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## Special Issue on “Learning Objects and Their Supporting Technologies for Next Generation Learning”

Welcome to the October 2009 issue of Learning Technology.

Learning objects are used in many different contexts and applications. This issue discusses current research about learning objects and their supporting technologies, and especially their radically new usage for the next-generation learning. The issue introduces papers dealing with practical frameworks for learning objects, innovative learning technology solutions, and summaries of research about specific topics.

The first three articles are related to the design of learning objects and accordingly their proposed frameworks/systems. The first article, by Liu, Shi and Shang, discusses the design of learning objects to support the constructivist approach. The second article by Churchill specially considers the learning objects to facilitate the learning of conceptual models. In the third article, Matar, Hunaiti and Matar propose a unified repository of learning objects managed by the Electronic Resource (ER) Course system.

The next two papers focus on some innovative integration of learning objects in various e-learning applications in which the article by Yeung, Tam and Lam firstly propose an integration of learning objects into an interactive simulator to facilitate the learning of various computer systems. Independently, Sullivan, Baum, Dyer and Braman outline a project to include learning objects in a virtual environment as the Second Life, and share their valuable experience in creating learning objects for students in the areas of Interactive Media Design, Interdisciplinary Object Design and Computer Science.

The next two papers deal with the flexible and interesting uses of learning objects in various contexts. Jara, Agila, Sarango, Valdiviezo and Cartuche consider an appropriate recommendation scheme on learning objects based on the students’ program contents. Furthermore, Ganoë, Borge, Jiang, Carroll and Rosson carefully investigate a usability case study on learning objects for collaborative authentic education.

Subsequently, Rodríguez and Martín discuss the concept of adaptivity and adaptability applied to design of learning object interfaces so as to adapt to the end user. This work clearly reveals the potential of learning objects for personalised learning.

In the next article, Gilbert shares his insightful reconsideration on the re-purposing or re-use of learning objects, and also proposes a conceptual model of competence for intended learning outcomes to facilitate future re-uses.

The last three articles in this issue belong to the regular article section. First, Depetris, Severini and Sergi propose an interactive program to enhance the reading-writing connection for learning English-as-foreign-language (EFL) students. In the next paper, Peña de Carrillo and Carrillo Caicedo present how their university provides their students with adaptive and personalized life-long education. Subsequently, Chawla and Singla critically suggest a set of criteria to evaluate existing learning management systems and also compare some popular open source software based on some of their suggested criteria.

We sincerely hope that this special issue will help in keeping you abreast of the current research and developments of learning technologies, especially in the area of learning objects and their supporting technologies, and can stimulate further discussions, research, and developments in this area.

We also would like to take the opportunity to invite you to contribute your own work in progress, project reports, case studies, and events announcements in this newsletter, if you are involved in research and/or implementation of any aspect of advanced learning technologies. For more details, please refer to the author guidelines at [http://ltf.ieee.org/learn\\_tech/authors.html](http://ltf.ieee.org/learn_tech/authors.html).

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## Design of Learning Objects to Support Constructivist Learning Environments

Constructivism is a learning theory which assumes that learning is an active process of constructing knowledge, and instruction is a process of supporting knowledge construction (Jonassen, 1993; Henning, 2004; Jonassen, et al., 2004). In constructivism, learners can make the best judgment of what to learn and how to learn if they are given the whole picture and allowed to try various components, and use all learning materials that they can make sense of to achieve their current learning goal. After achieving a new level of understanding, they create new learning needs and goals and can make sense of more things. Learners usually go through this process iteratively for several times. Thus, learning materials need to be presented multiple times, differently each time according to the learner's knowledge level. This requires learning materials to be compositional, reconfigurable, and navigated easily and flexibly.

Some research on learning theory-based design of learning objects has been conducted (Wiley, 2002). A few researchers (Bannan-Ritland, et al., 2002; Orrill, 2002) made the effort to combine learning objects and constructivism focus largely on how learning objects can be used in specific constructivist learning environments instead of seeking a generic structure to help learners learn in many possible creative ways.

Guided by the constructivism learning theory, we design learning objects to facilitate learners in organizing related learning materials, viewing the materials in appropriate forms in the iterative learning process, and easily accessing and navigating the whole set of knowledge. Our learning object design approach allows learners to easily participate in the construction of learning objects and makes the learning objects easily changeable throughout their usage. Learning objects are rendered according to different view patterns, and the patterns can be further configured and refined by the learners. The complete knowledge structure is always presented first and is easily accessible at any time. Learning objects are designed for multiple levels of granularity to support reusability, flexibility, accessibility, and adaptability.

We propose a generic architecture of learning objects that can be applied to various domains and that authors can easily work with. The design of a learning object divides the knowledge into a few levels to be adapted to various situations. At each level, a set of attributes are defined to describe the content, including content type, difficulty level, detail level, etc. Some attributes are strongly associated with the context where the learning object is used. For example, difficulty level and detail level are much more meaningful and accurate when they are used to compare a set of knowledge units within the same parent knowledge unit. Some other attributes, such as content type, are weakly associated with the context.

In our approach, the smallest unit of knowledge is *section* whose schema is shown in Figure 1. A section has one *core* and several *extensions*. The core is the most essential part of a section. The core summarizes the content of the section, while extensions can be added to provide more detailed learning materials of the section. Metadata of a section is used to provide some other information about the section such as goal, keywords, background, etc.

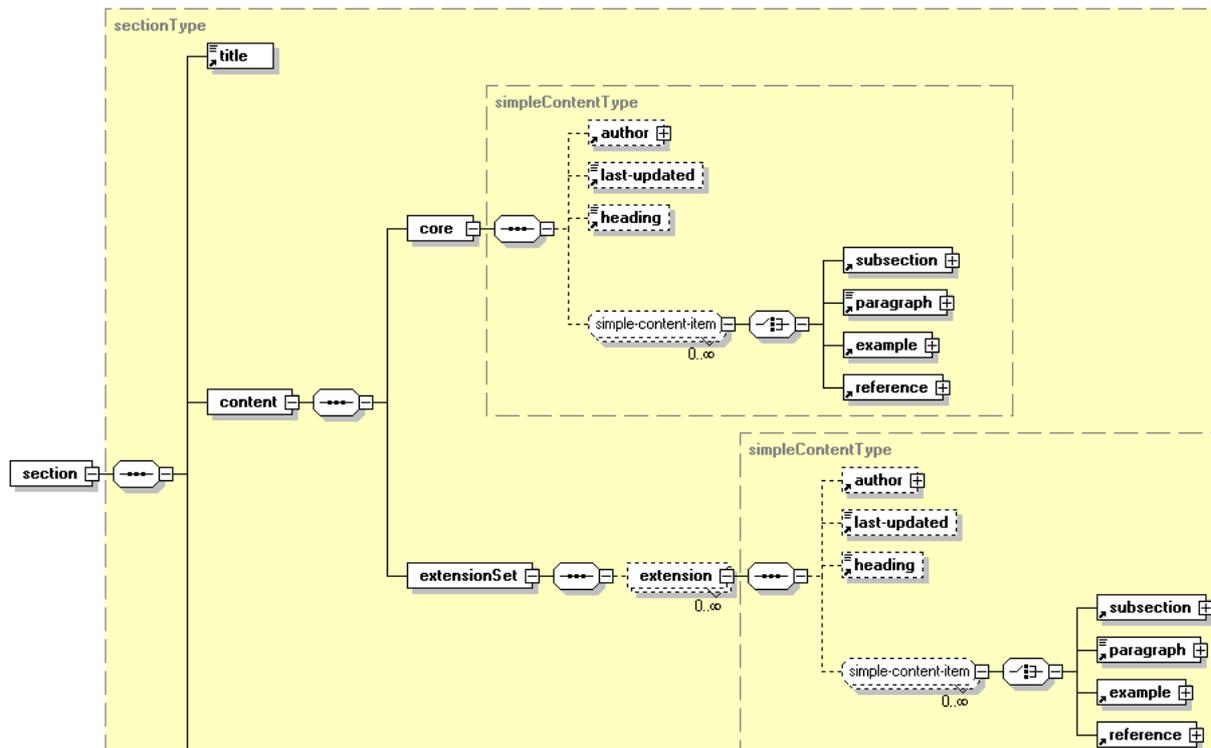


Figure 1: Graphic representation of part of the XML schema of a section

Going up the knowledge granularity level, multiple sections can form a *component*. Multiple components related to a learning topic can be grouped to form a *cloud*. A course is generated from clouds, either manually by an instructor/author or automatically by the learning environment. When a course is generated by an instructor/author, the expert experience can be embedded into the configuration of the course, such as selection of section contents, selection of components, sequence of components, display modes of components, etc. When it is generated by the learning environment, certain organizational patterns can be applied to generate a course corresponding to the learner's profile and the learning goal.

A student can view the learning materials in different ways. She can click "view default" to choose to view the course created by the author/instructor if such a version is available. Alternatively, she can choose to have the course generated automatically by the system according to some patterns. She also has the choice to view the learning materials by her profile, by which the learning materials will be generated session by session. Finally, she can choose to just view all the raw components related to the topic.

Our approach demonstrates the possibility of using the constructivism learning theory to guide the design of learning objects. A prototype is implemented in the IDEAL e-learning environment (Shi, et al., 2002). The collaboration among learning object authors is supported, and learners can also actively participate in the construction of learning objects. It provides a way to allow learners to grasp the whole picture of the course quickly. The ease of viewing learning materials iteratively in different ways assists learners to learn efficiently in constructivist learning environments.

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# Learning Object for Conceptual Learning

## Introduction

A conceptual model is a particular type of a learning object from a classification consisting of the following types: presentation objects, practice objects, simulation objects, information objects, contextual representation objects and conceptual models (Churchill, 2007). A conceptual model is designed to represent one or more related concepts (e.g., triangle, acceleration, inflation, volcano, and migration). Primarily, the conceptual model is a multimedia representation designed to facilitate development of learners' conceptual knowledge, and support learning tasks where relevant conceptual knowledge is required. Learning should not simply include remembering facts but also the development of conceptual knowledge. The conceptual model might serve as a useful tool to support conceptual learning. If appropriately designed, the conceptual model can be effectively delivered to a variety of learning environments via computers, personal digital assistants and mobile phones. The conceptual model can be provided to teachers, who must then decide how to integrate it in instructions, to students for use in their independent learning, or to instructional designers to use as a media object for integration in larger structures such as computer-based instructional packages.

## Examples of Learning Objects for Conceptual Learning

Here are some examples of conceptual models (Churchill & Hedberg, 2008):

- a representation that enables a learner to construct an internal model of a rule to be used in solving algorithmic problems, such as a representation of how to divide two numbers
- a conceptual model that allows a learner to explore if-then or cause-and-effect scenarios (e.g., effect of spread of bird flu in Asia)
- a representation of a concept that guides an expert in diagnosing a problem and proposing a solution, like a concept of Ohm's Law
- a representation of a value system held by an expert that supports his or her judgment (e.g., value system of a movie producer who produced a controversial film)

A more descriptive example of a conceptual model is presented in Figure 1. This conceptual model contains information about a number of important river parameters, enables calculations of river discharge, presents the impact on flow rates caused by the shape of a riverbed, and allows identification of common bedrocks at different locations along the river. Various items of information are presented based on a learner's interaction with the conceptual model. A student can arrive at an understanding of the issues affecting the river through interaction and manipulation of specific parameters, such as how the cross-section of the river changes as one moves down the river, and by systematic exploration of specific information (e.g., how the river discharge is calculated based on values of width, depth and velocity).

