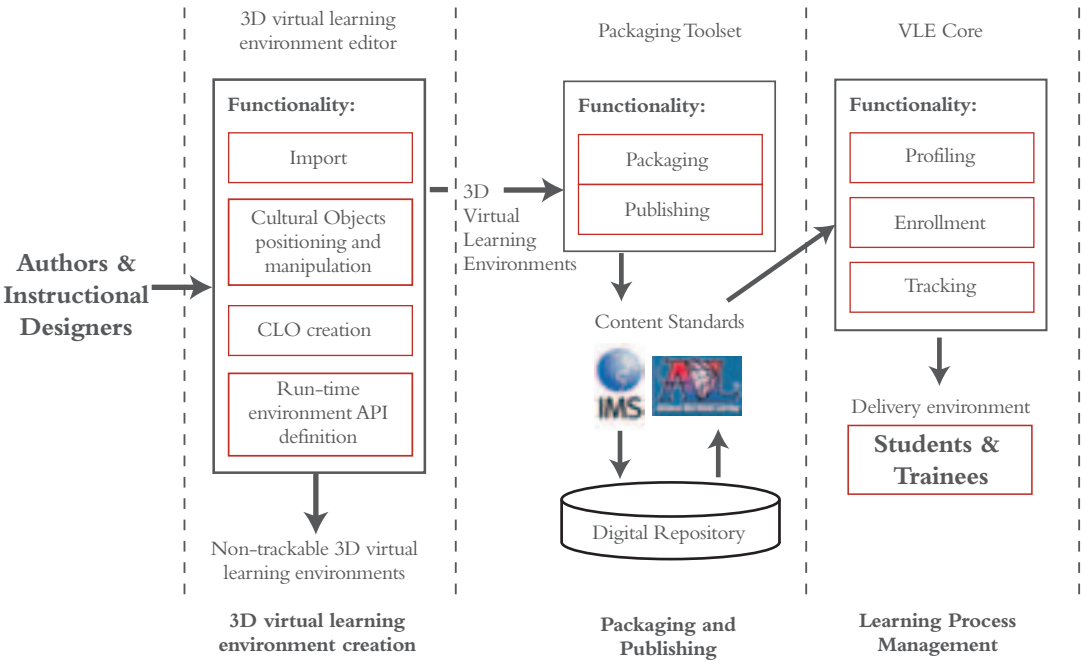
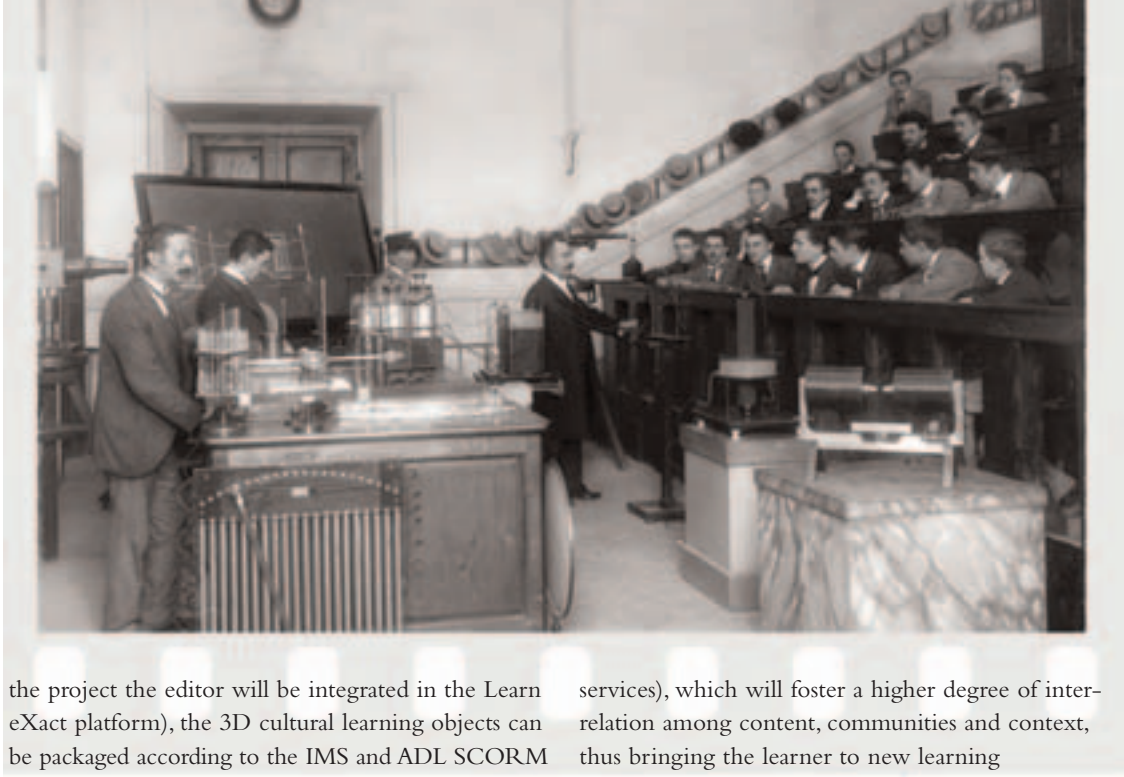


