EDITORIALE

Questo numero della rivista è dedicato a un tema specifico, vale a dire alle interazioni tra due campi di ricerca molto vasti: l'e-Learning e Knowledge Management (KM).

Cosa si intenda per e-Learning è per i lettori di questa rivista un concetto comune o almeno lo dovrebbe essere con qualche inevitabile sfumatura interpretativa. Meno chiaro è probabilmente cosa si intenda per KM, sicché credo sia utile dare qui per i lettori meno informati alcuni cenni introduttivi che possano favorire la lettura dei lavori di questo numero.

Il punto di partenza è la constatazione che la conoscenza costituisce una risorsa per qualunque organizzazione sociale e che anzi nelle imprese essa sia il fattore competitivo per eccellenza. Questa constatazione non è poi così moderna, l'idea che il sapere costituisca una forma di potere è da molto tempo connaturata nella nostra visione del mondo, ma recentemente alcune cose sono drasticamente cambiate nella economia e questi mutamenti hanno reso maggiormente evidente questo legame.

Gli autori che enfatizzano questi aspetti di mutamento parlano di processi di smaterializzazione della economia, dell'impresa e del lavoro e mostrano come nel corso del tempo da una economia basata sulle risorse «tangibili» (terra, macchine, lavoro, materie prime) si sia passati a una economia basata su risorse «intangibili» (informazioni, esperienza, conoscenza e in genere sapere). A conforto di questa tesi si portano importanti indici statistici come la variazione della percentuale di occupati nell'agricoltura, nell'industria e nei servizi del secolo scorso che ha visto progressivamente crescere la forza lavoro impiegata nei processi dell'economia immateriale e ad alto contenuto di conoscenza a scapito delle altre due componenti. Questo fa dire a questi studiosi che il vero patrimonio delle imprese è costituito dal loro capitale intellettuale, ovvero dall'insieme delle conoscenze possedute da un'impresa.

Questo cambiamento di prospettiva apre non pochi problemi intellettuali, alcuni addirittura paradossali. Il primo di questi problemi è la natura della risorsa conoscenza e di chi la possiede. Si riconosce comunemente che essa sia un bene intangibile individuale derivante da processi dinamici di interpretazione di fatti del mondo reale (interpretazione dei dati) ottenuti attraverso complessi processi sociali di mediazione e rielaborazione. Si riconosce altresì che la conoscenza compaia nei sistemi organizzati in forme diverse, ad esempio possa essere tacita (maggiormente soggettiva e difficilmente codificabile) o esplicita (più oggettiva e maggiormente codificabile).

La possibilità di codificare la conoscenza secondo modelli formalizzabili o almeno parzialmente formalizzabili assume quindi un significato cruciale in questi studi. Infatti affinché la conoscenza possa essere elaborata come una risorsa, essa deve essere esplicitata e successivamente codificata secondo un modello formale A questo stadio la conoscenza è trattabile con strumenti elettronici e quindi può essere usata come una risorsa per i processi operativi di un'organizzazione.

Il KM si configura come una galassia di studi e di processi reali che hanno tutti un obiettivo comune, ovvero intervenire nel processo che porta dalla creazione della conoscenza alla sua esplicitazione e quindi alla sua formalizzazione e attraverso questo passaggio finale a un uso della conoscenza posseduta come una risorsa. Detto ciò risultano immediatamente evidenti i legami tra l'universo degli studi sull'apprendimento e sui sistemi istituzionali della formazione e il KM. Infatti a un macrolivello il sistema di formazione e ricerca di un intero paese può essere visto come lo strumento o uno degli strumenti istituzionali del KM di quel paese. A esso è assegnata la funzione di creare, codificare e diffondere la conoscenza posseduta da una società in modo tacito ed esplicito alle nuove generazioni della stessa. Non solo, ma la tradizione dei sistemi educativi (ovvero la conoscenza tacita ed esplicita dei fatti del mondo e dei metodi migliori per favorirne l'apprendimento) è una conoscenza strategica per ogni progetto di KM.

I modelli teorici di riferimento nel settore del KM comprendono esplicitamente il Learning come componente fondamentale del processo. A titolo di esempio si può prendere in considerazione il modello proposto da Ikujiro Nonaka e Hirotaka Takeuchi nel 1995 che vede il processo di creazione e di diffusione della conoscenza come un modello dinamico che si sviluppa come una spirale. Il modello prevede quattro fasi fondamentali che si ripetono espandendosi a ogni ciclo. Il primo di questi momenti è quello che gli autori definiscono *socializzazione* ovvero una fase in cui gli attori del processo condividono conoscenza tacita lavorando insieme. La successiva è definita *esteriorizzazione* si tratta cioè di trasformare la conoscenza tacita scambiata durante i processi di socializzazione in conoscenza esplicita. La terza fase è quella della *combinazione:* la conoscenza esplicitata viene combinata con conoscenze preesistenti per dar vita a nuove «reificazioni». Infine segue una fase di *interiorizzazione* ovvero una fase in cui la conoscenza «reificata» diviene parte integrante del patrimonio di conoscenza delle persone, dei gruppi delle organizzazioni e della società nel suo complesso. Come si può osservare tutte queste fasi sono di fatto momenti di apprendimento di diversa natura.