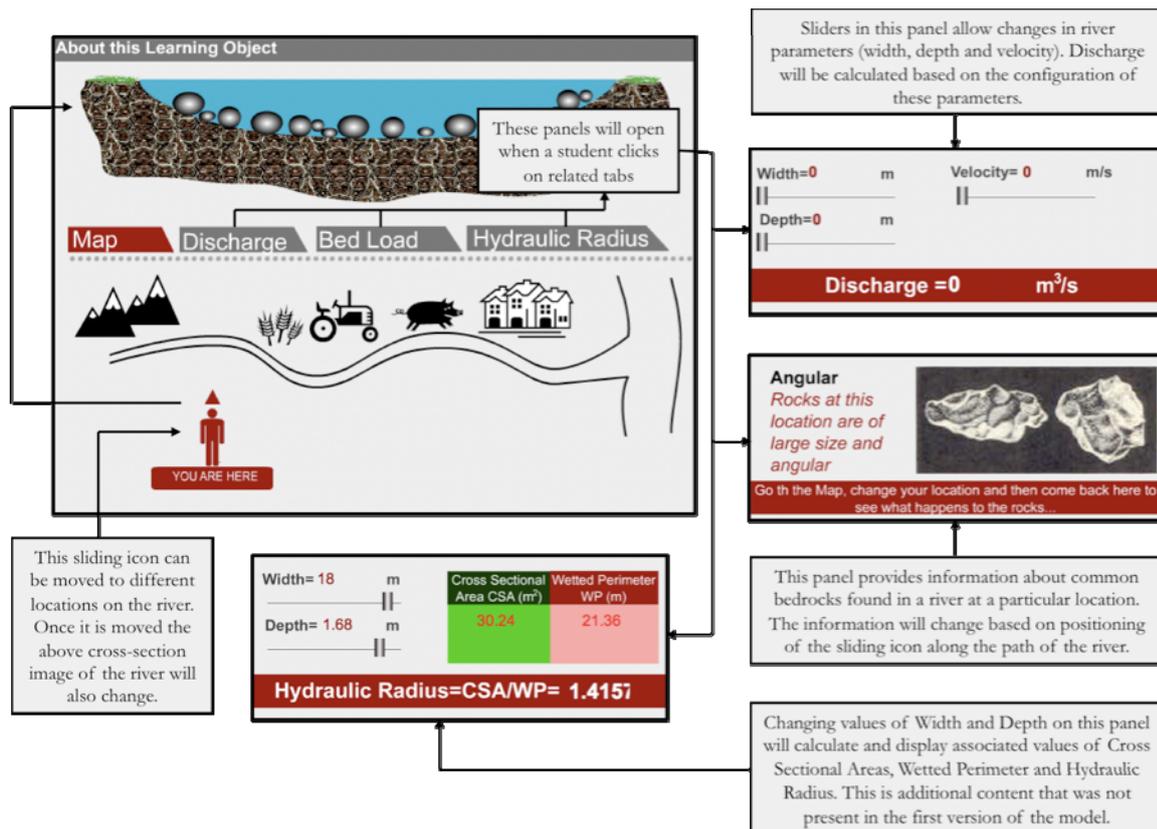


Figure 1: "River" conceptual model

## Models for Teaching and Learning – Theoretical Background

Models have been described as powerful tools for learning, and their educational use has been described as model-centered learning and instruction (e.g., Seel, 2003, Gibbons, 2008). Lesh and Doerr (2003) define a model as a conceptual system "consisting of elements, relations, operations, and rules governing interactions" that are used to "construct, describe, or explain the behavior of other system(s)". For Dawson (2004), a model is "an artifact that can be mapped onto a phenomenon" and that is "easier to understand than the phenomenon being modeled". Johnson and Lesh (2003) more specifically discuss technology-based representational models and suggest that these models can be used for communicating, modeling, describing, or experimenting with other system(s). The term conceptual model was used by Norman (1983), who refers to it as a representation of a target system designed to serve as a the conceptual model as a representation designed for teaching and learning purposes, and writes that such a representation "highlights the major objects and actions in a system as well as the causal relations among them".

Contemporary technology enables design of conceptual models in a effective multimedia form. This form is predominantly interactive (sliders, buttons, hot-spots, text-entry) and visual (diagrams, illustrations, pictures, videos, animations). It can also contain other modalities such as text and audio. This idea of a conceptual model as visual and interactive digital representation is influenced by theoretical work such as: external multimedia representations (Schnotz & Lowe, 2003), dynamic visualization (Ploetzner & Lowe, 2004), information visualization (Bederson & Shneiderman, 2003), visual explanations and envisioning information (Tufte, 1990; Tufte, 1997; Tufte, 2001), visual and multimedia displays and conceptual models (Mayer, 1998; Mayer 2003), conceptual models (Norman, 1983), multiple

representations (Van Someren, 1998), modality and multimodality (De Jong et al. 1998; van Someren et al. 1998) and pedagogical models (Fraser, 1999). Overall, the literature suggests that technology creates opportunity for design and application of conceptual models and other forms of technology-based representations that can effectively support teaching and learning (e.g., De Jong et al., 1998; Fraser, 1999; Norman, 1983; Johnson & Lesh, 2003; Van Someren, 1998). It is also suggested that learning with these representations is supported through activation of certain cognitive processes such as mind modeling and linking between internal representations (Churchill, 2008; Seel, 2003; Mayer, 1989; Mayer, 2003).

Overall, when appropriately designed, the conceptual model can support development of more advanced forms of knowledge such as conceptual knowledge and mental models. Curriculum content can be analyzed to identify key concepts. These concepts can be represented through conceptual models that can serve as powerful tools for teaching, learning and instructional design, and that can be effectively delivered to learning environments via a variety of technologies, such as computers, handheld personal devices or mobile phones.

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# Unified Learning Object Repository Approach Using ER-Course System

## Introduction

In many Arab countries in the Middle East region, the adoption of e-learning has been a slow process. A recent study showed that out of 172 universities in the region only 41% have adopted e-learning.

The same study showed that the quantity of e-course in the Middle East region is between 5% and 15% out of the 41% universities that adopted e-learning. This is a result of different factors that are hindering the advancement of e-learning in the Middle East region, the most important factor being the lack of knowledge and preparation for creating learning objects, especially since many tools do not support the Arabic language alphabet [1].

To overcome those obstacles since no abstract solution exists for such universities, a learning object repository should be provided that addresses their needs with respect to the diversity of learning courses and the language of instruction used (either Arabic or English) [2].

Such a solution should emphasize on sharing the available learning objects from different universities in order to save time and cost and not to be caught in the reinvention wheel concept [3].

## ER-Course - Learning Object Repository as a Solution

A prototype solution has been presented and tested towards enhancing the adaptation of e-learning by making the creation of e-courses and the integration of learning objects into those e-courses an easy process, which requires no sophisticated or prerequisite expertise in creating and integrating those learning objects into the e-courses.

The ER-Course System (which stands for Electronic Resources Course) also provides an option for choosing learning objects that have been created in Arabic alphabet or language, which makes the selection of learning objects an easy process for many faculty members while creating their e-courses.

The ER-Course system can be used as a standalone system since it is specialized in storing and sharing learning objects according to a predefined structure, or can be integrated with different learning management systems in order to use different facilities such as chatting and assessment, etc. [1].

A website (see Figure 1) was built that implements the novel idea which was called ER-Course and it is operating on the following domain: <http://www.u-elearning.net>.

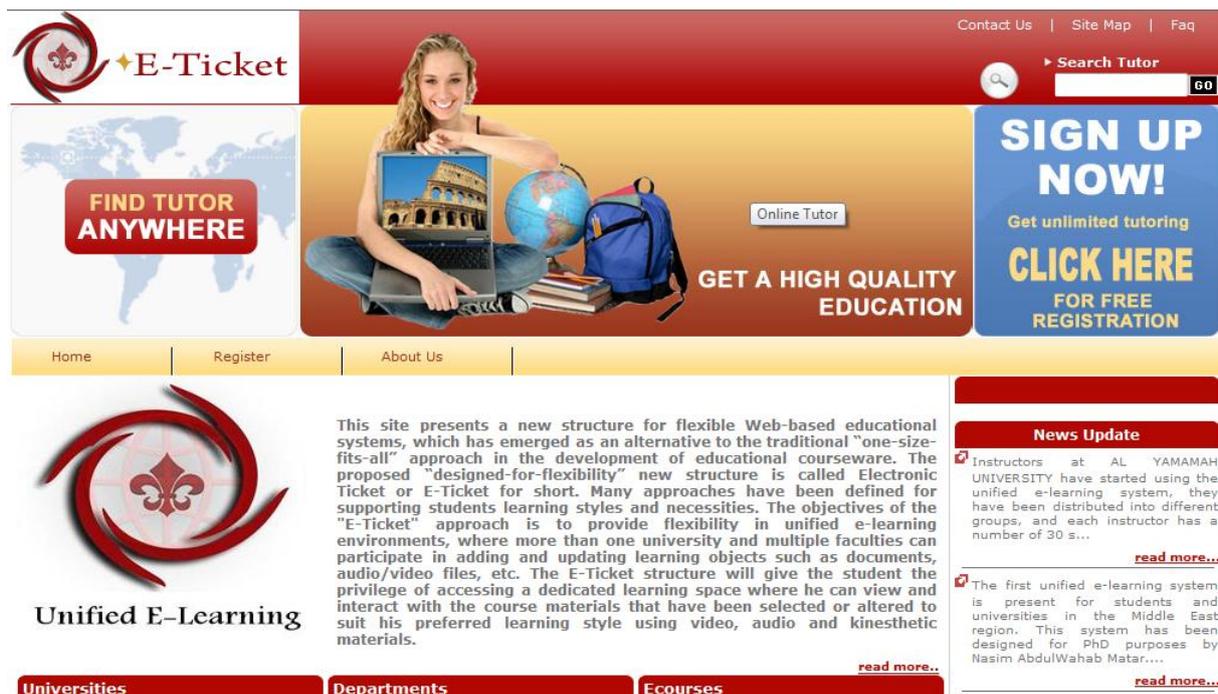


Figure 1: ER Course Website

### ***ER-Course Functionality***

The ER-Course system includes 3 different parts towards providing its services that are controlled by 3 different users (Site Administrator, Instructors, Students).

The system's main block depends on building the main course structure for any taught subject by a specialized committee of instructors from the participating universities, where they come up with a final document that illustrates the needed structure of the course. The person responsible for implementing the structure on the site is the site administrator.

This structure will show the needed chapters and topics with a detailed description for each part of the structure, as it is show in Figure 2.

#### **A. Instructors' Role**

Each registered instructor can participate in uploading the learning objects they have for the course according to the provided topics and based on the description attached to each topic.

Adding resources to the system should be based on collaborative efforts from all participating instructors from different universities. Each instructor can add the available resources either as files or as URL, and each instructor is responsible for the resources he is adding in terms of copyright regulations.

Instructors use the repository to build their courses and for sharing learning objects they have for other instructors to incorporate them into their e-courses.

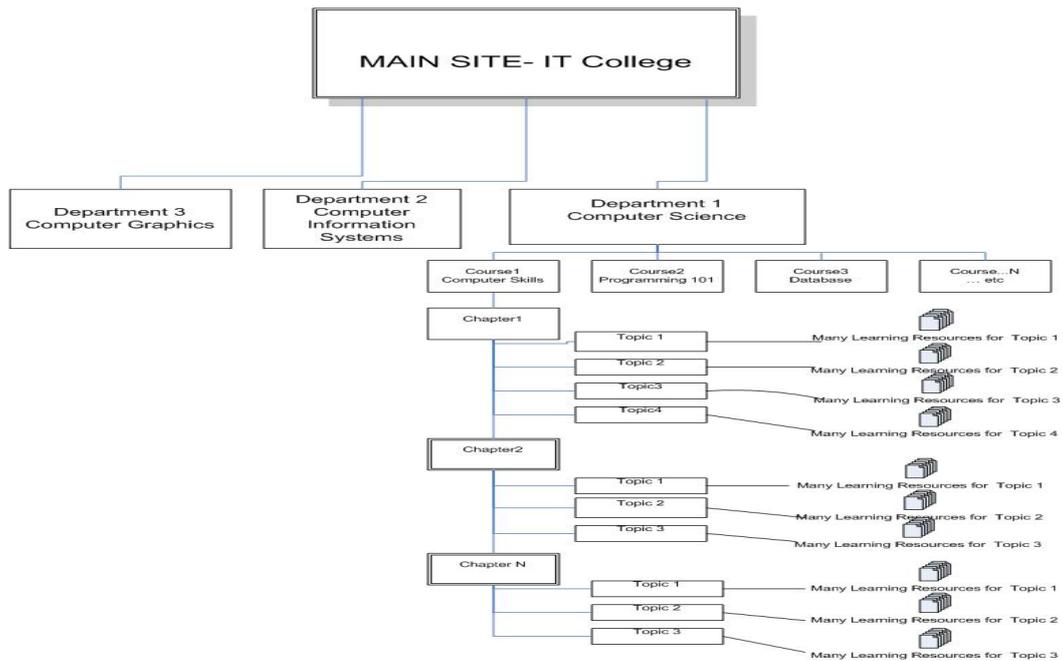


Figure 2: Course structure

The creation of e-courses is implemented through the use of easy steps which start by adding a course name, selecting the course, then selecting the needed chapters that are defined by the university syllabus, finally selecting the needed topics and finishing by selecting the appropriate resources for each topic either by the rank of the learning object which is set by the users or by the language specification.

