e-Learning in higher Education: a Casestudy

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Summary
The authors present in this paper a generalized framework for small (typically half a year) educational programs in the field of higher education. This framework has been derived from experiences with a minor program on E-business which took place in the fall and winter of 2003 on the University of Professional Education in Utrecht, the Netherlands. The framework will then be used as a reference on deciding how and where to use e-learning elements in such a program.

Introduction

The introduction of the Bachelor/Master structure in the field of higher education in the Netherlands has led to a rethinking of the various educational programmes. The focus in this paper is on a *minor* program (a minor being a self-contained and coherent unit of study) with E-business as its theme.
From the start the use of an e-learning tool was a central element in the program. In this paper we will present, after an introduction of education and the use of e-learning in the Netherlands, an overview of the various ways in which the tool was used. From our experiences we wil derive a general framework for minors and the way e-learning tools may be used in a minor program.

Transforming education – towards e-learning tools

Changes in the field of higher education
Since September 2002 the Netherlands have implemented the Bachelor/Master structure in the field of higher education, in line with the intention made in Bologna (1999), to create ´an open and transparent European Higher Education Area´.
The University of professional Education in Utrecht (see www.hvu.nl for more information on the University), has seized this opportunity to reform its curricula. One of the changes is the implementation of *minors* in its Bachelor programmes, a minor being defined as a coherent program of 30 ECTS (30 ECTS in the European Credit Transfer System being equivalent to 840 hours or half a year of study for a full-time student) which supplements the students main course (which by contrast is called the *major*). A student with a major in Software Engineering can in this way broaden his (her) scope with a minor in Human Computer Interaction, Business Informatics, e-Learning or even Russian. The only restriction on his (her) choice is the existence of a program which conforms with the quality standards of the higher educational curricula and the program must be offered by a University.

By introducing minors, the University of professional Education in Utrecht now has a very flexible system in which the student may to a great extent follow his (her) own interests in his (her) professional education. Other elements in which a student may choose his own way are traineeships and the thesis. These elements are however restricted by the topic of the chosen major.

Apart from changes in the structure of the programmes, the University of professional Education in Utrecht is rolling out e-learning tools. Contrary to countries as Australia where distance learning is necessary for people living in the interior, in the Netherlands the distances to a University are small (typically less than 50 kilometres). The need for e-learning tools comes from the increasingly dominant role of ICT, especially the use of Internet, in our society. Furthermore a paradigm shift has taken place in the field of education, from knowledge transfer to learning by doing where the quest for information and knowledge is now the responsibility of the student with the professional in the role of tutor (see *figure 1*).

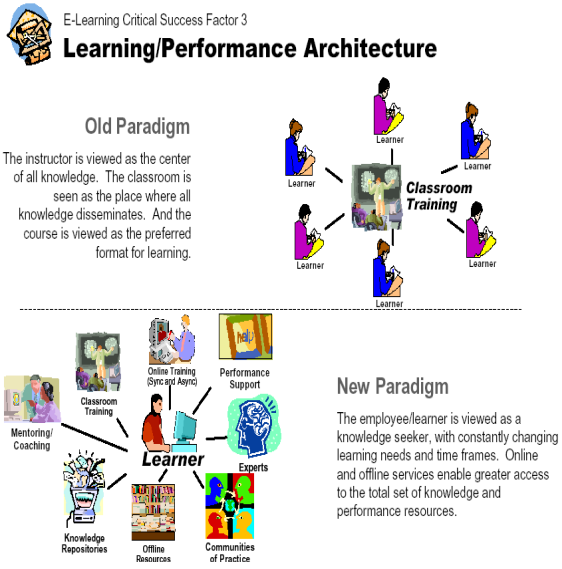

Figure 1. Learning/Performance Architecture (Gartner)

Solving problems with e-learning

Under the influence of the developments mentioned before, the essence in managing educational institutes is shifting from managing curricula towards managing the process of learning. Electronic learning environments like Blackboard or Lotus Learning Space offer educational institutes the possibility to develop flexible and transparent learning paths.

Students are able to learn theory and make assignments independent of time and place. No longer do institutes decide when learning takes place by planning lectures, but students will plan their own course within given timeframes. The e-learning environment is integrated with university libraries, knowledge databases and other sources to help students with learning and assignments. Progress and results will be made transparent by posting assignments on the Internet and by integrating the student's digital portfolio in the electronic environment. A digital portfolio is a student's personal website that is updated during the entire education (and working life). It shows a persons experiences, capabilities and learning moments throughout different courses, in different organizations and situations.