Figure 9: From the 3D VLE creation to delivery: processes, resources and standards *(see p.38)*



the project the editor will be integrated in the Learn eXact platform), the 3D cultural learning objects can be packaged according to the IMS and ADL SCORM specifications and stored in a digital repository, ready to be retrieved by a VLE and delivered to the end-user (students and trainees). Thanks to the adoption of these specifications, the 3D virtual learning environment can also be exchanged with other VLEs and the 3D cultural learning objects can possibly be re-used for other applications.

Figure 9 illustrates the full process of creation, packaging and delivery of a 3D virtual learning environment of trackable cultural learning objects.

The information about the state (learning material experienced, test scores, sequence of user actions) is stored in the SCORM data model by the run-time API environment embedded in the generated VRML. In a more complex scene (several 3D models, many learning materials), the data storage provided by the SCORM data model can be inadequate to save all the information required to resume the 3D virtual learning environment where the student last left off. For these reasons, SCULPTEUR, through Giunti Interactive Labs, is also contributing IMS's Shareable State Persistence Project Team to support the development of new specifications and promote the CHAPTER® initiative for an application profile for the CH sector.

Conclusions

Technology-based learning (TBL) solutions have always achieved higher levels of interactivity, collaboration and personalisation, as soon as new information and communication technologies have hit the marketplace and have been correctly applied to education. Today, we are at the dawn of a new revolution in TBL solutions to be generated by the rapid uptake of new broadband (faster Internet connections) and technologies (XML and Web services), which will foster a higher degree of inter-relation among content, communities and context, thus bringing the learner to new learning experiences, and the content used to new levels of effectiveness and efficiency. The VLE tools are the response of the educational technologists to the increased request for new technologies capable of online learning content delivery and management.

However, all this can make sense only if learning content (called 'learning objects') reaches a higher degree of granularity, as regards content reassembly, tracking and sequencing, thus fostering higher levels of content personalisation and adap-tation. To allow this, international specifications bodies such as IMS and sector profiling bodies like ADL and OKI have issued a new set of internationally agreed specifications for content tagg-ing, packaging and tracking, thus superseding the limits and constraints of previous e-content standards.

Unfortunately, current specifications are not always sufficient to address all the needs of increasingly complex learning objects. For this reason, learning content providers, technology providers and instructional designers are working together to improve current specifications and promote their use for a better exploitation and diffusion of learning objects.

There is a clear need and market potential for specific VLE platforms that foster e-learning uptake within the cultural heritage educational sector, as well as a standards Application Profile for assuring e-learning technologies & content interoperability and reusability.

This paper introduced CHAPTER®, the Cultural Heritage Application Profile for Technologies in Education Reusability, the approach to cultural heritage e-learning standardisation promoted by e-learning R&D and standardisation actor Giunti Interactive Labs together with results from one of the main R&D projects within this framework, called SCULPTEUR.