Through the previous techniques, instructors can generate e-courses targeted to specific problems. Such flexibility has proven to be helpful for organizing courses and producing better learning outcomes.

### B. Students' Role

Registered students create their own ER-Course as a copy of the instructor's e-course structure along with the selected learning objects. Students can add more learning objects to each topic according to their preferred learning style. Within each displayed resource there is a set of buttons to rank and add more resources if they feel that they need more learning objects to master the learning context provided for the topic. Students can view all the learning objects in the repository with respect to the main course structure, and they can also select the resources based on the rank number or the needed language.

Providing such flexibility has been appreciated by students, as they are not constrained to the one size-fits-all, which is provided by the current leaning content and management systems.

Figure 3 illustrates the functionality of the system from different angles based on the users that interact with the system.

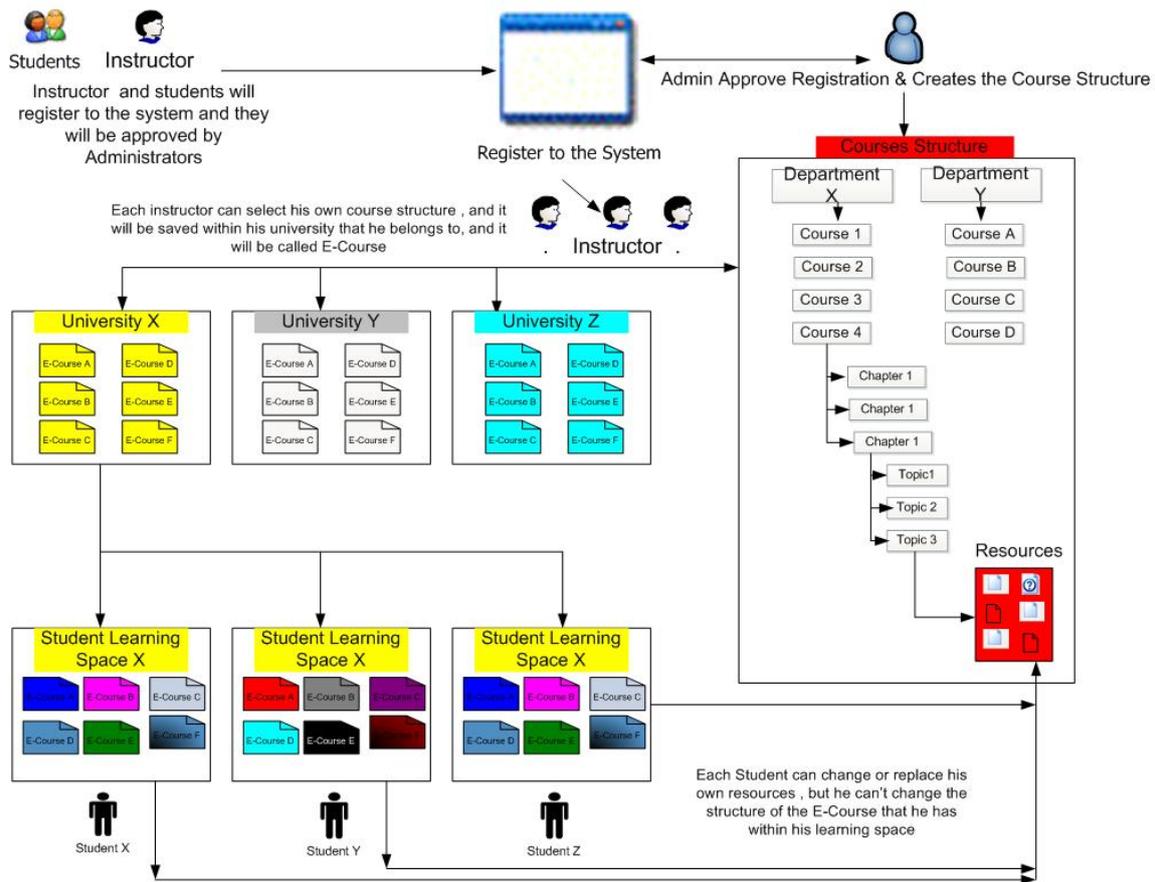


Figure 3: Functionality of the ER Course system

## Conclusion

The limited availability of different learning objects is the main reason for the low penetration of e-learning in the Arab Universities in the Middle East region.

The ER-Course system facilitates sharing different learning objects in an easy way, through a predefined structure for the course contents. The ER-Course system is not a complete environment for e-learning, but it is a prototype tool for effective sharing of learning objects between different universities.

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# Integrating Learning Objects into an Interactive Simulator for Computer Systems

**Abstract:** In the 21<sup>st</sup> century, learning is an important concern to most people. However, some e-learning applications contain complicated knowledge structures that may hinder reuse and sharing of knowledge. Previously, we developed a simulator to facilitate the understanding of advanced concepts related to computer systems through live animations. To encourage the sharing and reuses of knowledge, we propose to integrate learning objects and relevant technologies into our interactive simulator. By adopting the IEEE learning object metadata (LOM) standard, our simulator may easily exchange or reuse learning objects of relevant concepts with other e-learning systems.

## Introduction

The IEEE Learning Object Metadata (LOM) standard [3] has become more and more popular among the eLearning community. By properly breaking down the original content into learning objects, course content developers can easily maintain and update the knowledge structure of the underlying subjects, and also make the content easily available to encourage the sharing or reuse of relevant materials, especially to facilitate interactive discussion during and after classes.

In a previous e-learning project funded by Microsoft Research Asia (MSRA), we built the COMPAD simulator to facilitate the understanding of concepts related to computer systems through live animations of events for program execution on relevant components [5]. To promote the advantage of learning objects and related technologies in our educational simulator, we propose to integrate a flexible LOM editor and general-purpose multimedia system to enhance knowledge sharing. The functions of the system includes simulating the execution of an assembly program on the selected computer architecture, implementing relevant concepts as learning objects into the simulator so that users can modify the existing learning objects to create his/her learning objects based on the underlying application domain. Also, it provides a platform for users to create new computer architectures using learning objects depending on their own needs and preferences, with a multi-media system [2] that can be selected by users to show and display the resources and information provided for the selected learning objects.

The paper is organized as follows. Section 2 reviews the system architecture design of the resulting simulator. Section 3 shows the prototype implementation and evaluation. Finally, the conclusions and future directions are described in Section 4.

## The Architecture Design of the Simulator System

The core functions offered by the COMPAD simulator are provided by the simulation engine [1] and the multi-media controller. The roles of these two components are shown in the system architecture design in Figure 1.

Basically, the simulation engine reads in the three configuration files and the source program to generate a sequence of attractive animation. On the other hand, the multi-media control reads information of the metadata for learning objects and the corresponding users' options to retrieve a specific multi-media file, such as an image or video, stored in the local server.

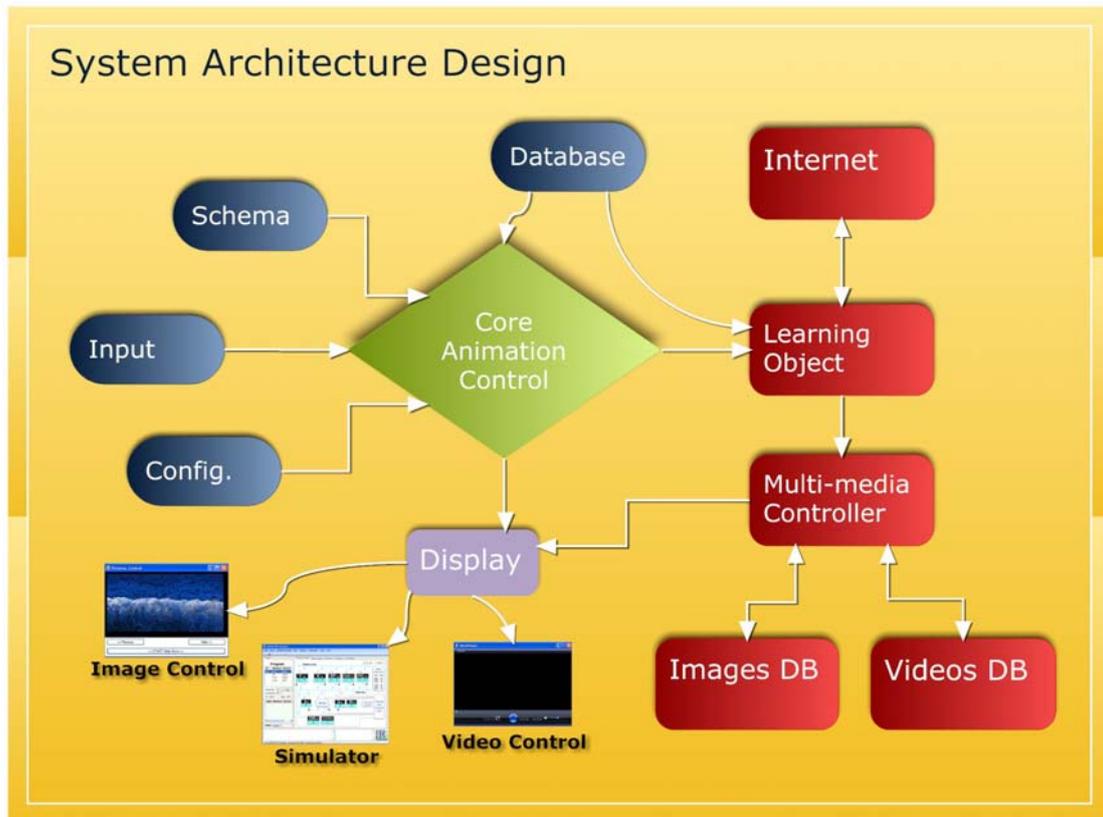


Figure 1: System Architecture

In general, users can simply import the saved assembly program or directly key in the program in the COMPAD simulator. The results generated after the simulation will then be displayed in the simulator. Users can learn more from the information provided in the field of the schema design. There is a platform provided for them to view the related information of the selected learning object so that they can have a clear idea of what the learning object is doing and their inter-relationship more quickly. For more experienced users and designers, they use not only what is provided in the simulator, but also creating something new according to their knowledge about the computer architecture and ultimately integrating them into their designs. They can also search for information that is stored in the schema according to their preference and show it in different media by displaying the images or videos that are stored in the definitions of relevant learning objects.

### Prototype Implementation and Evaluation

We have successfully built a simulator embedded with a platform to help users to tackle with their problems regarding computer architecture by retrieving relevant information. The role of LOM in our project is to capture explicit knowledge, context, perspectives, and opinions. The information retrieved can be obtained either from the web or from the database in the form of textual, images or videos, which is monitored by the multi-media controller. Thus, each user will be able to access, discover and find information. Hence, the processes of learning and knowledge creation can be enhanced and accelerated.

Figure 2 and 3 show the LOM editor and the multimedia control developed respectively for our COMPAD simulator.

