

# Developing the New Web-based Training Environments: towards an Instructional-based Learning Object Strategy

Vassilis Karamanis<sup>1</sup>, Panagiotis Zaharias<sup>2</sup>, Angeliki Poulymenakou<sup>2</sup>

<sup>1</sup> Department of Informatics

<sup>2</sup> Department of Management Science and Technology  
Athens University of Economics and Business, 10434 Athens, Greece  
Email: {bk,pz,akp}@aueb.gr

**Abstract.** Learning objects have changed the way computer-based instruction is viewed and used and have provided new opportunities for delivering customized and personalized e-learning. Since so far there are a lot of research and development efforts concerning the technical implementation of the learning object concept and the interest for the subsequent development of standards is very high. Nevertheless the learning object concept, as used in design and development of e-learning, has also instructional – pedagogical value to offer. This paper discusses a research effort aiming to develop a web-based training service by stressing the instructional benefits of the learning object-based implementation. During this effort a certain strategy guided the whole design and development process while certain learning theories were associated to the learning strategy followed. The idea behind this association was to highlight the advantages from applying the learning object idea to create appealing e-learning courses for adult learners; advantages that are not directly related to any technological or standard implementation but contribute a lot to the pedagogical quality of an e-learning service which is usually underestimated or neglected. The main purpose of this effort was to prepare, structure and develop web-based courses and training materials in a way that would provide sound instructional benefits to the main recipients of such services: adult learners and trainees.

## 1 Introduction

The idea of learning objects has been embraced by more and more researchers and practitioners that create e-learning experiences, and implementation standards have been developed to support this trend. As a consequence, a lot of conversation is undergoing on the technical aspect and use of learning objects, which unquestionably changed the way e-learning is viewed and presented opportunities for offering customized and personalized learning. However, there are numerous opportunities not only for the technical aspects of e-learning but for the instructional/pedagogical aspects as well, which most of the times are neglected. That is exactly the idea behind this paper, to describe and illustrate the instructional benefits from applying a reusable learning object strategy developed by Cisco [3] to an undertaken e-learning project called TrainSEE (see acknowledgements).

## 2 Towards a Learning Object Strategy

The industry that focuses on the design, development, and delivery of computer-based instruction is currently undergoing a period of standard setting focused on the distribution of instructional experiences over the World Wide Web. The learning object idea has great potential as a common building block for a diverse range of technology-based instructional products [5].

From the earliest days of computer-based instruction, the goal has clearly been creating instruction that was: (1) *adaptive* to the individual, (2) *generative* rather than pre-composed, and (3) *scalable* to industrial production levels without proportional increases in cost [1].

Although the need for the characteristics mentioned above was apparent, the courses created in the past were characterized as monolithic, linear and non-flexible in a way that would not distinguish them from traditional classroom lectures. Most of these computer-based courses were designed to imitate the traditional training paradigm where the instructor gives lectures providing very little opportunity or not at all for learner interaction. Since that era, it has become apparent that computer-based instruction is not just another way of presenting the training material. Web-based training/instruction has evolved promoting a new idea for creating learning experiences in a different, more creative, and highly exploitable way. Closely related with this, is the new idea of chunking the information into little pieces and delivering it as needed. These chunks of information are known as ‘learning objects’ or ‘instructional objects’ [5]. The changes that this idea brought can be discerned in the three characteristics of computer-based instruction [13, 14]:

- *Adaptivity* is obtained as independent instructional objects are assembled and implemented in response to current learner states.
- *Generativity* is also favored by an analysis that identifies at a high level of granularity the terms that might enter into the instructional dialogue at any level.
- *Scalability* involves production of quantity at specified levels of quality within specified time and resource constraints.