Selected Resources

Standards overviews:

Canadian Heritage Information Network (CHIN): Standards, http://www.chin.gc.ca/English/Standards/

Diffuse - Electronic Learning Standards and Specifications, http://www.diffuse.org/eLearning.html

Standardisation bodies:

CEN/ISSS Learning Technology Workshop, http://www.cenorm.be/isss/workshop/lt

IEEE Learning Technology Standards Committee, http://ltsc.ieee.org

ISO/IEC JTC1 SC36, http://jtc1sc36.org

Specifications and application profiles:

IMS Global Learning Consortium specifications: http://www.imsglobal.org/specifications.cfm

Advanced Distributed Learning (ADL) SCORM programme: The Sharable Content Object Reference Model (SCORM) is a collection of specifications that define a common framework that permits the interoperability of learning content and delivery technologies, http://www.adlnet.org

Open Knowledge Initiative: OKI develops an open and extensible architecture that specifies how the components of an educational software environment communicate with each other and with other systems, http://web.mit.edu/oki/

Other important organisations and initiatives:

Ariadne Foundation: Ariadne's overall goal is to enable better quality learning through the development of learning objects, tools and methodologies that enable a 'share and reuse' approach for education and training, http://www.ariadne-eu.org

CETIS: UK's Centre for Educational Technology Interoperability Standards provides a rich, up-to-date resource on e-learning standardisation issues, http://www.cetis.ac.uk/

PROMETEUS: Works to establish a common approach to e-learning in Europe, http://www.prometeus.org/

Learning resource metadata:

Learning Object Metadata (LOM): IEEE Learning Technology Standards Committee: Standard for Information Technology - Education and Training Systems - Learning Objects and Metadata, 1484.12. 1 – 2002, http://ltsc.ieee.org/doc/wg12/LOM_ 1484_12_1_v1_Final_Draft.pdf
For an interesting use case of LOM see the UK's National Curriculum Online schema, vocabularies and implementation guidelines, http://metadata.ngfl.gov.uk/

IMS Learning Resource Meta-data Specification (IMS): http://www.imsproject.org/metadata/

Dublin Core Metadata Initiative (DCMI) - Education Working Group (DC-Ed): Develops proposals for the use of Dublin Core metadata in the description of educational resources, http://dublincore.org/groups/education/

CanCore - Canadian Core Learning Resource Metadata Application Profile: http://www.cancore.ca

Educational modelling languages:

CEN/ISSS WS/LT, Learning Technologies Workshop: Survey of Educational Modelling Languages (EMLs), Version 1. Authors: Adrian Rawlings, Peter van Rosmalen, Rob Koper (OUNL), Miguel Rodríguez-Artacho (UNED), Paul Lefrere (UKOU), September 2002, http://eml.ou.nl/forum/docs/EML%20Survey %20version%201.pdf

Koper, E.J.R.: Modeling units of study from a pedagogical perspective. The pedagogical meta-model behind EML. June 2001, http://learningnetworks. org/downloads/ped-metamodel.pdf

Open University of the Netherlands, Learning Networks: Education Modelling Language, http://eml.ou.nl/eml-ou-nl.htm

On learning objects:

FD Learning papers: http://www.fdlearning.com/html/company/papers.htm

A. Littlejohn and S. Buckingham Shum (Eds) Reusing Online Resources (Special Issue) Journal of Interactive Media in Education (April 2003), http://www-jime.open.ac.uk/2003/1/

P. R. Polsani: Use and Abuse of Reusable Learning Objects. In: Journal of Digital Information, volume 3, 2003, issue 4, http://jodi.ecs.soton.ac.uk/Articles/ v03/i04/Polsani/

D. A. Wiley (Ed.): The Instructional Use of Learning Objects, Online Version, http://reusability.org/read/

Learning objects repositories:

Educational Object Economy Foundation: Offers a repository of learning objects in the form of Java applets, http://www.eoe.org/eoe.htm

Iconex Learning Objects Repository: Provides access to various online course materials, http://www.iconex.hull.ac.uk

Other online resources: MERLOT - Multimedia Educational Resource for Online Teaching and Learning, http://www.merlot.org

Learning (Content) Management System (LMS/LCMS):

LMS/LCMS, by David A. Williams, http://www.humancapitalmanagement.biz

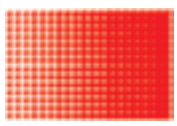
Evaluation of Learning Management Systems, http://www.edutech.ch/edutech/tools/ev2.php

Managed / Virtual Learning Environments:

MLEs and VLEs explained, http://www.jisc.ac.uk/index.cfm?name=mle_ briefings_1

E-learning glossary:

http://www.learningcircuits.org/glossary.html



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As a researcher at the laboratory on electronic knowledge industries (CRIS/SERIES), Dr Arnaud focuses on the use of ICT tools for online learning. Specific domains of interest cover public access to the Internet and standards for e-learning. He is in charge of an open source e-learning platform project with the secondary objective of proposing open standards at the European (CEN ISSS LT) and international (ISO SC36) levels. At present he is also working on an online curriculum aimed at professionals wishing to start e-leaning applications in companies or in public institutions.
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Paolo Buonora holds a degree in Philosophy from the University of Rome 'La Sapienza' (1976). He worked in the Italian State Archive Administration from 1978, where he was first involved in editing the Guida Generale degli Archivi di Stato italiani. From 1986 he worked in the Soprintendenza archivistica per il Lazio, surveying audiovisual archives, municipal

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Lorna M. Campbell is an Assistant Director of the UK Centre for Educational Technology Interoperability Standards (CETIS) http://www.cetis.ac. uk/. She has been involved in developing and supporting the use of learning technologies to facilitate teaching and education since 1997. She has also played an active role in a variety of projects facilitating the reuse of interoperable educational resources. These include the Scottish electronic Staff Development Library, the DNER and Learning Objects project and the CEN/ISSS WSLT Taxonomies and Vocabularies Project. She is also a member of the IMS Global Learning Consortium and regularly participates in the IMS Digital Libraries and Metadata Special Interest Groups. Associated areas of research include the implementation of learning technology interoperability specifications and learning object metadata, the identification of common practice frameworks and development of application profiles, and the use of educational classification systems and controlled vocabularies. Recently Lorna has contributed to the development of the UK Common Metadata Framework, an application profile of the IEEE LOM developed for use across UK educational sectors, http://www.cetis.ac.uk/profiles/ukcmf/.
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Fabrizio Cardinali is CEO of Giunti Interactive Labs (http://www.giuntilabs.com), Europe's leading company in e-learning R&D and standardisation activities with more than 25 active R&D projects in the field of e-learning future (e.g. eLearning Content Brokerage, Web Services, Mobile Learning, Interactive TV, Learning Content Management Solutions), more than 100 bespoke projects for leading European corporations, universities and public bodies, and developer of learn eXact® (http://www.learnexact.com), Europe's first eLearning Content Management (LCMS) technology fully based on XML, Learning Objects and the full set of IMS and SCORM specifications.
Today Fabrizio Cardinali, one of Europe's main e-learning standards experts and author of numerous papers in international journals and conference proceedings, is co-chair of the IMS technical board, invited NATO's ADL SCORM reviewer, member of IEEE, CEN ISSS, ISO SC36 and EliG Elearning Industry Group e-learning work programmes and signatory of the Prometeus MoU fostering worldwide exploitation of Europe's achievements in e-learning.

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For several years Mike Collett has been involved in promoting open technical standards to support learning in UK, European and international groups. Mr Collett is Chair of the CEN/ISSS Learning Technology Workshop, a European group that deals with international standards from a European perspective. He is also Chair of the British Standards Institution's IST/43, the committee responsible for learning technology standards in the UK. In this position he represents the UK at the international ISO/IEC learning technology subcommittee, SC36, and is convenor of the participant information working group.
As an active participant in the IEEE Learning Technologies Standards Committee, LTSC, Mr Collettt was an influential member of the group that successfully developed the Learning Object Metadata (LOM) standard and directly influenced some of the components that have enabled it to be adopted worldwide. Current projects include helping to steer the technical standards and specifications for Curriculum Online and working with C2k to develop technical specifications to be used in a learning platform for 380,000 users in schools in Northern Ireland. Mr Collett is working with The Stationery Office to investigate the use of digital object identifiers and metadata and is advising the Office of the e-Envoy and the e-learning strategy unit.
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Dr Adam Cooper is a Software Architect at FD Learning where he has specialised in the design and implementation of interoperability standards and European R&D. His work on the European