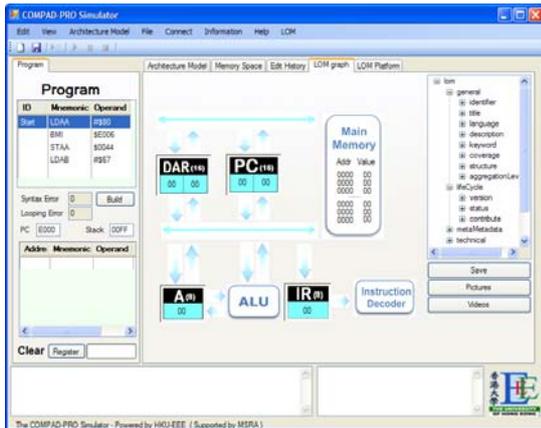


Figure 2: The LOM Editor

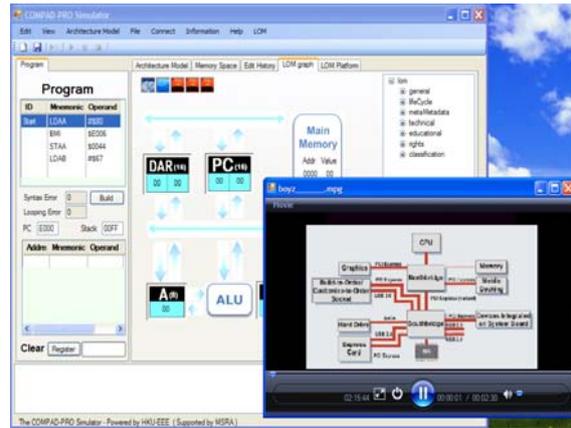


Figure 3: The Multimedia Control

Through the resulting simulator integrated with the LOM editor and multimedia system, users can create the learning objects to suit their needs simply by drag-and-drop, and linking them together according to their relations. For the schema of learning objects, the LOM editor provides convenient facilities to add, modify or remove any content of the learning objects in the schema so as to create their own definitions. Besides, the multimedia system gives flexible supports to display images or videos as readily embedded in each learning object.

## Conclusions

We integrate a learning object metadata (LOM) facility into an educational simulator for users to create and work with the specific learning objects in the underlying subject area. The system is generic so that users may reuse or modify the information inside the existing learning objects so as to create their own learning objects to suit their needs. This will help to shorten the development time of relevant course or simulation materials. All in all, our work has many possible future extensions including the use of sophisticated visualization techniques to guide the systematic structure of learning objects in a specific field, or the integration of an interactive discussion forum to foster the exchange of ideas among students over a peer-to-peer network.

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# Immersive Learning Objects for E-Learning and Collaboration through Second Life

## Introduction

With increased interest in using internet based virtual worlds as a teaching tool, a vast number of different approaches and classroom activities have been designed and implemented to use these spaces effectively. While web based learning platforms often bypass norms of traditional face-to-face styles of interaction, virtual environments such as Second Life, present new challenges to educators. With these challenges however, this type of media allow instructors to adopt their pedagogy to the information age by providing a malleable immersive environment. This paper briefly outlines our initial work in Second Life (SL) and our experiences in creating learning objects for students in the areas of Interactive Media Design, Interdisciplinary Object Design and Computer Science.

## The Towson Innovation Lab

Instead of using typical web based tools for online learning, we are extending the classroom experience virtually through Second Life. The Towson Innovation Lab is a 3D virtual campus, designed for the use of faculty collaborators, their students, and the Center of the Advancement of Instructional Technology outreach and training programs. Here students have access to an international venue of research opportunities, social networking, classroom activities, online lectures and personal interaction with instructors involved in the project. Students can also showcase the results of their academic and creative endeavors. Over several semesters, the authors have utilized SL in many ways, receiving positive reactions from their students with encouraging results (Sullivan, Baum, Braman, Dyer, 2009; Wang & Braman, 2009).



Towson Innovation Lab

## Virtual Learning Objects

While Second Life is not by itself a typical Learning Management System, it does nevertheless possess several similar characteristics. The platform can be augmented by linking

3D objects to external applications and web content. We see learning objects as reusable virtual artifacts within an educational context that can enhance the learning process through methods that allow the creation, manipulation and interaction of such objects in an immersive environment.

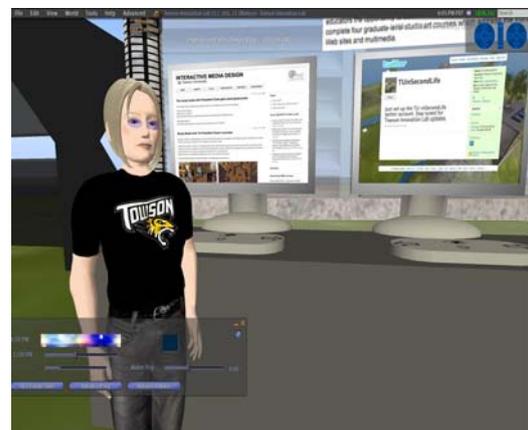
Once created, SL objects can be reused, duplicated and distributed similarly as other encapsulated learning objects as in other web based platforms. SL objects are limited however to exist only within its environment. Extending the inherent visual aspect of learning, these objects can be enhanced through the integration with external data objects, websites and databases through the Linden Scripting Language (LSL), an in-world scripting language.

## Interactive Media Design

Interactive Media Design students in an online web design course utilized interactive presentation boards to learn basic SL concepts and building techniques. Students created scripted presentation board objects for in-world critiques of their real life website designs. The learning objects created were simple in design, yet a useful resource as students worked in-world. Student building skills and confidence increased as their level of familiarity and experience grew (Sullivan *et al*, 2009). The nature of Second Life lends itself to pedagogy as learners are immersed in an interactive space encouraging alternative perspectives and expanded creativity. Some students designed entire buildings to display 3D versions of real life designs. Another project included the simulation of a portion of the real Towson University Campus. Working in Second Life afforded students the opportunity to analyze the impact of 3D environments on future trends in interactive media design (Sullivan, 2009).



Presentation Board Example



Computer Objects Linked to Web Content

## Interdisciplinary Object Design

Creating immersive environments for artistic brands, product lines, exhibitions, and portfolios, Interdisciplinary Object Design students use Second Life as a visualization tool (Baum, in press). Students work collaboratively to reach new markets for their products and work, test marketing strategies, and strive to reach new and global audiences. Design solutions for presentation methodology are explored in an unparalleled manner through SL. Students can meet and work collaboratively with peers and experts from distant geographical locations. Second Life and similar environments provide new revenue streams and the opportunity for young professionals to test market strategies using an array of digital tools linked into SL such as product specific websites and Twitter. Virtual worlds provide

numerous opportunities to expose/train students in methodologies for next generation learning while permitting access to new global audiences.



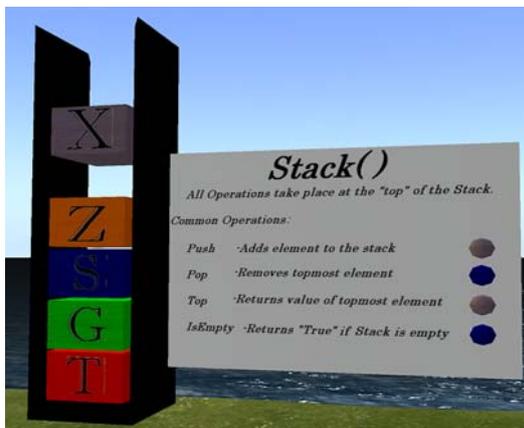
Example of Student Exhibition



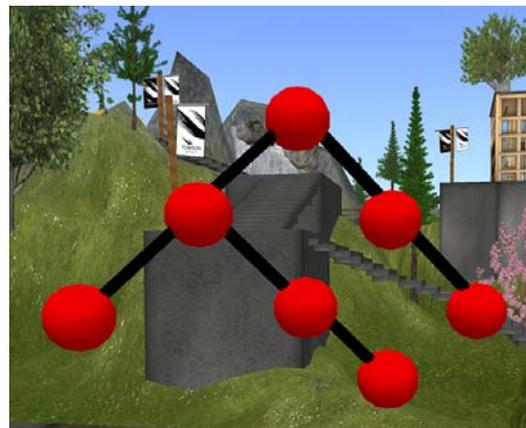
Student Created Designs

## Learning Computer Science Fundamentals

Certain topics in Computer Science curriculums can be challenging for students to understand due to the high levels of abstraction, particularly when it comes to learning data structures. Second Life in particular has potential to be a useful tool to help students visualize these concepts by allowing students to “see”, “feel” and interact with these concepts. Students can walk up to a structure, click buttons to activate animations within SL or link to external content on the web for more information. Interactive data structures can be designed that allows students to visualize concepts as well as interact with them in a “natural” space (Braman, Vincenti, Arboleda, Jinman, 2009).



Stack Data Structure



Visual Tree Example

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## Recommendation on Learning Objects According to Program Contents

Nowadays, service customization is an area that different types of institutions and companies, including online education providers, consider it as very important. It is therefore essential to customize the educational process, that is, according to the characteristics and preferences of individual students. At the *Universidad Técnica Particular de Loja* (UTPL), the teaching objectives within the educational process are mainly based on educational materials, tutorials and exams. Educational materials are comprised of: textbooks (printing of UTPL publications), didactic guides and *learning objects (LO)*, which are complementary to the educational process.

According to the IEEE, a learning object is defined as “any digital entity which can be used, reused or referenced during technology supported learning”. [1]

Learning objects are managed (developed, organized and stored) via a learning object repository, which can be open source, including DSpace, PlanetDR and Door. For the management of learning objects, UTPL utilizes the institutional repository Dspace<sup>1</sup>. DSpace works with the metadata standard Dublin Core (DC)<sup>2</sup> [2], in which 2 levels are established: simple and qualified [3]. The first level consists of 15 elements. For the second level, 3 elements are added to the previous level.

Table 1. Dublin Core Levels

FIRST LEVEL			SECOND LEVEL
Resource Content	Resource Viewed as intellectual property	Resource Entries	Added elements
Title Author Description Subject	Type Date Format Identifier Contributer	Origin Language Coverage Point of Reference Laws	Audience Origin Copyright

Having used DSpace as a repository for educational materials, it was necessary to change the Dublin Core scheme to LOM v1.0 metadata (Learning Object Metadata) at the UTPL. The objective was to promote the interoperability of the LO. The key component of DSpace is its search engine (Lucene); it is identified by the indexing that is performed via elementary units known as *documents*. Each of these documents has a name and a textual value. Lucene provides support for a specific type of query called *query range*. In essence, it restores indexes using alphabetically arranged strings using a low- and upper-limit range. These individual searches can be improved using the semantic mapping of contents. Hence, an ontology<sup>3</sup> was developed which represents the LOM standard used in the DSpace repository for LO labelling.

<sup>1</sup> Open Source Software developed by the University of Massachusetts and the HP laboratories enables the processes of storing and cataloguing via a metadata system for different educational resources such as: text, video, presentations, etc.

<sup>2</sup> One particular system with 15 descriptors, designed to provide a vocabulary with “base” characteristics. These are capable of providing basic descriptive information on any bibliographic resource, no matter what the original format, area of specialization or cultural origin are.

<sup>3</sup> An ontology is a specification of a conceptualization (Grubber, 1993).

At the UTPL, the teaching-learning process is supported by a Virtual Learning Environment (VLE-Moodle). Students are provided with access to tutorials and resources as well as resources that are stored or available in DSpace. In order to simplify usage, modification, and re-elaboration of the LO, a link from VLE to the DSpace repository was introduced.

In order to fully support the learning process, a mechanism was developed that suggests learning objects to students, i.e., in accordance with the course contents that are being studied. This component runs when the student is logged in VLE, it detects the program and courses that the student is following, and with those parameters the component searches in the ontology inferring from the instances the program content of each course, and the learning objects stored in DSPACE.

Based on this objective, the previously mentioned ontology was used. Another ontology (Figure 1) was created, which represents part of the UTPL academic offer, namely academic subjects, programs, courses, and contents. For the development and integration of both ontologies, Methontology<sup>4</sup> was chosen, this is based on the IEEE 1074 standard software life cycle; Protégé 3.3.2 for formalization; OWL-DL (as ontology language), and, Racer Pro and Jess (to validate taxonomy concepts and inference rules respectively).