As we will show in this paper, e-learning does not only solve problems of time and space in learning (giving more flexibility to students and lecturers alike), it can also help organizations innovate and develop new learning modules more quickly by reusing learning objects, we will elaborate on this in the next chapter.

Current status of e-learning in the Netherlands

The last decade a lot of different projects have been undertaken by Dutch educational institutes in the field of e-learning. We have seen universities implementing e-learning in entire educational programmes, trying to outsource e-learning technology or even content development (with the help of publishers and/or companies). Only a couple of these first initiatives have been successful because of technological problems (e.g. bandwidth) or cultural problems: a lot of lecturers have had a hard time adapting to new ways of teaching. Today universities mostly use a blended learning concept in which e-learning has a supportive role, although there are still courses that are taught exclusively via e-learning.

There are a lot of different theories and methods on how to build up an e-learning course. Most of these describe the way in which to use e-learning on a module level or lower. The lowest level at which we can look at e-learning is that of the learning objects. In learning objects, content is broken down into small parts that can independently be created, maintained and reused, and like the well-known Lego building blocks, can be stuck together and pulled apart.

Teletop as a flexible tool for e-learning
Currently the Dutch market for e-learning is divided between several suppliers of electronic learning environments: Blackboard (by far the major player), Lotus Learning Space, WebCT, N@tschool Teletop. This paper focuses on experiences we have had with Teletop in developing and running a minor.

Teletop (see www.teletop.nl for more information on Teletop) is a modern, web-based Course Management System (also known as Virtual Learning Environment). It is grounded in more than 20 years of experience and research in learning and training at the University of Twente and in the role of technology in the learning context. Teletop is an example of how technology can be used as a tool for new approaches to teaching, learning and strategic change. Prof. Dr. Betty Collis, Shell Professor of Networked Learning and also based at the University of Twente, is the founder of the Teletop version as we know it today.

The key features of Teletop that are important to us in developing and teaching minors are:
- The support of didactical processes.
- The flexible use for different educational styles and didactical insights.
- Teletop has a clear user interface based on standard web browser technology.
- It is possible to exchange data because Teletop is based on the ADL SCORM specifications.

Besides, Teletop is based on IBM´s Lotus web technology with which we have had already several years of experience. In our experience Lotus technology is robust, flexible, open, functional and scalable.

Experiences in the minor E-business

The students and the curriculum
As said before, in this paper we will focus on a minor in *E-business*, a program developed for ICT-students from 3 different faculties by staff from these faculties.

> The University of Professional Education in Utrecht offers 7 different Bachelor-programmes in ICT for students in three different domains:
> *Science*: Software Engineering, Information Engineering, Technical Software Engineering and Media Technology
> *Economics*: Business Informatics
> *Communication*: Communication Systems and Communication & Multimedia Design

From the start it was apparent that we had to deal with different educational cultures and different views on the subject. After ample discussions (in the best of Dutch traditions) agreement was reached on the following starting points:
-1. An E-business application for a real organization should be the end-result of the minor.
-2. To provide a common language and understanding, a framework of courses would be mandatory.
-3. Students should be able to tune the minor to their personal interests by choosing additional courses.
-4. The organization should provide a professional working environment, to stimulate students in working together in multi-disciplinary teams on the subject.

From these starting points the following program was developed:

1. Developing an E-business application for a real organization (9 ECTS)

2. Mandatory courses (15 ECTS):
 + Strategy, change and vision (4 ECTS)
 + E-commerce, e-procurement & supply chain management (4 ECTS)
 + Organization and technology (4 ECTS)
 + Capita Selecta by business professionals (3 ECTS)

3. Free courses (6 ECTS); examples:
 + portfolio management (3 ECTS)
 + project management (3 ECTS)
 + knowledge management (3 ECTS)
 + XML (4 ECTS)

The use of E-learning in the program
We decided to support the resulting program, with its focus on multidisciplinarity, with an electronic environment which should meet with various demands. On the one hand it should be possible to create a virtual office in which students could work on the E-business application, but also on cases and questions. Furthermore, the environment should help in the exchange of ideas and documents on various topics (student-student and lecturer-student(s)). Finally, the environment should provide a platform for discussion and assessments.