5th Framework projects EASEL and KOD focussed on application of interoperability specifications for learning object repositories, aggregation and personalisation.
Adam has made major contributions to three IMS specifications: Content Packaging, Vocabulary Definition Exchange and Reusable Definition of Competence and Educational Objective, and co-led the working groups for the first two. His current interests are in the application of knowledge management technologies to intelligent and personalised e-learning environments.
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Fabrizio Giorgini took a degree in Electronic Engineering in 1997 at the University of Genoa, Italy. In February 2001 he obtained a PhD in Electronic Engineering and Computer Science. At present Dr Giorgini is R&D Projects Manager at Giunti Interactive Labs Srl where his main activities are multimedia publishing, authoring and visualisation 3D, and advanced technology and standards (IMS, ADL SCORM) for e-learning. He is also a contributing member of the IMS Global Learning Consortium. He has participated, as project manager, in several national and European projects (e.g. TARGET *HC1049*, CEMUVIS *AVS-TTN*, STRETCH *Esprit 24977*, ARTISTE *IST_1999_11978*, JUST *IST_1999_12581*).
He is currently involved, as project manager, in the ARCO project (digital capture, enhancement and archiving of 3D objects, *IST_2000_28336*) and I-MASS project (Multi-Agent Systems to access distributed and heterogeneous data repositories, *IST_1999_20878*). Dr Giorgini is project co-ordinator of the SCULPTEUR project (Semantic Web and content-based analysis applied to multimedia digital libraries, *IST_2001_35372*). He is also author or co-author of numerous papers in international conference proceedings.

John Gordon, eLearning and eKnowledge, UK
John Gordon has 20 years' experience as an academic in Further and Higher Education in Scotland, with his main activity being the development and roll-out of technology-supported learning. He has focused on

the use of technology to enhance learning, and has explored the market opportunities enabled by technology-enhanced learning. Mr Gordon led the Microelectronics Education Development Centre at the University of Paisley (MEDC), the main support agency for learning technology in the Further Education sector in Scotland, until its merger with SCET in 1998. Subsequently, he was Director of Operations at SCET until leaving to join the private sector.
Mr Gordon has acted as a consultant internationally in the application of technologies for learning. He has been involved in major EU-funded projects in the application of Web-based and eLearning. He has chaired various committees of the Scottish Vocational Education Council and has been involved in recent major changes to the Scottish Vocational Curriculum. John is currently a member of the Board of Management of South Lanarkshire College. Mr Gordon's commercial experience includes directorships of several learning and IT companies.

Ian Huckvale, Simulacra, UK
Ian Huckvale plays a central role in Simulacra's consulting team. He is currently leading a series of pilot projects funded by the Department for Education and Skills which aim to improve the quality of digital learning content from the cultural sector, and to make it easier for teachers to find relevant content and increase the level of usage in the classroom. The pilots involve Resource (the council for Museums Archives and Libraries), the British Museum, Shrewsbury Museum Service, Cheltenham Art Gallery & Museum, and the Royal Shakespeare Company. Past experience includes:
Leading a team of consultants in the development of a broadband convergent media strategy for the Sci-Fi Channel (part of Universal Communications). The project examined new ways of engaging with audiences including the use of electronic programming guides to link through to supporting materials, interactive content both online and onscreen, video-on-demand and online avatars.
Running a series of workshops for consultants and managers involved in the New Opportunities Fund (NOF) Digitise programme. NOF Digitise is a £50m programme spread across more than 100 projects aiming to capture national treasures, make them accessible to a wider audience and preserve them for future generations.
Convenor of a workgroup for the British Standard Institute's learning technologies committee (IST/43), which is developing a standard for interoperability between metadata systems used for learning, education and training.
E-government and knowledge management consultancy for a range of projects focusing on delivery of information services to citizens for clients including the Countryside Agency, Tees Strategic Health Authority, the Qualification and Curriculum Authority and the Department for Education and Skills.
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Chris Jackson has been Senior Architect at FD Learning since 2000, with particular responsibility for e-learning products and projects. He takes an active interest in e-learning standards and is a voting member of the IMS Technical Board. Chris has been involved in several national and European R&D projects, and acted as the technical authority on the European 5th Framework projects EASEL, GUARDIANS and KOD. He was also the design authority on the recently launched e-sy.info system (http:/www.e-sy-info) launched by the South Yorkshire e-Learning Programme. This programme, partially financed by European Objective 1 funds, aims to bring e-learning to over 35,000 learners in some 140 schools and 370 small and medium enterprises across the South Yorkshire region. Chris has had over 20 years' experience in the IT industry since graduating from Cambridge University in 1983. Since the early 1990s he has focussed on large-scale systems design and application architectures, across a wide range of technologies and business sectors.
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Jon Birger Østby, born in 1945, graduated as a civil engineer from the Norwegian University of Science and Technology, and has taken part in courses in ethnology and folklore at the University of Oslo. Mr Østby has worked at the Institute of Town and Regional Planning at the Norwegian University of Science and Technology, Trøndelag Folkemuseum and Norsk Folkemuseum. At Norsk Folkemuseum he was curator for several years and led projects for the development of nomenclature for cultural historical material and for the development of databases for museum catalogues. For a time he was head of the Scientific Department and head of the Documentation Department. In 1990 he was appointed interim director of the museum.