In questo numero sono raccolti un certo numero di contributi di studiosi italiani e stranieri che lavorano nella prospettiva di integrare i due campi di studio. Molti di questi lavori affrontano il problema del KM da un punto di vista tecnologico e solo alcuni hanno un respiro più generale. Come curatore della raccolta non posso che assumermi la responsabilità di questa scelta probabilmente ideologica. A parziale giustificazione posso addurre la mia convinzione che la ricerca tecnologica cerca soluzioni a problemi che per la loro natura e per la loro complessità non potrebbero semplicemente essere affrontati senza la tecnologia stessa.

Per rendere esplicito il filo che lega i lavori presentati in questo numero userò il modello di Nonaka & Takeuchi, già richiamato, ordinando i lavori come nella loro spirale di quattro fasi. Ovviamente i singoli autori potrebbero non condividere la mia categorizzazione del loro lavoro e avrebbero le loro buone ragioni. Infatti molti lavori affrontano aspetti che si collocano a cavallo di due o più fasi della spirale descritta nel modello. Di questa scelta interpretativa quindi mi scuso con gli autori e contemporaneamente ne assumo la responsabilità con i lettori.

Il lavoro di Macchi, Scotti, Paggetti, Palm e Ilie-Zudor «eSCM: a web-based institute for sharing knowledge and competencies in the educational area of supply-chain management» presenta una infrastruttura tecnologica finalizzata a trasformare in conoscenza tacita (quella acquisita nelle attività supply-chain management) in conoscenza esplicita. L'attenzione del lavoro è focalizzata sul passaggio dalla fase di *socializzazione* a quella di *esteriorizzazione.*

La fase di *esteriorizzazione* e quella di *combinazione* sono quelle rappresentate dal maggior numero di contributi. Come abbiamo già detto è il processo di codificazione della conoscenza esplicita che la rende trattabile attraverso strumenti di elaborazione. Il processo di codifica della conoscenza è un processo sociale che vede gli attori usare strumenti di codifica differenti per scopi diversi. Il lavoro di Di Iorio, Feliziani, Mirri, Salomoni e Vitali «Continuously updated e-learning material through easy authoring processes» mette in risalto come i problemi e le soluzioni alla questione di tradurre tra loro codici differenti siano alla base di ogni processo di *esteriorizzazione* e come dalla bontà di questo processo dipendano le possibilità di usare le rappresentazioni della conoscenza per i processi successivi di *combinazione*.

Tutta la tematica sulla creazione, diffusione e utilizzo dei Learning objects rientra a pieno titolo non solo nell'e-learning ma anche a maggior ragione nel KM, essendo di fatto i learning objects una forma di codifica di conoscenze esplicite operata a fini didattici. Il lavoro di Paolo e Stefano Lariccia e di Toffoli «Educommons.eu. Piattaforme di scambio per i Learning Object e implementazione di un repository sul modello OpenCour» è un buon esempio di come i due temi si intreccino.

Con il lavoro di Ardimento, Cimitile eVisaggio «Knowledge Management Integrated with e-learning in Open Innovation» siamo al confine tra la fase di *esteriorizzazione* e la successiva di *combinazione.* La conoscenza rappresentata in forme digitali crea le possibilità di un uso sistemico della stessa come ausilio all'intero processo di KM in cui l'e-Learning diviene un elemento centrale. La conoscenza trasformata in «reificazioni elaborabili» e diffusa attraverso strumenti di comunicazione elettronica genera nuovi scenari. In questi scenari i sistemi software cercano di migliorare il processo di *combinazione* della conoscenza. Diviene quindi rilevante misurarne le performance a parità di funzioni come nel lavoro di Maresca, Santiano, Fadini e Prinetto «Validation criteria for a GQM plan in e-learning platforms evaluation» che affronta il problema di come valutare differenti piattaforme di e-learning applicando i modelli ben sperimentati della ingegneria del software.

L'uso di sistemi software genera anche informazione che può essere utilizzata per migliorare le performance dei sistemi stessi come nel lavoro di Carbonaro e Ferrini «Managing concepts to improve e-Learning systems» che affronta la questione di come utilizzare informazioni derivate dall'uso di un Learning Management System da parte di studenti universitari impegnati nelle normali attività di studio. L'idea contenuta nell'articolo è quella di catturare informazioni sulle attività degli utenti e di utilizzarle per consigliare loro letture utili. Questo obiettivo è perseguito combinando sistemi automatici di retrieval e strumenti di cooperazione assistita da computer per dar vita a un sistema adattivo. Un approccio adattivo è anche contenuto nel lavoro di Maresca, Chang e Pesce «Application of Active Index to the Management of E-learning Activities» ma in questo caso l'adattività del sistema è perseguita utilizzando un approccio da *distributed intelligence systems* basato sulla tecnologia delle *index cell.*

L'uso di tecniche di retrieval ritorna anche nel lavoro di Hage e Aïmeur «Using Information Retrieval to Detect Conflicting Questions» applicato questa volta alle tematiche della valutazione. Nello stesso campo di applicazione compare ancora il tema della adattività, nel lavoro di Giouroglou e Economides «Adaptive Item Language Assessment Based on Students' Cognitive Abilities».