As not everyone (lecturers and students alike) was familiar with electronic environments, we decided that it should be an extra tool and should not replace other forms of education. This decision was strongly supported by our belief that students and lecturers from different backgrounds should meet on a regular base to create the necessary community feeling. So we chose for a form of blended learning as our didactical approach where Teletop provided the electronic environment (virtual office and E-learning tool).
For working on the E-business application and other cases we provided every student group (on the average 6 students) with a real office as well. These offices were provided with computers, meeting table, etc.

Students had to deliver all their products (individual and team alike) via Teletop, thereby effectively using the E-learning environment. Lecturers were asked to use Teletop as the way to provide students with documents: syllabi, sheets, articles, cases, etc. and to give feedback on students via Teletop.

Apart from the exchange of documents, Teletop was used as the only tool for the communication between administration and students cq lecturers. Examples are: schedules, announcements of guest lectures and results. As a rule the students knew that news, for the next day, could be added until 18.00 hours.
Any other use of Teletop (e.g. the electronic office) was free, not required.

Experiences with e-learning in the minor
Looking back, the chosen policy has proved a sensible course:
- Students were informed in time on changes in the schedule – even last minute changes: a lot of students made it their habit to look on Teletop before going to the Institute.
- We accumulated a lot of useful material (and some rubbish as well) on the topic of E-business which can be re-used in the next course.
- By monitoring the student discussions the staff was well-informed on relevant student-themes. A good example is the discussion on the use of software tools for creating the E-business application in which the students proved very creative in finding free tools.

The workspace provided by Teletop as virtual office was intensively used by all but one group. Most groups planned 2 to 3 physical meetings a week and did a lot of work at home while being in contact with other team members via Teletop. The group which was the exception on the rule decided to use the physical office on a daily basis (as a result we came to know these students quite well) and not to work from home.
In the next round we will probably not provide every team with their own office, but have a couple of offices available which can be reserved for meetings etc. In this way we expect an even more intensive use of the electronic environment.

Finally the use of Teletop as an instrument in assessments was unintentional but proved quite important. Students were asked to match their competences in the field of E-business before and after the program (a questionnaire on the various competences we aimed for was developed for this purpose). This provided us with a valuable insight in the added value of the various elements of the program – which proved in some ways quite different than we expected before starting. As an example we learned that students distributed tasks not on competences to be learned, but on the urgency of the task, thereby not always aiming on profit in educational terms but instead on rewards in the short term (which is probably a quite familiar pattern for anyone used in working with students). In the next course we plan to monitor individual progress on a more regular base and thereby possibly eliminating the use of some exams.

Creating a general framework

From our experiences with the minor E-business we decided to first develop a general framework for minors, i.e. a framework not depending on specific minor content. The building blocks that are used in a framework can have different forms of learning (e.g. theoretical, practical, individual or group assignments etc.). For all these different forms of learning a repository of educational components can be built. This repository has to be maintained on basis of new experiences.

The general framework (*figure 2*) consists of several standard modules (wp*x*), elective modules (km*y*) and an overall project. The project has to take place within one of several predetermined domains. A domain can be both in profit (e.g. automobile) and non-profit (e.g. healthcare, government) sectors.