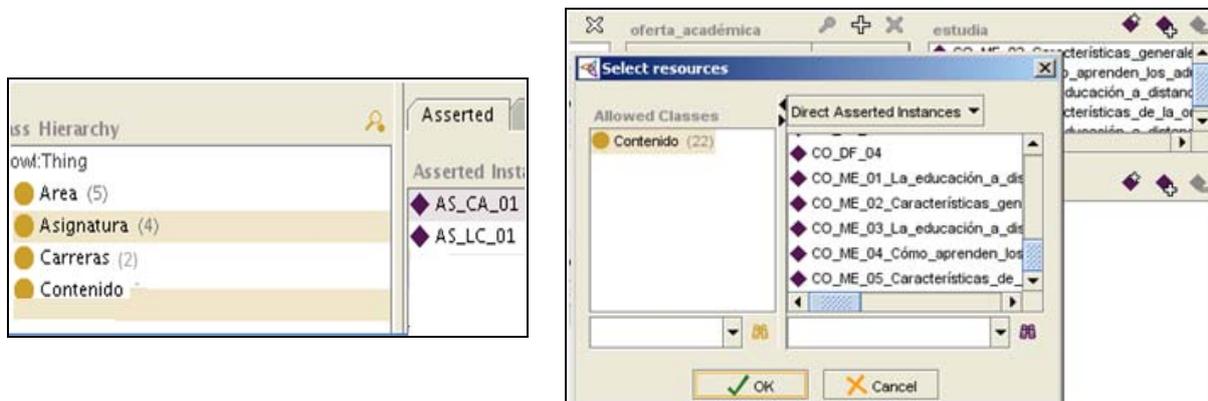


Figure 1: Protégé Ontology

Figure 2 shows the results of the pre-programmed block in the VLE system for using the created ontologies.

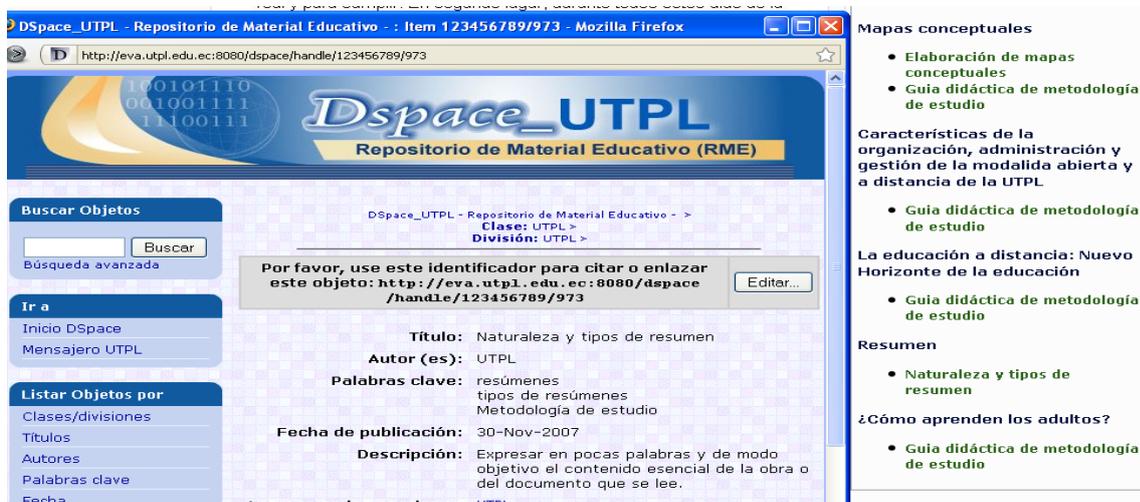


Figure 2: LO Recommendation as seen on the VLE system

<sup>4</sup> Methontology is a methodology for ontology development

## Future Projects

The virtual teaching-learning process will continue to advance in the future in accordance to how technology progresses and develops. In this specific case, the UTPL made a first step in the implementation of semantic definitions, pragmatic content, and learning objects (recommendations of learning objects). This has allowed us to provide students with LO that is related to the pragmatic contents of the courses they are studying.

In order to strengthen the development of the semantic applications, it is necessary to research and develop components additional to ontologies such as “intelligent agents”. These help to provide more personalized recommendations based on the different user profiles.

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# Usability Case Study Learning Objects for Collaborative Authentic Education

Authentic learning was a call for instruction to be more contextually bound in real world situations rather than confined to abstract concepts for students to memorize (Resnick, 1987; Brown, Collins, & Duguid, 1989). The argument being that by connecting concepts to real world problems the application of knowledge can be emphasized, helping students transfer what they learn in a classroom to authentic practice. Towards this aim we developed a usability case studies (UCS) library website (<http://ucs.ist.psu.edu/>) with detailed design cases of software projects developed by companies and other organizations. These cases serve as learning objects for students as they are a reusable, structured way to tie usability concepts and methods to real world practice; they demonstrate for students what usability methods look like in practice and provide students with opportunities to evaluate and reflect on the process of scenario based usability engineering design.

Case studies in the UCS library are not brief narratives; they are extensive hypertext collections, including actual design sketches and other design documents (Figure 1). The case schema corresponds to standard phases of a system's development process: requirements analysis, activity design, information design, interaction design, documentation design, and evaluation (Rosson & Carroll 2001). The phases further decompose into sets of 3-4 activities that take place during each phase, making 20 categories of software design activity.

The screenshot displays the UCS Library website interface. The main content area shows a case study for 'garden-com' under the 'Information Design > Envisionment' category. The case study includes a table with columns for Name, Type, and Date. The first entry is 'Hand Sketch based on Map Metaphor', a Design Sketch dated 11/13/2001. The description states: 'This is an early sketch created when the garden.com shopping experience was first being explored. A map metaphor was used as a basis for handling the information design.' Below the description is an 'Artifact' section containing a design sketch titled 'MapMetaphorIdea.gif 483x365 pixels'. The sketch shows a navigation layout with a 'Find Product' button, 'Search by Department' and 'Weekly Specials?' options, and a 'CLICKABLE MAP' area. The map area is divided into sections for 'Plants', 'Tools', 'Furniture Showroom', 'Books', 'Gifts', 'Customer Service', and 'Cashiers'. A green star is placed on the 'Plants' section, and a red arrow points to the 'CLICKABLE MAP' label. Below the sketch are three tables: 'ROSE SELECTION' with a list of roses and prices, 'PRODUCT INFO' for 'John Cabot Climbing Rose', and 'WHEELBARROW' with a list of items and a subtotal of 79.50.

Name	Type	Date
Hand Sketch based on Map Metaphor	Design Sketch	11/13/2001

**Description**

This is an early sketch created when the garden.com shopping experience was first being explored. A map metaphor was used as a basis for handling the information design. Even though the design is still in the early stages, the main sections are:

- the top navigation
- the side navigation
- the main screen

A heavy emphasis is placed on the visual nature of the design.

**Detailed Design Sketch**

This is a design mock-up in HTML. The top of the page, with the result search term provides a thumbnail image of the product.

**Detailed Design Sketch of Product**

This is a design mock-up in HTML from the search results page. As a product image. The product name is:

**Information Scenarios**

Having explored a variety of concepts, ready to see how these ideas could be implemented into an online shopping experience. Done collaboratively, over several sessions.

Figure 1: Detailed view of part of a case in the original UCS Library including an embedded image of an original design document.

A user navigates the library through the categories within each case. Categories are populated with sets of scenarios, artifact descriptions, claims and their pros and cons, along with associated media. For example, the requirements analysis category typically contains early statements of the design concept, results from requirements surveys, focus groups, and other market research (including, where possible, instrumental documents such as advertisements used to recruit participants into focus groups). Other phases contain complementary content.

Initially, the case library site was built on a database with tables of scenarios, artifact descriptions, claims and pros/cons related to claims. Taking advantage of these structures, we integrated our collaborative BRIDGE workspace (Ganoë et al. 2003) with the case library to provide a tool (Figure 2) for student teams to collaboratively interact around individual elements of case content through comments (Xiao et al 2008). This led to the realization that allowing students to be able to collaboratively interact with individual pieces of content within a case is a powerful concept.

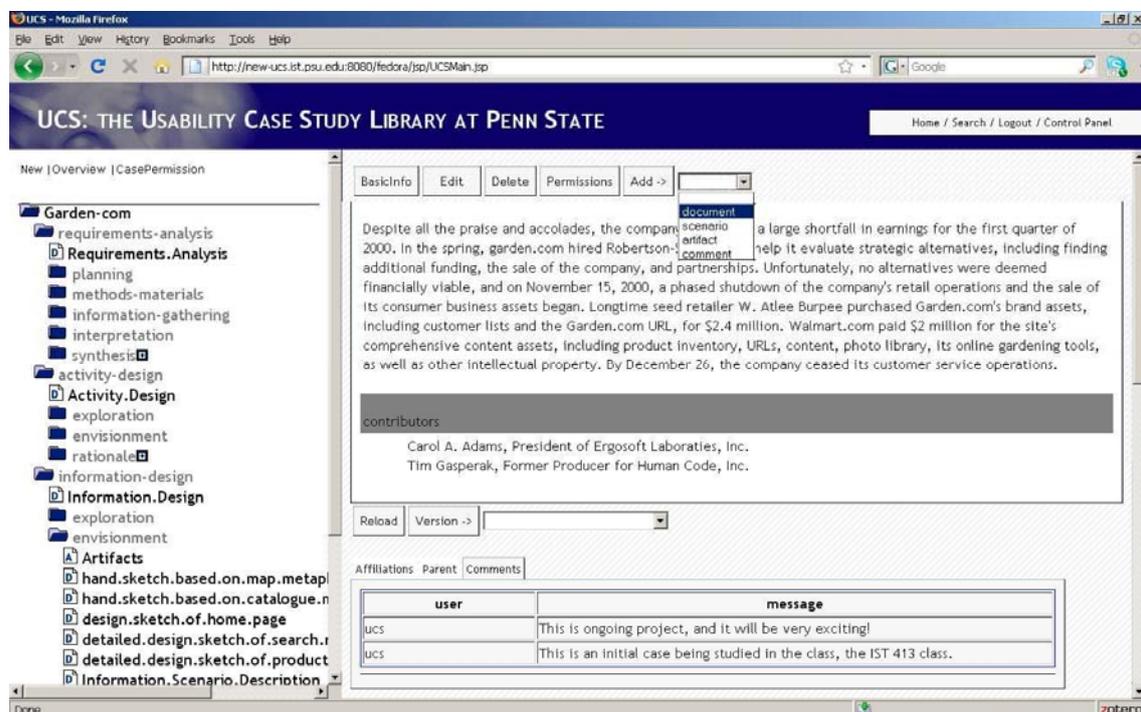


Figure 2: Redesigned case library operating around a content repository with integrated content commenting shown.

We also found other practitioners and educators who wanted to contribute new cases and use the cases in their own courses. This initiated a redesign of the case library to support collaborative construction of case content and collaboration around that content. The original case library was essentially just a website with a database backend. Photographs, scanned documents, etc. that were parts of the cases were stored as separate files on the web server and linked in with HTML tags embedded in the database record text. New requirements became distributed authoring of new cases by providing space for cases under development as well as those that were part of student activities, hidden from the published cases. We wanted an architecture that would embed media files in with the rest of the case content. Finally, we wanted to construct these content objects under a software application programmer's interface (API) that would ease creation of new learning object types around case-based learning

activities for students (sharing of lesson plans, and other activities that utilize the cases), along with providing access to external tools and searching the library.

We chose Fedora (<http://www.fedora.info/>) for our underlying architecture because it supports the object-oriented content features in our requirements. Technologies like Fedora (similarly Java Content Repositories <http://jcp.org/en/jsr/detail?id=170>) provide an ideal mechanism for the underlying management of learning objects. They do so by making it easy to create data objects with designer specified attributes, providing easy storage mechanisms for media data streams: audio, images, video, etc., and allowing for arbitrary linkages between the objects. Constructing a case library from well-defined repository objects allows for easier design of tools that interact with the objects in the system. For example, a repository object can support many user-specified content fields, while also easily adopting standard learning object metadata (e.g. IEEE 1484).

We have completed work on the redesigned case library (Figure 3; Jiang et al. to appear). We are now focusing on constructing a workspace where users can construct shared views of the content specific to their context. For example, if an instructor wants to have a lesson on the use of metaphor in design, he could create a custom view that aggregates examples of metaphor in design across all the cases, and he can annotate those results with lesson materials for the class. This aggregated view could be saved as a template in the repository and passed on to student groups as a design activity. The view could also be made public as a learning object to be reused by others. We see ability to flexibly aggregate of case content into authentic learning activities an important part of constructing next generation learning objects.