As already mentioned traditional methods for developing instructional content often result in the production of large, monolithic courses. These methods are inadequate to create courses in order to support learning and training in today’s business and working environment because they are translated in increased development time and cost, without providing motivation and control over the learning process. In a business environment the learners are adults with specific goals and very specific and demanding needs for training. Their motivation, time and needs must be taken into account when designing training courses that will address their needs. Therefore, today’s demands and needs for e-learning courses have led to the creation of the learning object idea. According to Wiley [16] ‘learning objects are elements of a new type of computer-based instruction grounded in the object-oriented paradigm of computer science’. Supporting the learning object idea of small chunks of instructional media, Reigeluth and Nelson [12] suggest that when teachers first gain access to instructional materials, they often break the materials down into their constituent parts. They then reassemble these parts in ways that support their individual instructional goals. This suggests one reason why these instructional components, or learning objects, may provide instructional benefits.

The instructional benefits of applying the learning object idea in e-learning can become apparent and justified if the learning object idea is based in learning and instructional theories. Cisco's [3] strategy for designing, building and delivering learning objects moved towards this direction, since it is grounded in two learning theories. Reusable Learning Object (as Cisco names it) strategy is the result of combining Information Mapping [6] and Component Display Theory [9] with the purpose to design, build and deliver content based on the learning object idea (see more in section 5). The connection of the RLO strategy to the learning theories was the reason why it was selected since the e-learning service to be implemented would be delivered to adult learners and the above theories address better than others the instructional needs of the particular kind of learners. This reusable learning object strategy is further analyzed and the way that has been implemented and adjusted in TrainSEE project is described, focusing on the pedagogical/instructional dimension.

### 3 Reusable Learning Object Strategy

The Cisco's [3] Reusable Learning Object Strategy (RLO) is built upon the Reusable Information Object (RIO). A RIO, as defined by Cisco, is a granular, reusable chunk of information that is media independent. An RIO can be developed once, and delivered in multiple delivery mediums. Each RIO can stand alone as a collection of content items, practice items and assessment items that are combined based on a single learning objective. Individual RIOs are then combined to form a larger structure called Reusable Learning Object (RLO).

The RLO-RIO structure defines a two level hierarchy. Labels often placed on these two levels are "Lesson" for the RLO, and "topic" or page for the RIO. This forms the hierarchy presented below:

- Curriculum
- Course
- Lesson (RLO)
- Topic / Page (RIO)

In order to comprehend the strategy developed from Cisco Enterprise, a brief description of the RIO and RLO will be provided. Reusable Information Objects are self-contained chunks of information built around a single learning objective. Groups of RIOs are then combined and form an RLO. Each RIO is built out of three components:

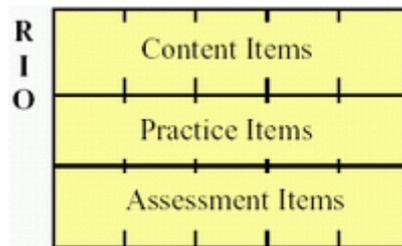


Fig. 1. Reusable Information Object [3]

1. *Content items*, where new concepts, ideas, or processes are being presented along with images, graphics and other media where necessary (audio or video).
2. *Practice items*, where examples and any reinforcement activity that gives the learner the opportunity to enhance the transferred knowledge are being presented.
3. *Assessment items*, where questions and exercises are being presented that facilitate the learner to assess if the learning objectives have been accomplished.

The other object mentioned is the RLO, which is a collection of seven plus or minus two RIOs that are grouped together to teach a common job task based on a single learning objective. In order to transform the collection of RIOs into a complete *learning experience* or "lesson", an Overview, Summary and Assessment section are added to the package.

1. *Overview*, which is used to introduce the RLO and serve as an advanced organizer for the learner by listing the objective and outline for this course
2. *Summary*, which is used to conclude the RLO and provide links to the objectives covered in each RIO.
3. *Assessment*, which is simply a collection of the assessment items that are written to match the objective of each RIO found in the specific RLO.