In 1992, Mr Østby became project leader for the development of a Norwegian centre for museum competence. As a result of this project, the Norwegian Museum Authority was established in 1994, and Mr Østby became director of this institution. In January 2002 he started planning the establishment of ABM-utvikling (The Norwegian Archive, Library and Museum Authority) where he is now director general. E-mail: post@abm-utvikling.no

Seamus Ross, HATII, University of Glasgow, UK

Dr Seamus Ross is Director of Glasgow University's Humanities Advanced Technology and Information Institute (HATII). He is also Director of ERPANET (Electronic Resource Preservation and Network) (IST-2001-32706), a European Union funded accompanying measure to enhance the preservation of cultural heritage and scientific digital objects. Previously he was Assistant Secretary for Information Technology at the British Academy, and before that worked for a company specialising in expert systems and software development, as a software engineer and then in management. He researches, lectures and publishes widely on information technology and digital preservation. Dr Ross acts as ICT advisor to the Heritage Lottery Fund and is a monitor for a number of large ICT-based projects in the UK. He is a member of a number of international organisations including the DLM-Monitoring Committee of the European Commission, the Research Libraries Group's PRESERV Working Group on Preservation Issues of Metadata, and InterPARES (as well as Co-Chair of its European Team).
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Bruce Royan, Concurrent Computing, UK

Bruce Royan has over 30 years' experience in the field of digital cultural, information and learning support services, working initially with British Telecom, the London Borough of Camden and The British Library. In 1976, he moved to Scotland as Head of Systems at the National Library and during the mid-80s he established a national information network for schools, universities, colleges and libraries in Singapore.

He returned to the UK as Principal Information Systems Consultant with Infologistix Ltd, consulting and lecturing worldwide. After seven years as University Librarian and Director of Information Services at the University of Stirling, in 1996 he set up the Scottish Cultural Resources Access Network (SCRAN), a learning objects repository licensed to all the schools in Scotland, and, via a JISC contract, to Universities and Colleges throughout the UK. Bruce serves on the Technical Standards Working Group of the UK's Curriculum Online, and is Chair of the Metadata for Education Group (MEG). He is also CEO of the e-Culture, e-Learning and Distributed Systems consultancy, Concurrent Computing Ltd.

Patrick Towell, CEO, Simulacra, UK

Patrick Towell specialises in leading teams to design, quality assure and deliver innovative digital cultural or learning initiatives for government and lottery-funded projects. This has included:

Heading up the work to help the cultural sector engage with the Curriculum Online programme. Curriculum Online is a £0.5bn programme run by the Department for Education & Skills which aims to increase the use of digital content in the classroom.

Serving as principal technical consultant for the Countryside Agency's successful £38m bid to the Heritage Lottery Fund for the Local Heritage Initiative – a programme to engage adults and children in informal learning and community action through their local history, archaeology and cultures.

Leading a project for the Design Council to create a digital services strategy and knowledge portal, including the integration of business, knowledge management and communications strategies.

Acting as Lead Consultant and Project Manager for the NetGAIN Web portal to enhance the employability of UK arts graduates on behalf of Metier, the sector training organisation for the arts and entertainment industries.

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DigiCULT: Project Information

DigiCULT is an IST Support Measure (IST-2001-34898) to establish a regular technology watch that monitors and analyses technological developments relevant to and in the cultural and scientific heritage sector over the period of 30 months (03/2002-08/2004).

In order to encourage early take up, DigiCULT produces seven Thematic Issues, three Technology Watch Reports, along with the newsletter DigiCULT.Info.

DigiCULT draws on the results of the strategic study 'Technological Landscapes for Tomorrow's Cultural Economy (DigiCULT)', that was initiated by the European Commission, DG Information Society (Unit D2: Cultural Heritage Applications) in 2000 and completed in 2001.