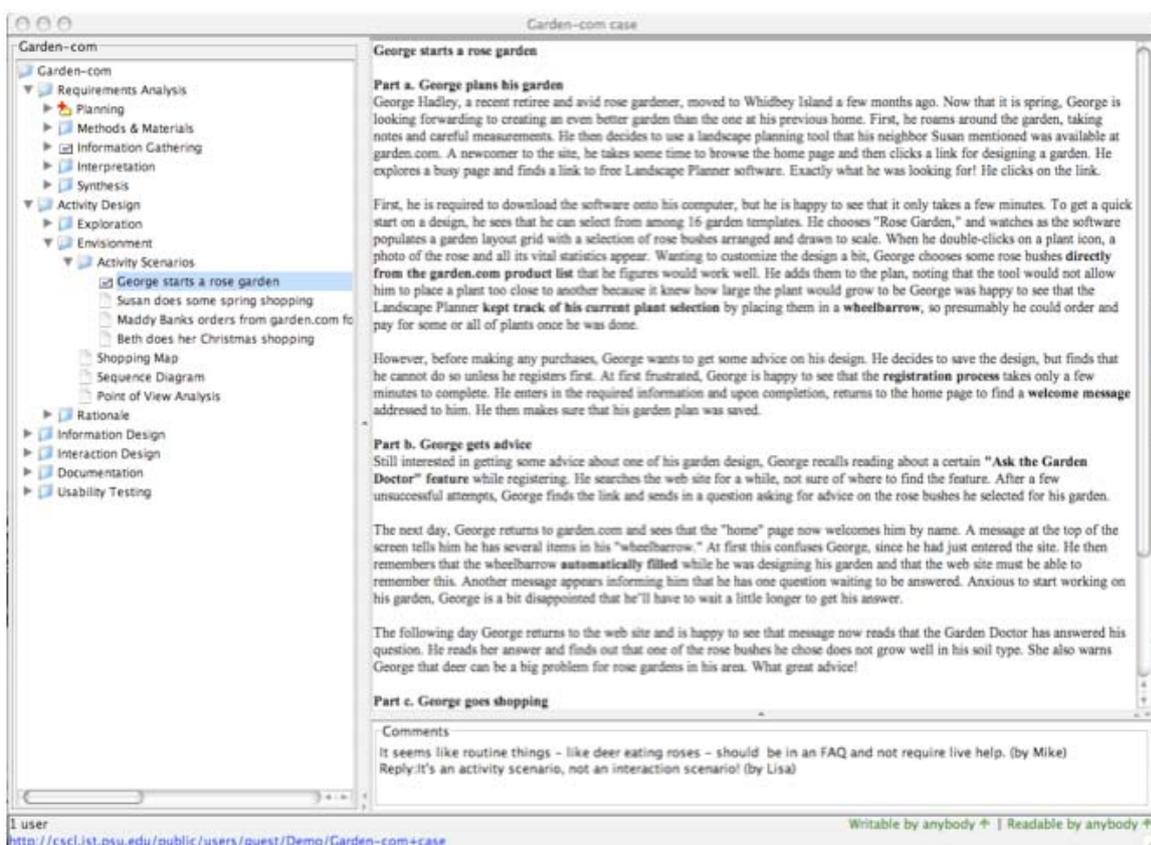


Figure 3: Collaborative case study commenting tool in BRIDGE.

We are also continually developing activities connected to the case library to further facilitate students' ability to apply important usability engineering concepts. Currently, we are experimenting with partially distributed team assignments in an upper-level undergraduate course on Usability Engineering (details at <http://ist413.ist.psu.edu/>). These assignments employ *case-based learning* (Carroll & Rosson 2005) where students analyze and apply ideas from the case library to their own design projects. The assignments also employ *distributed collaborative learning* (Ganoë et al. 2003; Xiao et al. 2008); student teams are asked to work together outside of class using collaborative software over a period of several days to several weeks to develop a design analysis or prototype, and a report describing their work. Our software provides tools to collaboratively comment on case content, construct cases, and write reports. In this research, we are not only interested in constructing a digital library of learning objects from usability engineering cases, but also in developing and maintaining a collection of collaborative activities that engage students in both the products and processes of usability engineering.

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# Adaptivity and Adaptability in Learning Objects

**Abstract:** This paper discusses the concepts of adaptivity and adaptability applied to the design of learning object interfaces. In this regard, adaptivity means the capability of learning objects to automatically adapt to the user, based on assumptions about him/her. Adaptability, on the other hand, regards the possibility of allowing the user to modify some parameters of the learning objects' interface. In this way, the aim for the learning object is to adapt to the user, not the other way around.

**Keywords:** *learning object, adaptivity, adaptability, mediatic object, user model, instructional design, customization.*

## Introduction

The learning objects' interfaces usually have the same look and feel for every user, regardless of his/her learning needs and individual characteristics, which compels the users' adaptation to the learning object. There are some interfaces that are "customizable"; where the user can choose to modify some characteristics of the interfaces' visual aspects. However, this does not entirely satisfy the needs of educational content presentation to the users. It is also required that the learning objects' interface adapts to the needs, interests and characteristics of students, allowing them to efficiently complete their tasks and learning activities. In order to achieve this, it is necessary to analyze the interests and preferences of the student, before the learning objects' interface can provide an appropriate support for the teaching-learning process.

## Adaptivity and Adaptability

Advances in adaptive interfaces have improved the design and development stages of customizable user interfaces; and those advances can now be applied to the learning objects' context. According to Oppermann [3], adaptivity and adaptability are two features of a system which make it able to adapt itself, modifying its interaction with the user.

As stated by Kobsa [2], adaptability means that the user is able to consciously personalize the application, while adaptivity refers to the selection and presentation of content done by the system, for example, according to the user's interests.

### *Adaptivity*

We consider *adaptivity* as the ability of learning objects to automatically adapt to the user, based on assumptions about him/her. The adaptivity of the learning objects' interface includes making decisions about what mediatic object is presented to a specific user and when, based on his/her interests and the guidelines of instructional design.

A mediatic object is a digital entity with different forms of representation (text, illustration, graphic, video or audio) which is an element of the contents presented on the learning object interface. The basic function of the mediatic object is to mediate the educational content based on its representative nature.

## Adaptability

*Adaptability* refers to the user being able to modify the system settings and adapt it to his/her preferences. In the context of learning objects, adaptability is related to the ability of a learning object to match the user's expectations based on his/her previous behavior. In this manner, the interface should display the mediatic objects in place according to the user's preferences.

## Learning Object Interface

Adaptivity and adaptability of the learning object interface include introducing relevant content according to the previous interaction between the student and the mediatic objects contained in the learning objects' interface. Thus, the learning objects' interface has to monitor the students' progress and to keep them aware of their own progress.

For the interface of a learning object to be adaptive and adaptable, we must consider the *user model*, *instructional design* and *customization* of the learning object.

## User Model

A *user model* is a representation of the set of beliefs concerning the interests and preferences of a particular user, used for the interactions with the learning object to enable adaptivity and adaptability of the mediatic objects in the interface. The proposed user model has two key elements:

1. *User interests*. Allow adaptivity of learning objects, making it possible to decide which mediatic object to present and when, based on instructional design (Figure 1a).
2. *User preferences*. Allow adaptability, defined as the personalized visualization of mediatic objects (Figure 1b).

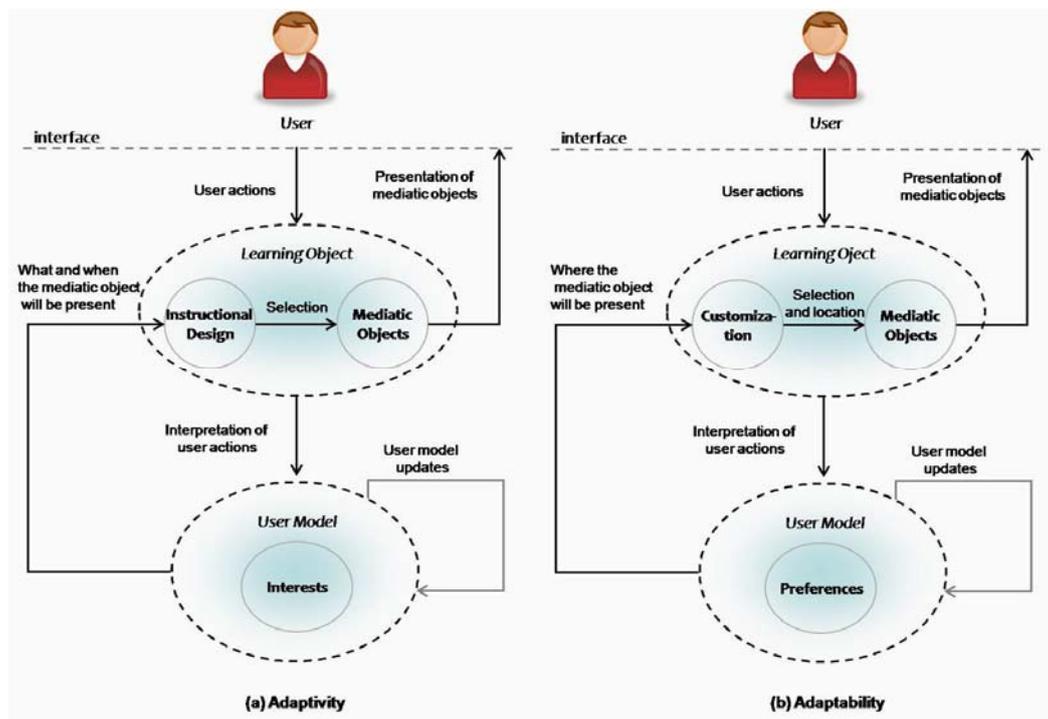


Figure 1: Adaptivity and Adaptability of Learning Object Interface

## ***Instructional Design***

According to the website of Instructional Design [1], instructional design is the process by which education is enhanced through the analysis of learning needs and systematic development of learning materials. Within the context of this work, we consider the instructional design from two perspectives:

1. *Instructional design applied to the design of mediatic objects.* Is related to the design and development of each one of the learning object's contents.
2. *Instructional design applied to the design of learning object.* Is related to design between user interaction and mediatic objects.

Instructional design must propose what, where, when and how [4] the mediatic object will be displayed in the learning objects' interface according to the user's interests. In this way, the learning object can recommend the user to interact with a given mediatic objects, for example according to his/her interests.

## ***Customization***

Customization refers to the user preferences about the location of mediatic objects in a particular place of the learning objects' interface. Since these preferences could not be detected automatically by the learning object, this information will be provided directly by the user.

## **Conclusions**

Learning object's interfaces related to adaptivity and adaptability must allow for the mediatic objects to be displayed in a personalized way, according to the user's interests and preferences. The considerations for the development of learning object's interfaces regarding to adaptivity and adaptability involve three key elements: *user model*, *instructional design* and *customization*.

The user model, the instructional design and the customization let the learning object to:

1. Analyze the interaction between user and mediatic objects.
2. Display the mediatic objects in the interface according to the user's interests and preferences.

We are working in the development process of a Methodology of Software Engineering for the Design, Adaptivity, Adaptability and Usability of Learning Object Interfaces. In this research, we suggest that the design of learning object interfaces based on the proposed methodology will ensure:

1. the presentation of mediatic objects in an adaptable way, according to the user needs and interests.
2. the efficient user performance doing the learning tasks, avoiding confusion and loss of interest due to the overload of mediatic objects in the interface.

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## Re-purpose, Re-use: Reconsider

Tam and Lam [1] notes, “learning objects (LOs) are potentially useful to many innovative applications for next generation learning”, and go on to suggest that the high complexity of the designed structures for LOs and the huge costs involved in the re-engineering of existing e-learning platforms will discourage LO reuse. There may be, however, a more fundamental, and insurmountable, reason for the lack of re-usability of LOs.

A well-designed LO addresses one or more carefully delineated intended learning outcomes (ILOs), where the LO activities, assessments, and content are specifically focussed upon the achievement of those ILOs. Since an ILO is an expression of an educational purpose, a LO is (or should be) a systematic embodiment of that purpose. This view derives from Ulrich’s contributions [2] towards the critical analysis of systems, and may be illustrated by Figure 1. Ulrich’s terminology is shown in bold, while the corresponding terms to be used in the subsequent discussion are shown in a smaller point size within parentheses.