L'ingresso delle tecnologie nei nostri processi di conoscenza sta generando un universo culturale completamente nuovo e per certi versi imprevisto. Esso non rispetta i confini geografici; non rispetta le tradizionali suddivisioni tra cultura umanistica e scientifica; non rispetta le suddivisioni tra i media (gli elaboratori possono integrarli tra loro in modo originale); e infine trasforma il concetto di «fantastico» traducendolo in quello di «virtuale», e così facendo cambia il nostro senso del reale. La conoscenza mediata dalla tecnologia può essere ora *interiorizzata,* cioè pronta a dar vita a un nuovo braccio della spirale. Cosicché se per un attimo ci soffermiamo a speculare su che cosa possa consistere in futuro il produrre cultura o svolgere un'attività intellettuale; ci accorgiamo che tutte le nostre idee implicano già l'esistenza e l'utilizzo di un'estesa rete di sistemi computerizzati e di attività svolte attraverso di essi. Su questo universo e sulle sue conseguenze pone l'attenzione il lavoro di Sorrentino «E-knowledge e oltre» dove si fa osservare che probabilmente ormai è inutile la distinzione tra *knowledge* e *E-knowledge.*

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Continuously updated e-learning material through easy authoring processes

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Abstract

The *«Anywhere, Anytime, Anyway»* slogan is frequently associated to e-learning with the aim to emphasize the wide access offered by on-line education to students. Our aim is to extend the reach of this sentence to content authors as well. Our idea is to produce tools to simplify drastically the task of creating, updating and publishing content for e-learning courses, and to allow them to produce learning objects of extremely high technical sophistication directly from off-the-shelf desktop application. Thus we introduce ISA-BeL, a conversion engine that can generate standard-based, visually homogeneous, accessible and graphically sophisticated SCORM learning objects by analyzing the internal structure and content of word processing files and generating the required output without requiring particular technical awareness by the user.

1. Introduction

The generation of high quality learning material is incredibly expensive: the thoroughness of the actual content must be accompanied by thought-provoking prose, stimulating rhythm, eye-catching video and animations, enriching interactive exercises and games, and stylish yet classy presentation and graphics. Of course a largish team of devoted professionals with good management, sophisticated state-of-the-art tools, plenty of time, and lavish means can provide educational material of excellent quality, built to impress, educate and entertain generation after generation of students.

Unfortunately, we e-learning course planners and builders are not always able to afford such project logistics and expenses. Depending on the kind of money available, we end up renouncing to professional directors, animators, writers, programmers, project managers, graphic designers, and rely on low-cost substitutes in their stead, such as students, colleagues, ourselves, playing all these different roles to the best of their and our abilities, whatever they are.

At the same time, the stakes keep getting higher. Not only we have to prepare fascinating courses of high educational standards, but new and sophisticated and required expertise must be gained just to keep up with regulations, expectations, technical evolutions. Consider, for instance, the impact of these two recent and relevant requirements on the difficulty of course authors' jobs:

1. *Accessibility*: producing fully barrier-free learning contents is one of the key issues to meet the goal of an inclusive «knowledge society».
2. *Portability*: conformance to e-learning standards enhances contents portability and is recognized as one of the fundamental aspects to preserve contents value over time.

Existing authoring tools, because of several different reasons, still fall short in providing an environment that is both capable of dealing with all the appropriate technical aspects and, at the same time, as easy to use as can be expected to be understood and mastered by an eager but non-professional computer user.

How should the ideal authoring tool be, in order to fully assist educators in creating accessible content for modern Learning Management Systems? What kind of support could we build for users that do not really want to deal with all the technical details of current e-learning technologies? We have identified at least seven dimensions:

1. *Ease of use*: the tool should be at least as easy to use as existing word processors and presentation tools, so as to lower its learning curve.
2. *Ease of re-use*: the tool should help and assist authors in reusing and converting to the new e-learning platforms existing documents and material they have already prepared in past times by using standard desktop tools.

3. *Ease of editing and updating*: the tools should aid in the continuous modification, improvement, and enriching of course material, and help in providing a fast and direct route to publication of updated material.
4. *Standards support*: the tool should generate learning objects that can be read by a large variety of commercial and open source e-learning platforms, being them produced according to some major e-learning standards.
5. *Visual Homogeneity*: the tool should produce content that easily undergoes platform- and site-specific styles and look&feel, by fully and easily adapting any content to the templating and styling locally mechanism adopted.
6. *Universality*: the tool should generate content which can be fully and at best quality displayed on a wide variety of applications, including non-dominant versions of browsers and operating systems, older versions of browsers and operating systems, new and emerging hardware devices.
7. *Accessibility:* the tool should create fully accessible content according to international standards and national laws.