Copies of the DigiCULT Full Report and Executive Summary can be downloaded or ordered at http://www.digicult.info.

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DigiCULT Thematic Issue 1 - Integrity and Authenticity of Digital Cultural Heritage Objects builds on the first DigiCULT Forum held in Barcelona on 6 May 2002, in the context of the DLM Conference 2002.

DigiCULT Thematic Issue 2 – Digital Asset Management Systems for the Cultural and Scientific Heritage Sector builds on the second DigiCULT Forum held in Essen, Germany, on 3 September 2002, in the context of the AIIM Conference @ DMS EXPO.

DigiCULT Thematic Issue 3 - XML: Towards a Semantic Web for Cultural and Scientific Heritage Resources builds on the third DigiCULT Forum held on 21 January 2003, at Fraunhofer IPSI, Darmstadt, Germany.

DigiCULT Thematic Issue 4 – Learning Objects from Cultural and Scientific Heritage Resources builds on the fourth DigiCULT Forum held on 2 July 2003, at the Koninklijke Bibliotheek - National Library of the Netherlands, The Hague.

DigiCULT Thematic Issue 5 – will follow the fifth DigiCULT Forum on Virtual Communities and Collaboration, which will take place at Napier University, Scotland, on 20 October 2003.

IMPRINT

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IMAGES

Fratelli Alinari

Image used on pages 1, 3 and 38: View of a science classroom of the Technical Institute during a lesson, Florence, 1899 - Photographer: Alinari. Alinari Archives - Alinari Archive, Florence. Inventory number: APA-F-004761-0000.

Page 5: 'Lesson Time', Italy, 1905 - Photographer: Brunner & C. Library of Fratelli Alinari Museum of the History of Photography, Florence. Inventory number: BFB-S-090611-0336.

Pages 21 and 22: A boy's class at a secondary school singing during a break, Italy, 1962 - Photographer: Villani, Studio. Alinari Archives, Villani Archive, Florence. Inventory number: VBA-S-053315-0009.

Page 26: Students binding books in the Aldini Valeriani Institute, Bologna, 15/06/1935 - Photographer: Villani, Studio. Alinari Archives, Villani Archive, Florence. Inventory number: VBA-S-A00023-0002.

Page 29: Pupils from the girls school in Via Santo Spirito portrayed during a shorthand lesson, Florence, 1907 - Photographer: Alinari. Alinari Archives - Alinari Archive, Florence. Inventory number: APA-F-006729-0000.

Courtesy of Fratelli Alinari.
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Page 7: Two young girls playing with floral alphabet blocks at table in garden. Clonbrock Collection, Library ref. no.: Clon66A.

Page 8: Group of school children standing in a line, probably pupils from Kilglass National School which was located on Clonbrock estate. 1902. Clonbrock Collection, Library ref. no.: Clon804.

Page 11: Miss Crowe and Mr Gildea with their pupils at Kilglass National School, Ahascragh, Co., Galway, by Dillon family, ca.1902. Library ref. no.: Clon486.

Page 14: Two groups of school children at York Street, Castleblayney, Ireland, ca. 1897-1904. Photographer: John J. Clarke (1879-1961). Library ref. no.: CLAR35.

Page 16: Boys from De La Salle School in classroom, 10 October 1902. Library ref. no.: PI902.

Page 17: Boys from De La Salle School in classroom, 10 October 1902. Library ref. no.: PI903.

Page 18: Teacher and pupils of Synge Street, Christian Brothers School, Dublin, by Keogh Brothers Ltd 1941. Library ref. no.: KE307.

Pages 30 and 32: Two young girls doing water-colouring, seated on lawn. 1900's. Clonbrock Collection, Library ref. no.: Clon42.

Page 43: Group of male graduates, Earlsfort Terrace, Dublin, by Keogh Brothers Ltd 1944 July 15. Library ref. no.: KE310.

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Editor's note: For the purposes of this publication the original images have been adapted to convey the impression of an old and partially damaged 'filmstrip'.

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Provision of such objects, demands closer collaboration between the heritage and e-learning sectors, that concentrates on the enhancement of e-learning interoperability, both in terms of technical standards and in terms of appropriate forms of learning. DigiCULT regards such collaboration as crucial to unlocking the richness and diversity of Europe's cultural and scientific heritage for e-learning within our knowledge-based society.

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