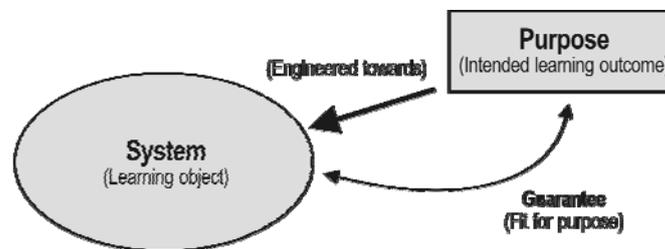


Figure 1: The relations between LO and ILO.

It is often said that one of the main benefits of LOs is that they can be re-used or “re-purposed”, yet the re-purposing of something which has been thoroughly engineered to fit a different purpose might be easily thought an exercise in pointless futility. Assuming no change to the LO content, it is rather difficult to imagine how it could in fact be fit for its new purpose or be said to be “re-purposed” (i.e., suited to a different ILO) in any logical or sensible sincere use of that phrase.

Purposes and ILOs tend to be individual rather than common. A project some years ago at a prestigious UK university secured a large grant and three years to produce an e-learning module (what now might be called a set of LOs) on “Introductory statistics” that would be suitable for engineers, psychologists, and medical doctors. Four years later, the outcome was a high pile of bitterly contested paper (and nothing else) which no one accepted. Everyone did agree, for example, that there should be a LO on Student’s t-test. Not unexpectedly, everyone wanted to use their own domain-specific examples, exercises, and case studies. But interestingly, no agreement could be reached on how the subject matter should be taught, or on the ILOs and their associated assessment.

The point of this unreported but often-repeated (other domains, other universities, other times) case study is to highlight the significance of contextual factors which surround seemingly detached, abstracted, and self-contained ILOs. What each stakeholder wanted were ILOs (and hence LOs) which suited their individual and particular ways of teaching, which were relevant to the particular departmental approaches to the topic, and which were appropriate to their particular subject matter domains. What the project attempted was the definition and delivery of re-usable LOs. It all failed.

A development of current ideas surrounding competencies suggests a conceptual model of ILOs augmented by contextual factors, as illustrated in Figure 2 [3]. Such augmented ILOs might be called competences.

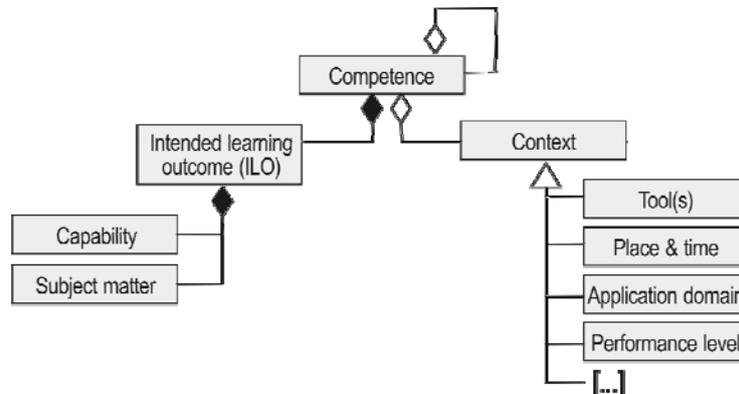


Figure 2: A conceptual model of competence as contextualised ILOs.

The point of highlighting contextual factors in the use (and attempted re-use) of LOs is to suggest that, while the re-purposing of a LO to some different ILO might be thought to involve considerable conceptual difficulties, the re-purposing to a different competence should be considered impossible in practice and perhaps even impossible in principle. This follows from the richness of context which is hinted at in Figure 2. While an ILO may be reasonably constrained by an agreed ontology of capability terms (e.g., Bloom’s taxonomy) and an agreed subject matter topics list, context is in principle limitless and dependent upon particulars (if not peculiarities) of the target students, teachers, locations, times, tools, required mastery levels, available services, etc.

There are circumstances where a LO might be thought capable of re-purposing. Such a LO would probably have an ILO of such generality that it would be better described as an aim or goal, capability on Bloom’s hierarchy that hardly ventured beyond ‘knowledge’ or ‘comprehension’, and content that focussed on facts rather than on richer material which might be described by Merrill’s concepts, procedures, or principles [4]. Another way of saying the same thing would be to suggest that such a LO would likely have negligible value as front-line learning and teaching material (though it may well have application as background reference material).

Editing a LO, of course, opens the possibility of better re-using its content in the service of a re-purposed ILO. However, this is not what is meant by “re-using a LO”, and for purists the discussion therefore stops here. We might just explore the potential, though, of editing LO content to see if such an approach might at least yield some pedagogic value from re-purposed or re-used material.

We could approach the question by considering the learning transaction [5], a simple analysis of a learning and teaching situation based upon the conversational model of Laurillard [6], integrating it with the competence model of Figure 2, and expressing it as a conceptual model of teaching and learning compatible with IMS Learning Design (IMS LD) [7]. The result is shown in Figure 3.

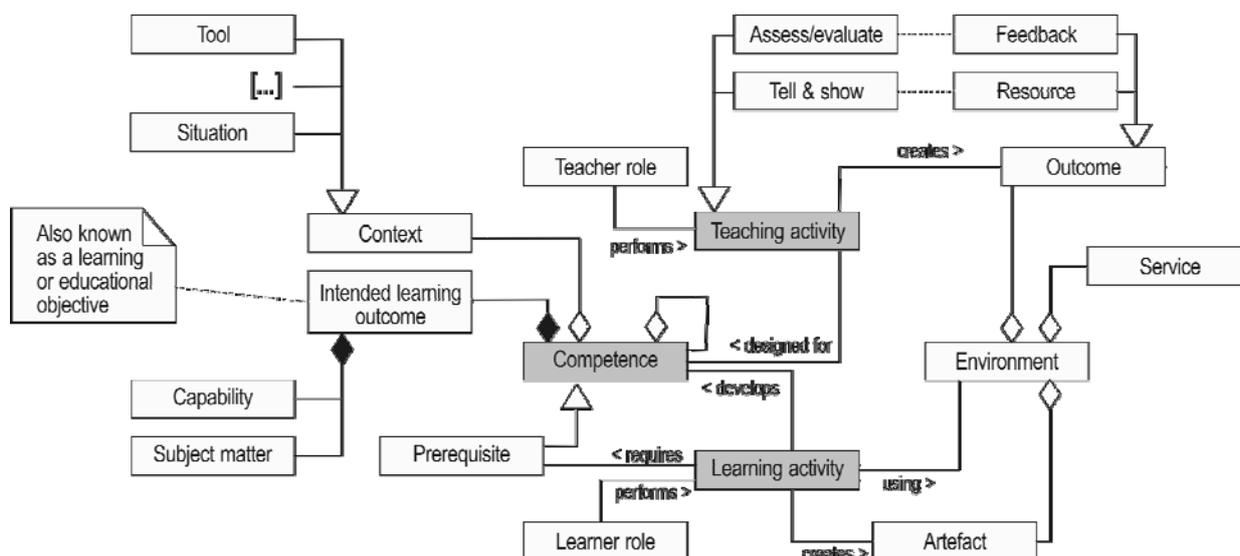


Figure 3: Conceptual model of learning and teaching.

The key points to note are that a pedagogically effective IMS LD Unit of Learning, which could be thought of as a fully elaborated LO, is based upon learning activities which are entirely connected to the ILO, and upon teaching activities similarly. Editing LO content so as to effectively re-purpose it is equivalent to simply originating a (new) LO in service of a (new) ILO. The purists are right about the conceptual inadequacy of the idea of editing LO content and calling the result a “re-used” LO.

We may conclude that we cannot meaningfully (conceptually or practically) re-purpose a properly executed LO to a different ILO, and we should not be surprised by little evidence of meaningful LO re-use.

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## An Interactive Programme to Improve EFL Reading-Writing Skills

Reading and writing are interactive processes which can be enhanced through the use of modern technology. Research in the area has shown that the new technologies have positive effects on language learning and the development of both *lower and higher level skills* (Skehan, 1998). These technologies also represent one of the most authentic teaching resources since they increase motivation, create real learning contexts, use a wide range of resources and highlight authorial voice. Interactive technology also fosters students' autonomy since they have to develop not only literacy but also technological skills required for academic performance (Linder, 2004).

With the upsurge of interest in computer assisted language learning, researchers and teachers have acknowledged the importance of incorporating technology in the second language classroom. The reading-writing connection can actually be strengthened through computer-based tasks by means of which learners may have access to model texts (as shown in Figure 1) and perform different activities that will allow them to identify text-type and organization patterns, formal structure of the text (as shown in Figure 1 and 2), and lexico-grammatical features (as shown in Figure 3) – among others. Through these reading input learners are provided with a contextual framework that they will later transfer into their own written productions. Transfer of skills is not automatic; systematic teaching and student's ongoing practice so that the second language (L2)<sup>5</sup> reading / writing relationship can be effectively used to turn learners into successful writers (Carson 1990).

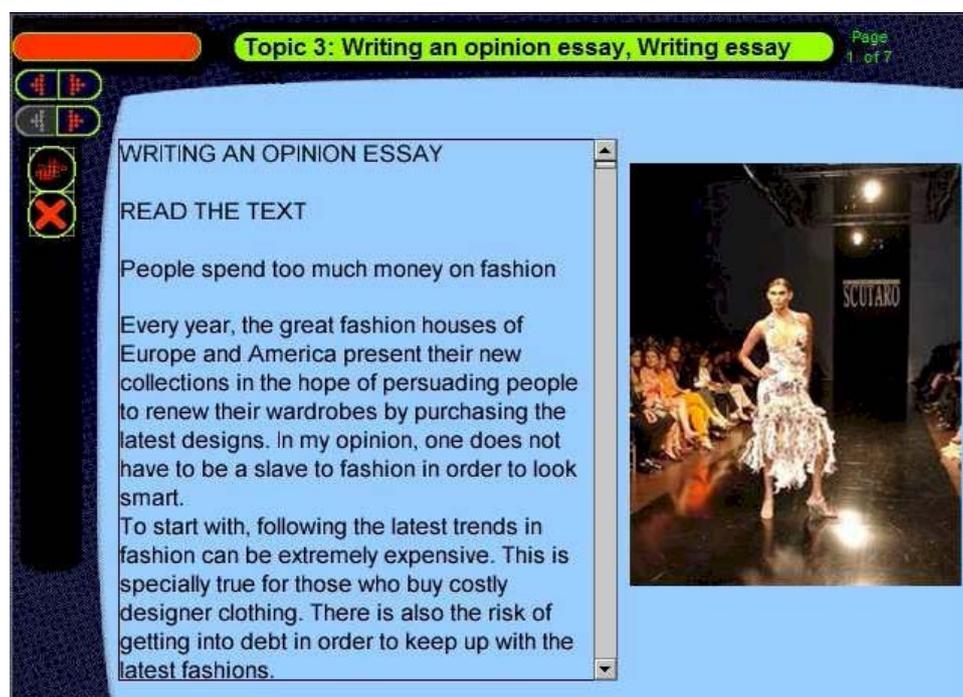


Figure 1: Argumentation – This figure shows the first paragraphs of an opinion essay. The text is shown as a model for recognition of the rhetoric structure of this text-type (different stages, transition devices, logical development of ideas), as well as proper use of vocabulary and syntax required for successful academic writing.

<sup>5</sup> Second Language is defined as the one learned after the first language or mother tongue (L2).

Next Page **Topic 2: Telling a Story, Narrative (b)** Page 4 of 18

Telling a story (narrative) (b). Pre-writing stage. I. Consciousness raising activities.  
Have a look at the pictures and number them (drag the pictures) in the order you consider the events take place in the story:

1 2

3 4

[Click here to read the story and check whether the sequence is correct](#)

Figure 2: Narrative – This activity in the program is presented after students read a short recount. It is intended to raise students’ awareness about the different stages of the narrative ordering the events in the story through a “dragging” operation.

Next Page **Topic 1: Describing People, Lexico-grammatical(c)** Page 7 of 14

**Lexico-grammatical features (c)**  
Match the adjectives to their justifications. Drag the flags.

-generous		always buys family presents
-talkative		doesn't like working
-energetic		always tells people what to do
-intelligent		wears smart clothes
-bossy		isn't polite to other people
-rude		does well at school
-impatient		is very active
-popular		cares only about him/herself
-cheerful		never stops chatting
-lazy		hates waiting for anything
-well-dressed		always smiles
-selfish		is liked by everyone

Then, you may use your answers to write about your friends and/or relatives.  
E.g.: My sister is a generous person who always buys her family presents.