In this paper we concentrate on the issues connected to ease of re-use and ease of editing and updating of existing e-learning content. In particular, we discuss the all-too-frequent situation of a course author that would like to bring in the course the content of existing WP files and presentation, and do so in an iterative way: converting, testing, changing, re-converting, re-testing, re-changing and so on.

When this is done by a team of devoted professionals with state-of-the-art technical tools, plenty of time and lavish means, one can expect negligible costs and excellent and breath-taking results at the end of the very first iteration. But when constraints exist on means and time, a more likely process is the conversion of existing material as the first step of many where the content is edited, massaged, cut, proof-read, readied, published, tested (possibly even by actual students), and then edited again, re-massaged, re-cut, etc.

Clearly in such processes the ease of use of an authoring platform is of paramount importance. Widespread authoring applications provide editing interfaces on the final output of the publication, the learning object. This creates a thorough fracture between accessing and using the original content in the original format (before the conversion) and the updated content in the authoring platform (after the conversion), and makes the conversion a pivotal event in the workflow, the event after which, for obvious economic and practical reason, we are forced to use the authoring platform for all subsequent editing and updating.

In this paper we present a methodology and some tools for the creation and management of accessible and universal learning objects (LO) which modifies the authoring relationship with the content conversion. In our approach the authoring environment is an automatic conversion engine that generates high quality, visually homogeneous, standard based and accessible content out of the content of standard desktop applications such as word processors and presentation applications. ISA-BeL, designed and implemented to support automatic production of standard compliant e-learning materials, therefore allows authors to keep on using the original files and modify and update them, without creating a fracture between the original files and the converted ones. This greatly simplifies the tasks related to content re-use and update, and allows the authors to keep on using the original applications and interfaces. The process has been widely used to publish more than 200 learning objects which are currently in use by our University and other institutions for several e-learning activities in a number of subjects, from computer science to business sciences. Accessibility of the whole process and of all the produced LOs have been verified on the field.

The remainder of the paper is organized as follows. Section 2 provides some background information about authoring e-learning content platform. Section 3 introduces the creation and management process in e-learning contexts using ISA-BeL. The final section provides some conclusions and suggestions for future works.

2. Background

2.1 Systems and standards

Systems providing e-learning services can be divided in two main categories: LMSs (*Learning Management Systems*), which are web-based platforms by actually providing content to the users and LCMSs (*Learning Content Management System*), the authoring environments used to create learning objects. The main features of an LCMS are related to the content management, from the production to the storage including reusability and distribution of content. On the other hand an LMS manages the administrative functions, the distribution of contents to learners, and the tracking of the learners' experiences and assessments.

A relevant role is played by existing e-learning standards, in ensuring interoperability and reuse of didactical materials. Main interoperability specifications have been developed by IEEE (Institute of Electrical and Electronics Engineers), with a specific working group, the Learning Technology Standards Committee, which is working on e-learning standardization (IEEE LTSC WG12, 2006) and IMS (Instructional Management System) Global Learning Consortium (IMS Global Learning Consortium, 2006). A relevant role is also played by Advanced Distributed Learning (ADL) initiative (Advanced Distributed Learning, 2006), which has developed a de-facto standard called SCORM (Shareable Content Object Reference Model) (Advanced Distributed Learning, 2004c), based on some specifications previously defined by IEEE-LTSC and IMS.

2.2 Learning Object Production

An interesting field in e-learning research is the simplification and automation of the learning objects production. Several projects and products provide authoring tools (4system, 2006; ReadyGo Inc., 2006; SumTotal Systems Inc., 2006). They give authors different interfaces and functionalities so that they can create e-learning materials, manage resources, add metadata, and so on. In many cases, the use of these new tools cannot be fully appreciated by authors, who may prefer to rely on well-known productivity tools, which could allow them some savings in time and money. Products and platforms are designed by moving onto in this direction and they generate e-learning course materials starting from well-known productivity tools, such as Microsoft Word (Horizon Wimba, 2006; Serco, 2006). The main advantage in exploiting such products is that no learning and training phases are needed. On one hand these tools provide a too rigid structure in drawing up created contents, on the other hand they keep authors' stylistic choices, instead of maintaining only designers' ones, invalidating accessibility and usability principles. One of these products (Horizon Wimba, 2006) provides a partial support to accessibility of created contents, but, in some cases, generated LOs are not compliant to international guidelines and laws, denying actual benefits to learners with disabilities.

Generative Learning Objects (GLOs) (Boyle et al., 2004; Bradley et al., 2004;) follow a different direction. The underlying idea is based on the division into two different parts the LOs creation. The first one consists of building a Learning Object Template (LOT), while the second one is devoted to adding the template a subject specific content. The LOT encloses the deep general structure of the e-learning course. Once a template has been created, authors and/or tutors can add different subject specific contents, i.e. the surface structure, so as to produce Learning Objects which fit the specific fields of the discipline.