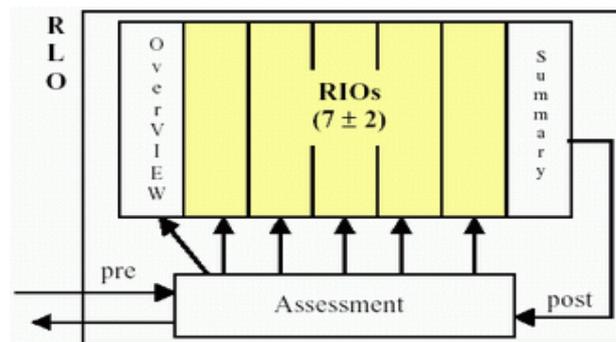


Fig. 2. Reusable Learning Object [3]

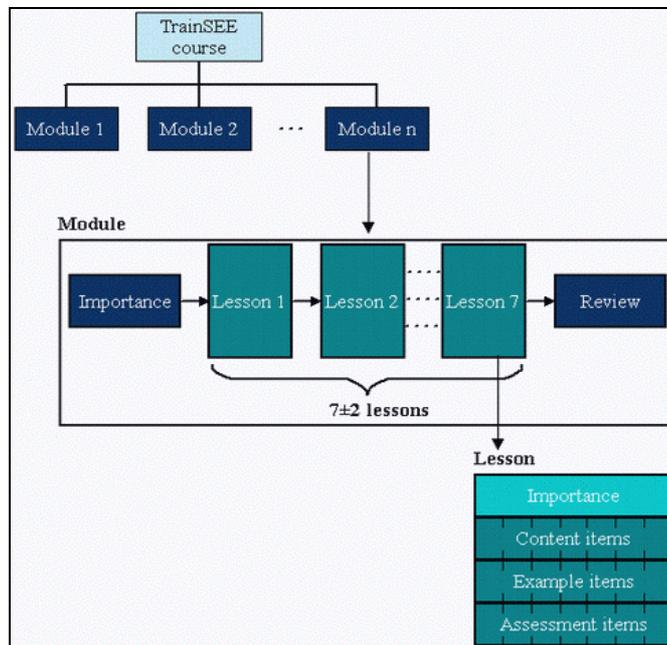
#### 4 Implementation of RLO Strategy

The strategy was applied in the project TrainSEE (see acknowledgements) which strategic goal was to set up an e-Learning service that would provide web-based training courses. These courses aim at enhancing Information and Communication Technologies' (ICT) skills and competences needed for the implementation of the Information and knowledge-based society in the region of South Eastern (SE) Europe, while providing the ladder for career progression to the SE Europe people in the novel environment created by the global economy.

The e-learning courses have been integrated and uploaded on an e-learning platform [7] and together serve as the proposed e-learning service. Focus in this section will be concerned on the idea behind the development of these e-learning courses.

The *RLO strategy* provided a guide to the whole design and development effort during the project. Nevertheless it became apparent that the strategy could not be applied without some adjustments due to the specificities and particularities of the project being developed. The content for the project should cover broad areas that could not contain too much detail and thus an RIO should constitute a larger chunk of information than the one proposed from Cisco and respectively making the RLO even greater as well. For this purpose the RLO strategy was followed with some adjustments concerning both the hierarchy used and the components of each reusable learning and information object.

In TrainSEE web-based courses' development, the hierarchical structure that was followed differed from the Cisco's proposed hierarchy in the following way: Course → Module (RLO) → Lesson (RIO). Regarding the instructional design dimension each RIO is consisted of an importance section, content items, examples, and assessments and has been given the label of 'lesson'. Each lesson represents a stand-alone chunk of information about a specific concept, process or idea with examples and assessments embedded in the end of the lesson. The lesson is based on a single objective and the assessment ensures the mastery of it. The lessons form a greater structure labeled module that is similar to the RLO according to Cisco's RLO strategy. The difference lays on the fact that the assessment is not taken in the end of the module (RLO) but inside every lesson (RIO). The reason for this modification was that the lessons were created to cover larger concepts than those suggested in Cisco's strategy. The graphical representation of the TrainSEE course structure can be discerned in figure 3.