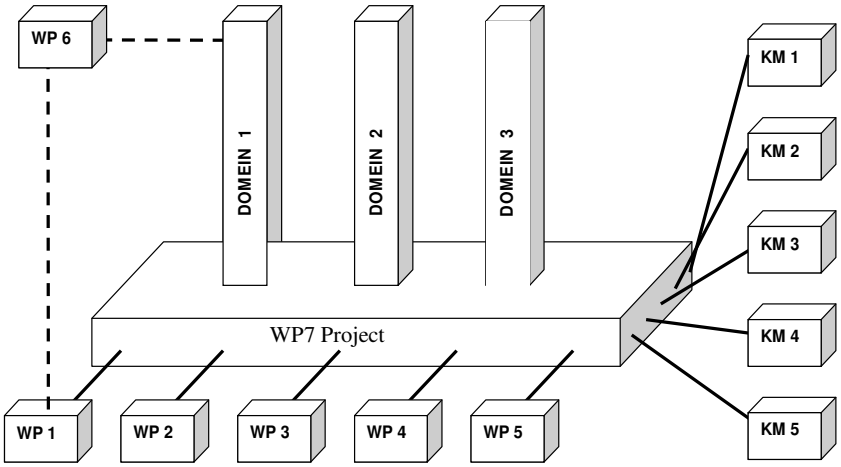

Figure 2. A general framework for minors

The different modules that are to be developed can have a complete different design. When designing a module we start with defining how a module is taught, for example in our E-business minor we have the standard module *eStrategy, Change and Vision* which consists of 14 lectures where we teach our students common concepts in E-business, next to this the students have 7 group assignments (every two weeks an assignment has to be posted on Teletop).
Of course not all modules will follow the same pattern; for some modules e-learning will be the only didactical approach having individual assignments while other modules may have group projects with an external customer. The different module designs can be stored in a repository for ease of future use.

To ensure that all students will participate and reach basic learning goals we have dedicated one module (WP6) as a preparation to writing the final thesis. In this module a student most choose a specific domain and a topic (within the scope of the minor) on which a paper should be written.

eStrategy, Change and Vision

This is an introduction module on E-business; what is E-business, what types of revenue- and business models are there? What are the latest trends and developments within business, government and society?
During the module we specifically pay attention to creating a vision of the future and how companies develop a strategy that leads an organization into the envisioned future and, of course, what tools do companies have for implementing change?
Furthermore we give an introduction to concepts as marketplaces, e-business applications, supply chain management and customer relationship management theories and tools.

Central in the framework is WP7: the project. The duration of the project is the same as the duration of the minor and consists of an assignment by a company (external partner) that is done by a group of five or six students. The project incorporates elements of all standard modules and preferably also of elective modules. In this way knowledge attained by the students in the several modules will immediately be brought into practice.

Next to bringing together the different modules in the minor, the project also links the minor to the various domains in which a department is actively doing research (for instance within our university these domains are amongst others healthcare, retail and media technology). In this way the framework is applicable for all kind of different educations within different universities and across countries.

The role of Learning Objects in the Minor Framework

Learning objects vs. educational components
A core concept in the approach to create the building blocks that are used in our minor framework is the learning object. In learning objects, content is broken down into 'bite size' chunks. These chunks can be independently created, maintained and reused, and like the well-known Lego building blocks, can be stuck together and pulled apart *(also see the Appendix for more on learning objects)*.
A first step towards interoperable and reusable learning objects is to start with *educational components*. As we already mentioned in the introduction, these components can also be stored in a repository; thus providing a step between the overall learning content and specific (much smaller) learning objects. *In this way an educational component is a self-contained unit of education (from the point of view of the student), which can be studied (and assessed) in itself.*
Our current Minor framework consists of 6 standard modules, 5 electives and 1 project module, which means that we should try to transform these elements into reusable and interoperable learning components.

Let us start with the work packages, each of which in our general framework typically entails 3 ECTS or 84 hours of study. These 84 hours can be broken down into, let's say, 21 educational components with the size of 4 hours (or half a day of study). An educational component should then contain the following metadata: learning component (x), prerequisites, didactical approach, introduction to the educational component, an outline of the assignments, required literature, use of tools and cases, definitions of competences to be achieved, information on the lecturer and course specifics. This means that the work packages are built-up as shown in *figure 3*.

In principle, it is possible to use the same set-up for the elective modules. However, in some cases the content of an elective module has not yet been broken down in educational component (e.g. when a student is asked to study some literature and make a summary). In cases like this, we define the elective as one educational component. In this way, it is still possible to create smaller and more specific educational components in the future.