A new way to think intermediate data format is promising to have an interesting impact on LO production: Microformats (Microformats.org, 2006). Microformats are a set of simple open data format standard which are developed and implemented for more/better structured web microcontent publishing. In (Downes, 2006) authors propose Microformats use in e-learning, by conceiving it as a network phenomenon, so as to facilitate a personal e-learning centre design.

Other academic works are devoted to produce accessible (according to W3C Web Content Accessibility Guidelines (World Wide Web Consortium, 1999c)) and personalized e-learning content. One of these proposes the design of a prototype which drives authors in creating accessible didactical materials (Gabrielli et al., 2005). The authoring interface of this prototype is developed in Java and its main aim is to support authors' job with suggestions and examples. ELENA (Dolog et al., 2003; Dolog et al., 2004) supports personalized access to distributed learning repositories. The approach to customization employed in this project takes advantage of semantic Web technologies and metadata description standards, such as LOM (IEEE LTSC WG12, 2002) and IMS AccessForAll Meta-data (IMS Global Learning Consortium, 2002a). In addition, it adapts and customizes access, delivery and consuming of learning services and LOs on the basis of rule-based matching of contents and learners descriptions.

3. From content creation to e-learning delivery

3.1 A simplified authoring architecture

The problem of producing usable, accessible and universal content goes beyond the only e-learning context. It is an expression of a long-term discussion: the tension between the authors' expertise and the quality of the final documents. Although an ideal and automatic publishing system should **both** minimize users effort **and** ensure high-quality results, in practice, trade-off solutions need to be taken by designers. We have identified three different editing models:

1. *Pre-structured editing*: users are totally driven during the editing process. Examples are those systems where authors add content by filling forms, by inserting predefined set of data, by using *ad-hoc* editors and so on. High-quality results are simpler to be achieved (since few errors occur) but users are more limited and need to learn new tools.

2. *Un-structured and totally free editing*: on the opposite edge of the spectrum, users are entitled to write content with their preferred tools and schemas, without following any rules. The system is in charge of extracting content and transforming it into high-quality output. The expertise required to the users is very low, their freedom is unconditioned but the overall result depends on the extraction capabilities of the system.

3. *Aided editing*: a softer approach consists of helping authors in writing content and respect some rules, that make conversions simpler and more reliable. Examples are those systems based on detailed guidelines, hints and macros, meant to help and drive authors, without imposing them any forced path. Such a model can be defined as «GIGO» (Good Input, Good Output): the more the input is well-structured (and the system give users precise and fine-grained helps to do that), the more the output will be good and reliable. On the other hand, authors are free to ignore such suggestions, to the (possible but not sure) detriment of the final quality of the documents.

We propose a solution positioned between the *aided editing model* and the *unstructured editing* one: letting authors to use their productivity tools to write documents and automatically extracting, re-flowing and transforming the content.

Such a solution relies on a basic but strong assumption: a limited set of constructs and elements can always gather the actual information (content) of any document regardless of its storage format and formatting. We consider the layout and the storage format as extra layers which can be modified and substituted at any time, without impairing the real information. For instance, a paragraph with style 'title' in MS Word, a fragment <h1>The Poem</h1> in HTML, and the fragment <title>The Poem</title> in XML, or an emphasized paragraph in PDF are all equivalent.

Then, we have designed a very simple language, called IML (Intermediate Markup Language) aiming at capturing only such actual content and structuring it into a set of sub-components (space limits prevent us to go into deeper details on IML, more details in (Di Iorio 2005b)).

On the basis of the simplicity, minimality and power of IML, we propose a flexible architecture based on the *superior standard model*(Diaz 2002): in order to transform a document from format A to format B, this is first transformed into an intermediate format S and, then, into the final one. As expected, the role of intermediate language is played by IML. The following picture summarizes our schema:

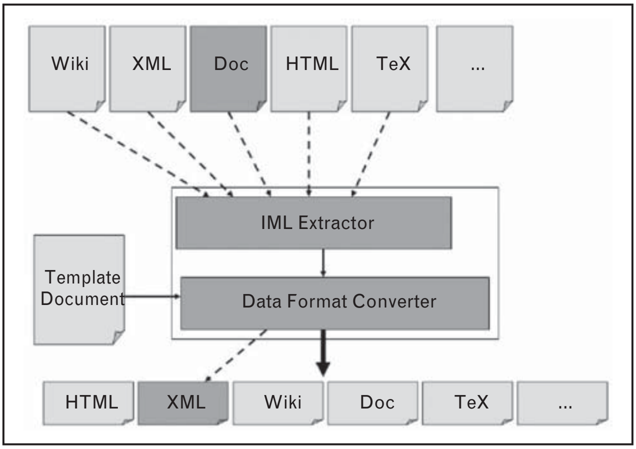

Figure 1 The general conversion schema instantiated by ISA-BeL.

We have implemented different applications based on the same architecture, conversion engine and internal language. ISA (Vitali 2003) is a content management system that simplifies and speeds up the creation of web pages, by letting authors to write content with MS Word. Graphic designers are simply required to draw layouts and associate content with their position, while the system is in charge of merging these two components into the final result. IsaWiki (Di Iorio

2005a) is a complex platform aiming at simplifying and strengthening the editing model of the World Wide Web, by moving it into a writable platform, where all users can write and customize content regardless of their skills, tools and locations.