**Fig. 3.** TrainSEE course structure

The RLO strategy was followed in general terms but the above differentiations helped the content authoring and development team to create more quickly the appropriate content and the e-learning service respectively. These changes also provided an easy way of monitoring the content preparation's progress because it reduced the complexity of the way content was prepared. The differentiated strategy was applied because it would serve as a consistent, easy and rapid way of preparing the content without losing any of the important instructional benefits for which it was selected in the first time. Nevertheless the alternative cost for not following the exact strategy was that due to time constraints and volume of content areas the components (RLOs and RIOs) were not prepared and implemented as they should be. No categories were distinguished between RIOs (fact, procedure, concept, process, etc.) and some elements (decision tables for procedures, staged tables or block diagrams for processes) were not included. The consequence of preparing the content in this way may have decreased the instructional value of the content but in order to smooth this drawback other techniques and strategies were embraced [15].

## 5 Instructional Benefits of the Strategy Applied

The RLO strategy was used mainly because of its association to four well-known learning theories that are essential to instructional design of e-learning courses. Basic key tenets of *Component Display Theory* [9], *Information Processing Theory* [10], *Information Mapping* [6], and *Preparing Instructional Objectives* [8] have been selected to support the TrainSEE RLO strategy. In this section the application of these theories in accordance to the RLO strategy will be presented along with the instructional benefits these theories provide to the trainees.

According to the *Component Display Theory* [9] instruction will be more effective if all three primary performance forms (*remember, use, generality*) are present in the learning content. These primary forms can be presented by either an explanatory or inquisitory learning strategy. The sequence of primary forms is not critical provided they are all present. In addition learners should be given control over the number of instances or practice items they receive. During the creation of the TrainSEE courses and lessons, the cognitive level of the concept, idea, skill, and knowledge, was taken into consideration in order to be able to measure the learning objective after the lesson is completed. This level (*use and remember*) helps in the creation of the practice and assessment items, and defines the criteria for mastering the concept, idea, skill, or knowledge presented in the specific lesson. Practically, these cognitive levels have been met in the lessons created, by providing questions with model answers, which cover the *remember* level, and by real-life case studies and situations (figure 4), where the trainee is called to take action and practice what he/she learned, which cover the *use* level. Because the trainees are adults, they are supposed to be actively involved in the learning process [4] and they usually value highly opportunities to practice the ideas and concepts presented in a course as well as they gain greatly from taking assessments where feedback is provided especially for wrong answers.

Regarding the Information Processing theory [10], two basic tenets have been incorporated in the RLO strategy followed in TrainSEE project: a) short-term memory

(or attention span) is limited to seven chunks of information, and b) processing information in sequential steps is a fundamental cognitive process. The information presented in each lesson is a single concept, idea, or process so each module is consisted of  $7 \pm 2$  lessons in order to help trainees retain the knowledge transferred and acquired from the specific module. In addition, the trainee can sequentially access the lessons inside a module beginning from a less complex to a more complex concept or process. This elaborative sequence from a simpler to a complex concept where the first lesson epitomizes the ideas and skills that follows provides a pedagogical facilitation for the trainee who can organize logically the information provided and be able to easily understand and retain it [11]. Another advantage of the use of the elaborative sequence inside a module is that the information provided can be easily accessed, understood and remembered because this sequence allows the creation of standardized information units (lessons) that contain one clear purpose as Horn [6] has proposed in the *Information Mapping* theory.

Modules | Business Strategy Planning & IT | Exit  
 Outline | Activities | Resources | Course Map | Help Center

**Real life situations**

*Being the manager of 7-Eleven*

Supposing you are the manager of 7-Eleven, a chain company with convenience stores (100) in Japan, and due to competition and high costs the company is losing a considerable amount of money. Your executives feel that your company is slow and distant from its customers. It is imperative to take action before being forced to declare bankruptcy.

**Question 1**  
 From the company's reserves you are provided with adequate funds to accomplish one of the following plans. Which one will you choose?

A. Promote your products and stores with more intense.

B. Establish 20 more stores across Japan, if possible next or opposite your competitors ones.

C. Try to lower operation costs and with the aid of logistics cut down stocks and reduce prices, to gain competitive advantage.