Figure 3: Descriptions – This activity appears in the program after a descriptive model text is read and it aims at evaluating students’ recognition and production of the lexico-grammatical features commonly present in people’s descriptions. After completing this matching exercise, readers are expected to use these vocabulary items in their own written productions.

One of the aims of the proposed interactive CD is to apply computer technology as a tool to increase student's motivation and to improve their writing skills. Regarding L2 writing instruction, exposing students to a wide variety of "text types" will make them aware of the co-occurrence of similar linguistic patterns in those texts (Paltridge, 1996). In the EFL<sup>6</sup> class students should be given the opportunity to develop their reading/writing skills through systematic practice by using multimedia technology. The interactive programme, *Enhancing the Reading-Writing Connection*, has been developed to enable students - through consciousness raising activities in the reading phase - to attend features of the input texts which they will later have to use in the writing phase.

This interactive CD consists of three units which present, as genre categories, texts labelled as descriptions, narratives and arguments (Martin, 1989 in Paltridge, 1996). These texts are used as models for the analysis of the rhetorical organization and lexico-grammatical features of each text type. Tasks in the three units of the programme promote the development of strategies that emphasise the reading-writing connection, leading students to produce their own individual texts. The students' written productions will then be typed in a word processor and sent via e-mail to the teacher for feedback.

As regards the interactivity of the programme, students can start by selecting one of the three units in the menu. The user can move along the programme as if "touring around it" and he will only be able to advance after having completed every exercise in each of the units; once this is done, the user can go back to the menu and start working with another unit. The programme offers feedback by allowing only two instances of error in every task. By clicking on a button which leads to a specific hyperlink, learners can go back to sample texts, grammar charts and references, whenever they need further information. The activities in this interactive CD include *multiple choice*, *drag and drop* and *matching* exercises. At the end of each unit the learner completes another set of free production tasks which will be typed in the programme itself and then e-mailed to the instructor.

This programme has already been piloted with a group of university students who manifested they felt satisfied with the layout, the array of colours, illustrations and emoticons displayed in it. They also made positive comments regarding the distribution of the information, task design, the clarity and precision of the prompts, the suitability of content and task gradation. Finally, they considered the programme as a useful tool for self-access practice.

It is undoubtedly true that at the turn of the 21st century we are in the centre of a very important technological-educational paradigm shift, one which has changed the way language instructors teach and the way students learn. Even though it is believed that technology should not take over the language classroom, it must be embraced so as to allow learners to cope with the necessary skills that would facilitate their academic development in the foreign language.

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## Learning Objects for Adaptive and Personalized Lifelong Education

Nowadays, environments for the professional development demand the academic formation processes, to extend the range of abilities in knowledge acquisition focused to understand more deeply “the making” and in the same way, to generate competences of social content associated to the communication, dialogue and negotiation proficiency, assertive thinking and easiness to approach and solve problems.

To fulfill these demands, the educative methodologies for the existent traditional education systems (that distribute the just-in-case knowledge) which support face-to-face or distance education programs are not enough. In consequence, institutional policies have become necessary to allow the reorganization of the academic curricula introducing the new role of teachers (reinvented as providers of learning opportunities) and students; in learning environments oriented to the student empowerment, the enhancement of his/her capacity and responsibility to express his/her difference, the enhancement of team work, the mutual help, the learning by doing, etc.

Currently, applied research based on postulates and prototypes created some years ago through formative research processes<sup>7</sup> is been carried out by UIS<sup>8</sup> experts, aiming at consolidate existent learning experiences using ICT, to enhance the teaching and learning processes, to promote didactic innovation and to add value to research initiatives, technological transfer and the university with the society convergence.

Enrolling educators today to integrate technology and learning is one of the ProSPETIC<sup>9</sup> challenges to reinforce its postulates. The UIS educators are working hard in this direction at different levels. Beginners are called to participate in training experiences with technology by creating and updating his/her own website using institutional web templates to build it. The structure of these templates allows teachers to organize online the diary, and teaching contents that support his/her courses. In this phase teachers acquire abilities to manage web-based tools, media formats, techniques to respect author copyrights and basic strategies for online and collaborative learning.

Advanced teachers are working together in transforming the traditional course curricula to a more innovative one that considers competence formation. This process is carried out using the functional analysis model (designed to develop labor competence) adapted to support academic program requirements. The Bloom cognitive domain taxonomy and the Felder learning style model premises are combined to allow in the curricular planning, the definition of instructional strategies and media needs that should guide the design and digital content production (Learning Objects – LO) focused to achieve meaningful and personalized learning in this emerging educational paradigm.

At the UIS context, lifelong learning necessities for all are identified to design and produce those digital contents to be exploited in adaptive virtual environments. The use of educational modeling languages and instructional engineering methodologies helped us to decide the LO articulation to ease the knowledge management and to promote active and personalized

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<sup>7</sup>C.I. Peña, Intelligent agents to improve adaptivity in a web-based learning environment, PhD thesis in Information Technologies, Universitat de Girona, Spain, 2004.

<sup>8</sup> UIS: Universidad Industrial de Santander, Bucaramanga, Colombia

<sup>9</sup> ProSPETIC: project to support in the UIS the education process using ICT

learning. Furthermore, the e-learning standards play an important role to guide the tools and LO design in levels concerning the technology to use, the implementation policies, the compatible formats and access devices used to allow the learning at any place, anytime, anywhere and any pace. That is why the SCORM specification was chosen to build the core of the e-escen@ri<sup>10</sup> architecture, composed basically by contents, students and interoperability elements. The following list explains details of these elements.

- *Contents* are considered immersed in a domain model (resources and didactic materials in different media, designed to match different learning styles) and a pedagogic model (logical structuring of the formation activities according to the curricular planning specification). This content design is based on strategies to: learn how to learn; build learning; establish relationships among knowledge; make easy the random and configured assessment and control the learning process; learn how to analyze and apply knowledge; and, recruit and motivate the student. For their production, multimedia principles are applied to help establishing a perceptive and open pedagogic frame and to guide the didactic innovation possibility given by the technological and cultural advances (to avoid using the same speech for all).

Figure 1 shows an example of the e-escen@ri template used to offer contents following directions of Felder’s learning style model and Bloom’s cognitive theory. Buttons of the right hand side allow the presentation of the same contents using different perspectives (verbal formats as pdf texts or audio tips; visual formats as video clips, graphics or schemas; interactive formats as simulation software or animations, etc.). In this case, the teaching unit and its contents are derived from the curricular planning structure created by means of conceptual maps.



Figure 1: A set of learning objects articulated in a template of the e-escen@ri Learning Management System

<sup>10</sup> e-escen@ri: electronic scenario for online learning and research. This is the UIS Learning Management System.

- *Student information* matches the student preferences, abilities and skills “captured” in the context of a student's model (interaction registrations, competences, subjective likes, learning styles, etc.). This model behavior defines the adaptive level of the virtual learning environment.
- *Interoperability* is concerned the Learning Management System (LMS) components involved in the integration of learning objects (protocols, architectures, user's interfaces, etc.) and the interconnection for their access with multiple LMSs. The construction of the IMSmanifest.xml (the gateway file used to define attributes for the resource integration) defined in the SCORM specification, is key to guarantee this interoperability. Likewise, if a user-friendly interface exists to help teachers or content authors to give sense in an intuitive way to the articulation of the domain and pedagogic model, this process will be widely accepted and will make easier the use of the technology in education. Figure 2 shows the e-escen@ri learning desktop assisted by a user-friendly intelligent agent (a recommender agent).



Figure 2: A learning session assisted by a recommender agent

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# Evaluation of Learning Management Systems for Learning Objects

**Abstract:** The paper specifies the criteria for evaluating LMSs and draws a comparative chart of popular Open Source Software available for LMS.

## Introduction

Learning objects can be combined to make up modules, courses and individual learning experiences [1] [2].

Downes [3] notes that a learning object “can only be determined by its use, not by its nature”. LMSs are known to be very useful in the delivery and engagement phase of learning objects [8]. They present a range of tools and technologies to facilitate collaboration, co-operation, feedback, practice, application, communities of practice, tracking, resource sharing, accessing, downloading, etc. [4][5]

## Methodology of Research

To select and evaluate the right OSS LMS, we designed a questionnaire to collect information on existing literature [6] and some initial benchmarks for the level of adoption. Questions include:

- What types of organizations are using LMS products?
- Where LMS users are geographically located?
- What vertical industries have the largest number of LMS users?
- Which systems are LMS vendors against most often?
- Average size, staffing of LMS vendor organizations?
- Total number of LMS implementations?
- Total number of registered e-learners
- Largest hosted implementations
- Largest locally installed, behind-the-firewall implementations
- Amount of money spent on LMS R&D (by vendor)
- Servers/databases most typically supported
- Most frequent ERP , other back-office integrations
- Depth of ERP integration in typical LMS implementations
- Third-party content most often interoperable with LMS solutions
- Authoring tools , LCMS ,CMS and Virtual classroom/live e-learning that are most often interoperable with LMS solutions

- Common LMS functionalities
  - Classroom management
  - Competency and performance management
  - Built-in content development and management tools
  - Average number of report templates
  - Analytics (calculate ROI for training)
  - Multiple domain support
  - AICC certified/compliant
  - SCORM certified/conformant
  - Built-in collaboration tools
  - Languages supported
  - Hosted vs. locally installed solutions
  - Built-in e-commerce
  
- Average implementation time for an LMS

## **Conclusion**

Our review indicates (as shown in Tab. 1) that Moodle, Manhattan Virtual Classroom, and ATutor are preferred if there is support to set up and run platforms on a remote server. dotLRN is also very usable, but it is very complex as well. Moodle is the most suitable choice since it is stable, reliable, accessible, flexible, easy to navigate and locate components. It is also quick to upload files and assignments, provides contextual help, learner control, and supports easy course development, importing and updating content, exporting reports, grades, etc. Research also revealed that over 66% of Moodle users are teachers, on-line learning researchers, educational administrators. One strength of Moodle is the strong community support as developers/users participate in Moodle's active discussion forums, sharing tips, posting code snippets, helping new users, and sharing resources. Moodle's low cost, flexibility and ease of use helps bring LMS technology to those with limited technical and financial resources. Moodle is a fine example of how and why OSS works. Moodle cannot work by itself so teaching staff must be given the responsibility for producing content, so that Moodle is not an empty shell like a good car without driver.

Table 1. Evaluation results

Platform Name	Site runs on public server	Overall Appearance	Menu Appearance	Ease of Use	Displays picture of student/teacher with message	Can upload files	Polling?	Discussion Forums?	Live chat?	Multiple languages?	Calendar?
<b>Yahoo! Groups</b>	Yes	A bit busy,	Good, clear categories	Fine, when registered and kinks handled	No	Yes	Yes	No	Yes	No	Yes
<b>BSCW</b>	Public server OR own server	Uncluttered, no ads	Clear	Easy to use	No	Yes	No	Yes	No	Yes	Yes
<b>Fle3</b>	No	Very basic	A bit confusing	Messages can be displayed by thread, by author, etc <sup>1</sup>	Yes!	Yes	No	Yes	No	Yes	No
<b>The Manhattan Virtual Classroom</b>	No	Fine	Excellent	Quite easy to navigate;	No	Yes	Probably	Yes	Yes	Yes	Yes
<b>ATutor</b>	No	Very sleek, easily modified by individual user	Somewhat similar to Blackboard	Preferable for students with computer knowledge	No	Yes	No, but test function could be adapted	Yes	Yes	In the near future	No
<b>dotLRN</b>	No	Look & functionality like Yahoo! Groups	Very sleek	Easy to use, navigation is very logical	No	Yes	Yes simple and advanced	Yes	Yes	No	Yes
<b>Moodle</b>	No, but site can be hosted for a small price	Themes/skins allow for easy font/color/layout, etc. to suit local needs	Excellent!	Fantastic!	Yes	Yes	Yes	Yes	Yes	Yes, plus easy navigation between languages	Yes

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