ISALearning is an authoring system customized for the e-learning context, based on our general schema (in the picture, the IsaLearning workflow has been remarked with a stronger grey). Authors write content, by using Microsoft Word and Power Point, that will be automatically transformed into portable learning objects. Actually IsaLearning is a sub-component of a complex system that produces SCORM objects from an intermediate XML output. We call the whole system ISA-BeL.

3.2 Context: the A^3 Project

Before describing ISA-BeL we need to introduce the context where the system has been developed and used: the A^3 project. Teaching basic computer knowledge is becoming a matter of big interest in a lot of fields, particularly in Universities, where in every degree course is necessary to certify a minimal skill in computer knowledge. For this reason, the Department of Computer Science at the University of Bologna has developed a project (called A^3, Accessible Learning Environment (University of Bologna, 2004), «*Ambiente Accessibile d'Apprendimento*» in Italian language) for the creation and fruition of contents taking in a particular account the training structure uniformity, a low management cost, and a little effort in resources and time consumption for the process startup. Two requirements related to LOs used in A^3 are due to:

- *Accessibility and Web standard compliance*. The project was developed and carried out inside an Italian University and it respects the Italian Law on Information Accessibility, the so called «*Stanca Act*» (Italian Parliament, 2004).
- *Portability of LOs and e-learning standard compliance*. Learning objects produced in A^3 are package SCORM 1.2 RTE compliant (Advanced Distributed Learning, 2004b), so that contents can be imported in every LMS SCORM compliant.

3.3 Semi-automatic production of e-learning content: ISA-BeL

ISA-BeL (Di Iorio et al., 2005) is a chain of tools, which allows users to easily create accessible and portable learning objects. ISA-BeL author writes a document of raw content and he/she indicates the role of each fragment (by using styles according to a set of given guidelines), and the conversion engine transforms each fragment in a proper element of the final learning object. Actually, information about the whole output structure as well as some metadata are required, but inserting such data is really simple and fast, as we will discuss later.

A three step workflow has been defined for ISA-BeL:

1. *Authoring* (*Content creation*), done by teachers using a word processor (or alternatively a different personal productivity tool, such as a presentation application). The output of this phase is a set of documents in common formats like rtf, doc, ppt, sxw, etc.
2. *Producing* (*Content transformation*), i.e. the process creating a LO from a set of documents produced during phase 1. The output of this phase is a LO which has to maintain accessibility features embedded in original documents.
3. *Delivery* (*Content distribution*), the real e-learning service, provided by a LMS which guests the LO which is produced in phase 2. The LMS has to guarantee accessibility of content and service provisioning.

The whole process is depicted in Fig. 1, which also shows the content production step performed by ISA-BeL. The output of ISA-BeL is not a simple set of common HTML pages, but a group of several alternative contents, which are used to enhance portability and accessibility, such as Learning Objects compliant to SCORM-CAM 1.2 or 1.3 (Advanced Distributed Learning, 2004a), web-based materials or printed materials obtained from the original contents by using XSL-FO.

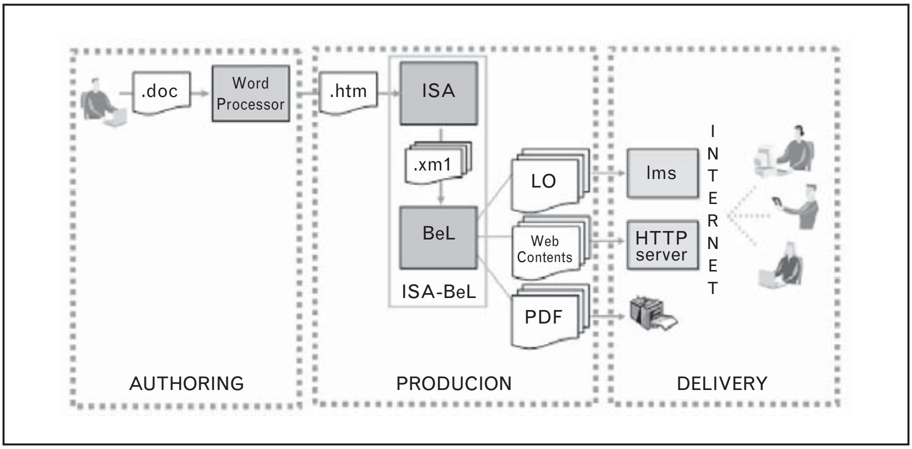

Figure 2 Authoring-management-provision of accessible e-learning by means of ISA-BeL.

3.4 Authoring

The ISA-BeL support for content creation consists of providing users an alternative and simplified way to express all the data and content useful to create learning objects. Focusing on the resources packaging (even if the whole project we are working on currently supports tracking, run-time monitoring and assessments management too), a learning object can be defined as *a set of structured resources* supplied with a *(SCORM) manifest* that describes them.