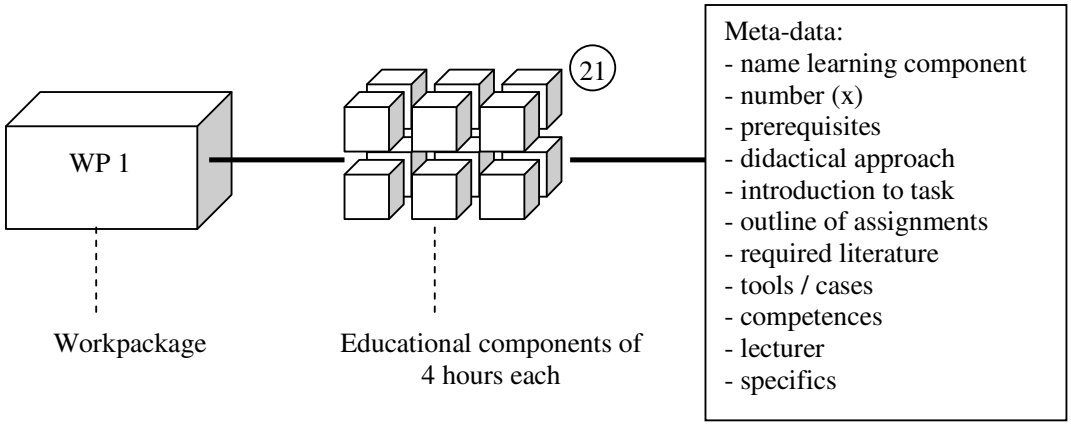

Figure 3. Educational components and metadata

Finally, the project-module entails 9 ECTS credit points, or 252 hours of study. The project can be subdivided into bigger educational components, where the size of each component depends on the specific project deliverable. A project educational component thus has a variable amount of study hours and encompasses a certain project-deliverable and a project domain. Notice that it should also be possible to attach educational components from work packages to project deliverables, to enhance the interaction between courses and the main project. This results in the following picture (see *figure 4*).

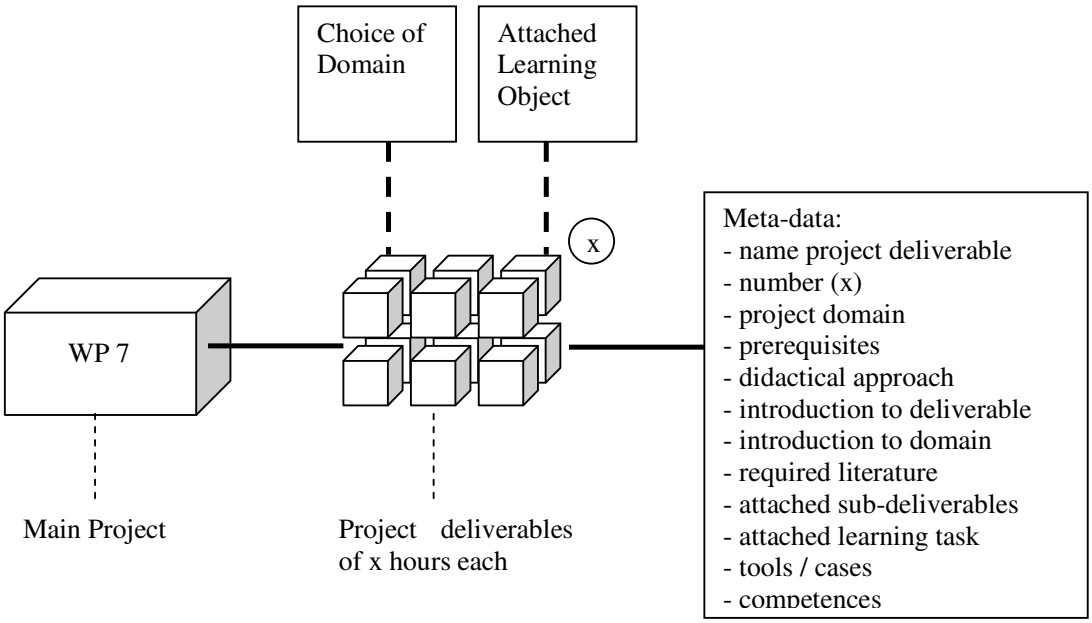

Figure 4. Projects and educational components

Costs and benefits

What are the benefits and the costs of development in the direction we described? Well, by properly breaking content into educational components, different parts can be maintained and updated separately. In creating the components, if a suitable (existing) learning object can be found, a new one does not need to be created. These are costs savers.

In the long run, as more and more standards-based learning objects become available, increased choice will also translate into more flexibility for designers. However, changing to a learning object approach from a 'self-contained system' approach involves retooling and retraining costs. By using the

intermediate step of educational components, these costs may well stay within reasonable limits as the size of a component typically corresponds to the ´unit of work´ involved with the familiar lecture.

Learning objects fit nicely into many Instructional System Development (ISD) theories. Instructional templates can be created with slots for specific types of educational components assembled from learning objects and these learning objects may encourage designers to operate in more disciplined ways. A drawback is that restrictions on learner information available could also restrict pedagogical approaches. Approaches using lengthy discursive material may not benefit from the use of learning objects.