D. Build an IS in order to collect customer information and restructure the product replenishment process.

**Situation presented**

**Problem to be solved presented**

**Decision nodes available**

**Fig. 4.** Real life situation inside a TrainSEE module

The RLO strategy used embraces the importance of clearly stated learning objectives [8] and associates each lesson with a single and clearly defined learning objective. However, each lesson is not only associated to a learning objective but also contains the mechanisms to define if this objective has been met or not. Thus by providing practice and assessment items, the trainee is provided with the opportunity to be able to test whether the learning objective has been achieved or not.

Modules | Business Strategy Planning & IT | Exit  
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**Overview**

**Introduction**

Information Technology can be used along with strategy planning to support or shape a business unit's competitive strategy, and significantly change the manner in which business is done. With the proper use it can also change the goals, processes, products, or environmental relationships to help an organization gain a competitive advantage.

With the help of Information Technology, systems can be built to help an organization gain a competitive advantage through their contribution to the strategic goals of an organization and/or their ability to significantly increase performance and productivity.

**Module Outline**

- Overview
- [Strategic Information Systems](#)
- [Innovation through IT and competitive advantage](#)
- [Competitive forces, response strategies and IT](#)
- [Porter's value chain analysis model](#)
- [Strategic information systems frameworks](#)
- [Web-based strategic information systems](#)
- [Implementing and sustaining SIS](#)
- [Summary](#)

**Start Learning >>**

Fig. 5. Module screenshot

Modules | Business Strategy Planning & IT | Exit  
 Outline | Activities | Resources | Course Map | Help Center

**Lesson name** → **Innovation through IT and competitive advantage (lesson 2 of 7)** ← **Current lesson inside a module**

**Why do I need to read this?**

**Learning objective**

By completing this lesson you will **learn how the use of IT can be innovative and provide competitive advantage**. Competition, according to Porter (1985 and 1996), is at the core of a firm's success or failure. An organization's competitive strategy is the search for a competitive advantage in an industry, which gives an advantage over competitors in some measure such as cost, quality, or speed. Competitive advantage leads to control of the market and to larger-than-average profits. Information Technology can help an organization gain a competitive advantage through its contribution to the strategic goals of an organization and/or its ability to significantly increase performance and productivity.

**Lesson importance**

**Next >>**

Fig. 6. Lesson screenshot

All the aforementioned learning theories present sound instructional benefits when applied in any learning context, regardless by the means of delivering learning (classroom-based, web-based, etc.). The learning object idea as it was applied in the particular context integrated the benefits from these theories because it was practically based on them. Therefore, the instructional benefits didn't come from any technological innovations or implementations used but instead they have been derived from the application of the learning theories, whose instructional value is unquestionable. This finding can lead to the assumption that the application of the learning object idea and strategy within any learning context can provide instructional benefits that are not related or based to any technical aspects but are derived from the instructional value of the strategy used itself.

## **6 Conclusion**

As stated in the introduction learning objects present yet another technology-based instructional delivery environment with exciting features and attributes that can empower learner-driven experiences. The use of learning objects can also promote cognitive processing if pedagogical considerations are taken into account in their development and evolution. The pedagogical/instructional benefits of applying the idea of chunking the information into objects are more apparent to adult learners, due to the fact that e-learning based on learning objects provides increased control over the learning experience, easier retention of information presented, and opportunities for practice and application. That is, learners are given the control over the different learning modules and lessons to choose those that apply to their personal interests and needs; knowledge provided in small chunks is easier to be retained, assessed, and eventually mastered by the learner, and learners acting in an object oriented learning environment have the opportunity to practice in a very specific and structured context that facilitates transfer of knowledge. As most of the issues and the current debate around learning objects has to do mainly with technical problems, interoperability and implementation of standards, the authors would like to stress the pedagogical/instructional potential benefits that can be derived from learning object-based design and development of e-learning courses. This is an aspect that is usually neglected but deserves more careful consideration and further research.

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