From this definition, we figured out alternative mechanisms to (i) indicate which pages compose the learning object and which content elements compose each page, (ii) verify these content elements express all the required information and (iii) add metadata associated to the learning object.

An ISA-BeL author, in fact, is assisted by three different tools, specifically designed to cover these three aspects:

- An *authoring toolbar* which offers a fast access to him/her main activities such as defining presentational aspects and structural elements, inserting accessibility related information and so on.

Figure 3 The ISA-BeL authoring toolbar (in MS Word).

- A *verification toolbar* which runs controls over the respect of accessibility and universality constrains. Such a sidebar has been introduced to meet accessibility requirements but it is an optional component.

Figure 4 The verification toolbar.

- A set of forms to collect SCORM Metadata. While some of them can be derived by the system (last-saved date, file size, language, and so on), other information have necessarily to be provided by the authors. The interface has been designed according to the principle of giving users the possibility of completing their tasks without having to learn new technologies and tools.

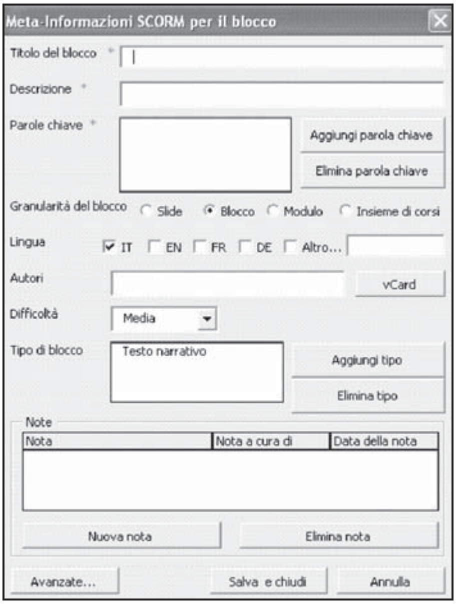

Figure 5 The form for Meta-Data.

3.5 Production

The production process is performed by an *ad-hoc* application, ISA-BeL which is composed of two modules:

- *ISALearning*: a conversion tool which actually transforms document from the word processor format into an intermediate XML representation, enriched by all the necessary metadata. The correct usage of MS Word styles, supported by macros and toolbar provided by the system, ensures and makes simpler the overall transformation process.
- *BeL (Backed e-Learning)*: a stand-alone application which gathers all the information stored in the intermediate XMLs, creates the SCORM structures (in particular the tracking scripts and the manifest file) and merges the content into a single .ZIP file, by processing the output of ISA. BeL also integrates into the LO a (multimedia) recorded accessible video lecture, which is automatically transcoded through a different line of the LO production(Salomoni et al., 2005).

The production process is based on a set of templates and configuration files which are used to define structural aspects as well as layout and graphical aspects of the automatically produced LO.

Figg. 6 and 7 show an example of a Word file produced by an A³ author, transformed into an HTML page and loaded on the e-learning platform.

Figure 6 The page created with MS Word.

Figure 7 The same page rendered by a LMS.

3.6 Delivery

Contents which were produced by the automatic process are loaded on the e-learning platform as SCORM LOs. Our choice has been made between the large number of open-source platforms and after a deep testing period we have adopt

ATutor platform (Adaptive Technology Resource Centre, University of Toronto, 2006). The choice has been driven by the built-in usability support even though it has been necessary modifying the platform to adapt it to the Italian Law on accessibility which is narrower than the Canadian one. Accessibility of the adopted LMS partially guarantees that produced contents maintain accessibility features and ensures accessibility and portability of services (chat, forum, news). Some modifications were needed to completely meet the «Stanca Act» requirements, and particularly the constraint to use Strict (X)HTML code.

The main delivery of A^3 was through the LCMS, but ISA-BeL produces also a printable version and a fully HTML one.

4. Conclusions and future works

The need for simplicity in knowledge creation and sharing has been a basic concern in the international e-learning community. This paper presents a content creation and management process allowing authors to easily produce accessible and portable LO by relying only on personal productivity tools.

ISA-BeL provides support to the content authors with regard to the seven main dimensions listed in Section 1: it allows author to edit contents, reuse existing materials, update source files, and generate sophisticated output. The tool supports the best know conciliation between e-learning standard and accessibility guidelines, so as to guarantee portability through LCMS together with the respect of WCAG (AA level) and of the Italian Law on accessibility.

Our main future work is devoted to extend the functionalities of the system, by offering supports in creating more complex contents to the authors, by ensuring accessibility and universality of the results together with simplicity of usage.

Acknowledgments

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Application of Active Index to the Management of E-learning Activities

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Abstract

An active index consists of a network of index cells. This paper demonstrates the application of active index to the management of e-learning activities in e-learning courses. An e-learning system is a distributed intelligence system where the instructors and students are intelligent human beings. What we want to demonstrate is how to augment human intelligence by an active index. Further research will demonstrate how sensors, mobile communications and search engines can be incorporated into the distributed intelligence system for e-learning.