A last benefit is that all leading system vendors and content producers are supporting (or are going to support) SCORM and other standards that are based on or that are complement with the learning object approach, which offers the possibility to exchange learning objects between learning systems like Teletop.

Conclusion: Independent Learning

With the help of electronic learning environments (e-learning) like Teletop it is quite possible that students learn the same, or even more, content than with the 'old' classroom-teaching method. As we have seen in the general framework it is possible to mix different types of learning concepts within an education (e.g. a minor) by using the concept of an educational component.

As a result, students will have to get used to a more independent style of learning. Nowadays some courses are completely offered via e-learning while in other courses the e-learning environment is only used as a central point for the course overview, articles, presentations, references etc.

If it is decided to completely setup a course via e-learning it is very important to give the course a good structure. In other words, it should be very clear for the student what part of the theory and which exercises have to be studied and done in a certain amount of time. It is also possible to implement self-assessment tests that students must complete before starting on new learning materials. When it is necessary for a lecturer to be available for answering questions, this can be realised via a question and answering system were the student posts his questions and once a day the teacher replies. Problems can also be solved among students themselves via discussion groups. We think the general framework presented in this paper, may contribute to a good structure.

In short, students and lecturers may benefit from the use of E-learning tools and E-learning itself can be a major step towards autonomous learning.

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Appendix

Learning objects and Teletop

A basic problem faced by every online learning community is how to produce and deliver high quality content for online learning experiences. Online learning content typically contains text, graphics, movies, a navigation scheme (easily a table of contents and/or buttons) and assessments. It may also contain collaboration tools as well as other interactive elements and graphical elements designed to produce a unified or branded look and feel.

In learning objects, content is broken down into 'bite size' chunks. These chunks can independently be created, maintained and reused, and like the well-known Lego building blocks, can be stuck together and pulled apart

Although learning objects are conceptually appealing, exactly what constitutes a learning object in practice has been unclear for a long time. In the past, different developers have had different ways of instantiating the notion of a learning object and different ways of enabling learning objects to communicate information about the learner.

However, nowadays there are widely adopted standards that allow learning objects to be described, assembled, delivered, and tracked in a standardized way, regardless of their shape, size, or intended purpose.

To start with, for content to be qualified as learning content, it should be aware of learners. At a minimum, learning content should recognize who the learner is and record information about the learner's experience. To make this possible, learning content has generally been developed in conjunction with some sort of learning system that keeps track of learners. This is where Teletop comes in. Although Teletop is not (yet) advanced enough to make a direct link between learning content and the learner by itself or to record user experience automatically, it possible to achieve these goals with a little help from the Teletop administrator. Within Teletop, it is possible to create so-called 'toolboxes' or directories that contain learning material and to give certain groups or individuals specific rights for accessing these repositories of educational components. In this way it is possible for students with various backgrounds to work with different learning content while sharing the same environment. In the E-business Minor, students from the Science Department had access to different resources (e.g. PHP and HTML manuals) than students from the Department of Economics.

Teletop is also able to record the experiences of the users of e-learning content. This can be done by means of the available online tests and polls; in this way the online learning content can be reviewed according to a broad range of criteria. The results of these feedback mechanisms can be used to adjust the learning content conform the demands and needs of the student using it.

In the near future these processes should take place automatically, while still accommodating the student; in the sense that it is the learner that logs on to the system and launches the content. As the learner interacts with the content, results are passed back to the system. If the system allows it, the content can also change its behavior based on learner information stored in the system. For example, learners might be sent to different places in the content based on test scores, language preferences, learning style inventories, competencies, certifications, organizational roles, and other data.

Interoperability and Reusability

In the development of a Minor framework it is very important to pay attention to issues of interoperability (content from multiple sources working equally well with different learning systems) and reusability (content developed in one context being transferable to another context). Interoperability and reusability are imperative to the sustainability of your work. Without them, anyone with a significant investment in either content or a learning system is locked in to that particular content or system. And every time a course, or an interactive electronic training manual needs to be updated, far more of the material must be rewritten than is necessary or desirable. Additionally, the process of developing high-quality content is often prone to unnecessary duplication of effort, in this way driving up the cost. For a framework it is therefore necessary to use learning objects that fulfil requirements of interoperability and reusability. Regarding the requirement of interoperability, Teletop allows for data-exchange based on the ADL SCORM specifications. This Sharable Content Object Reference Model (SCORM) is a suite of technical standards that enable web-

based learning systems to find, import, share, reuse, and export learning content in a standardized way. SCORM defines a Web-based learning Content Aggregation Model and a Run-Time Environment for learning objects.(see next paragraph).

There exists no standard for the size of a learning object yet, so we still have to define a suitable size for the chunks we are using in our framework. Larger learning objects are typically harder to reuse, and smaller learner objects save less work for those who are reuse them.

SCORM
SCORM focuses on two critical pieces of learning content interoperability: it defines an aggregation model for packaging learning content and it defines an Application Program Interface (API) for enabling communications between learning content and the system that launches it
SCORM also divides the world of learning technology into functional components. The key components are Learning Mangement Systems (LMS) and Shareable Content Objects (SCOs).

SCOs are a standardized form of reusable learning object. An LMS is (for the purposes of SCORM) any system that keeps learner information, can launch and communicate with SCOs, and can interpret instructions that tell it which SCO comes next. Additional components in the SCORM model are tools that create SCOs and assemble them into larger units of learning.

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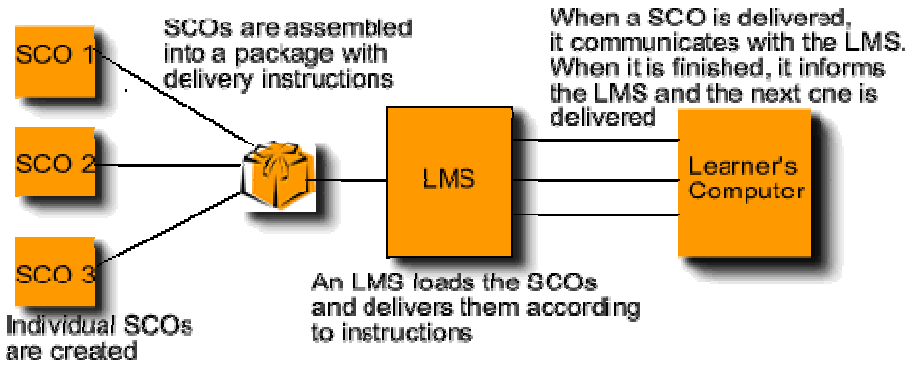

Content Aggregation
SCOs are self-contained units of learning. They can be used as building blocks (or legos) to create packages of SCOs, but they cannot be broken down into smaller units.. Three things must be done to create a larger unit of learning from SCOs.
1. The SCOs must be found and organized into a structure.
Instructions must be written that tell an LMS which SCO comes after which.
The SCOs and instructions must be bundled into a portable package.
This process is called content aggregation. Note that content aggregation includes instructions for moving between SCOs but not for movement within individual SCOs. SCORM has adopted a content packaging format from the IMS Global Learning Consortium. A SCORM package contains a manifest file that declares the contents of the package and is set upt ot describe the order in which the SCOs are to be delivered. It also tells the LMS where to find the SCOs themselves. The physical resources represented by the SCO can be physically included in the package, or they can be referenced externally by the package.

Communicating with Content
The magic of SCORM is that SCORM content can communicate learner information with *any* LMS using a standardized method based on Javascript. The SCORM specification (which derives from work done by the Aviation Industry CBT Committee) lays out exactly what pieces of learner information can be retrieved and updated. This information includes the learner's name, the learner's ID, scores on quizzes, time spent in a SCO, and the learner's physical device preferences. It isn't fancy, but covers the basics.

In the SCORM model, content initiates all communication. When it is launched, it tells the LMS it has started. When it wants something from the LMS, it asks for it. When it wants to update learner information, it tells the LMS. And when it is finished, it tells the LMS it is finished. This passes control back to the LMS, and the LMS decides which SCO will be delivered next. The delivery order of SCOs is not yet based on learner information but will be in the future.

Metadata

For learning objects to be used they must be found. It is not easy to find *anything* in a large distributed online environment like the World Wide Web or a large intranet. The solution is to store not only learning objects but also *descriptions of the learning objects.* Thinking of the learning objects as *data*, the descriptions are *data about the data*, or *metadata.* Learning object metadata potentially includes information about the title, author, version number, creation date, technical requirements and educational context and intent. Learning Object Metadata is compatible with the metadata used by the digital and online library community.

SCORM has a place for metadata in every SCO and in every content package.