1. Introduction

There are several key recent advances in information technology that will greatly impact our lives. The first one is *mobile communications*, which enable people to communicate anywhere anytime. The second one is *sensor networks*, which allow people to monitor events anywhere anytime. The third one is *search engines*, which allows people to search for information anywhere anytime. These technological advances together or by themselves provide new opportunities in many application areas. New challenges are also created. One central challenge is *how to bridge the gap between communications and intelligence*. With all these recent advances in communications technologies, can we design more intelligent information systems?

The conventional viewpoint is that in order to design intelligent systems in a distributed computing environment advanced techniques in artificial intelligence is needed to bridge the gap between communications and intelligence. However we want to make the following observation, which can be confirmed in our daily lives in a technology-oriented society: with the advances in sensors and sensor networks, *situated computing* is quickly becoming a reality. For example a car equipped with GPS knows how to behave when it approaches a toll gate. As a consequence of situated computing, hard problems requiring advanced techniques in artificial intelligence can now be substituted by simpler problems, each of which can be solved by distributed intelligence where only a low level of intelligence is provided for each object at each node.

A distributed computing system is therefore also a distributed intelligence system. The key application areas of such distributed intelligence systems include e-learning, tele-medicine, digital library and community network.

In our approach for designing distributed intelligence systems, each object is enhanced by an index cell. Such an object is called a tele-action object. Index cells behave like agents, however there can be numerous index cells. Objects enhanced by index cells can perform actions by themselves. Therefore, intelligence is distributed to these tele-action objects. Objects may also contain multimedia data.

Active index consisting of index cells can best be used in a distributed intelligence system. A lot of distributed knowledge can increase the overall intelligence of an intelligent system. An as example, the infrastructure of a crime-prevention community network can be based upon a distributed computing system equipped with sensors, microbots, GPS and active index. The crime-prevention community network supports the detection of significant events, by creating and maintaining relationships among multimedia objects.

In this paper, we will demonstrate the application of active index to the management of e-learning activities in e-learning courses. An e-learning system is also a distributed intelligence system, where the instructors and students are intelligent human beings. What we want to demonstrate is how to augment human intelligence by an active index. The fundamentals of the index cell will be explained in Section 2. In Section 3 the use of index cells in e-learning. Section 4 offers some concluding remarks.

2. The Distributed Intelligence System's Basic Element: The Index Cell

The following is a short *three-way Index Cell (IC) description* (Chang 1995; 1996; 2006) in order to explain what IC is and what it can do.

Three different point of view of the same subject: the most important is, of course, the mathematical one that is the formal definitions embracing all the possible descriptions. The others two are given to show how wide could be the applications domain related to the use of the Index Cells.

2.1 The Index Cell as a computational model

The Index Cell is a particular Finite State Machine which accepts Input messages, executes operations and sends one or more output messages to one or more IC or to external environment.

The amount and type (or types) of IC depends on the state and Input Messages. It is a Mealy model machine and, according to the problem domain, could be deterministic or non-deterministic, but as theory states, any ND-FSM could be transformed in a deterministic FSM.

2.2 The Index Cell as a Knowledge detector

The Index Cell is an *intelligent agent*, it **perceives** the environment through the messages and executes the **actions** in order to reach the **goals.** The **goals** represents the knowledge acquiring in the environment where the cell acts.

2.3 The Index Cell as a mathematical model

An *index cell* is described by $ic = (X, Y, S, s_o, A, t_{max}, f, g)$ where:

- X is the (possibly infinite) set of input messages including dummy input *d*,
- Y is the (possibly infinite) set of output messages including dummy output *d*,
- S is the (possibly infinite) set of states. S includes a set of ordinary states **S** and a special state s_{dead} called the dead state. If an index cell is in the dead state, it is a dead index cell, Otherwise it is a live index cell. s_o in **S** is the initial state of the index cell *ic*,
- A is the set of action sequences that can be performed by this index cell,
- t_{max} is the maximum time for the cell to remain alive, without receiving any messages. If t_{max} is infinite, the cell is perennial,

- f is a function: 2^X x S -> {0,1} where 2^X is the power set of input X,
- g is a function: 2^X x S -> 2^{ICB} x Y x S x A.

The following figure 1 shows an example of a generic index cell named IC deficiency cell inside a generic IC network composed of other two Index cells IC Proficiency Cell and IC self adjustment cell. it is a particular module 2 counter with a reset functionality.

This Index Cell is analogous to the proficiency cell, the only difference resides in the number of states necessary to realize the counter (3 in the proficiency cell). In this case two single states d_0, the initial state, and d_1 are necessary. Particularly d_1, indicates the access to the document of deficiency from part of a single student. In the state transition $d_0 \rightarrow d_1$, as it happens for the Proficiency Cell, the deficiency cell sends a message of output to the Professor Cell, in order to notify the regression of the virtual class and a message of reset to the Proficiency Cell, to the aim to reset the counter. Differently to Proficiency Cell, this cell sends to the Self-Adjustment Cell the message *easier*, in such way to impose the distribution of one lesson with a smaller level of difficulty.

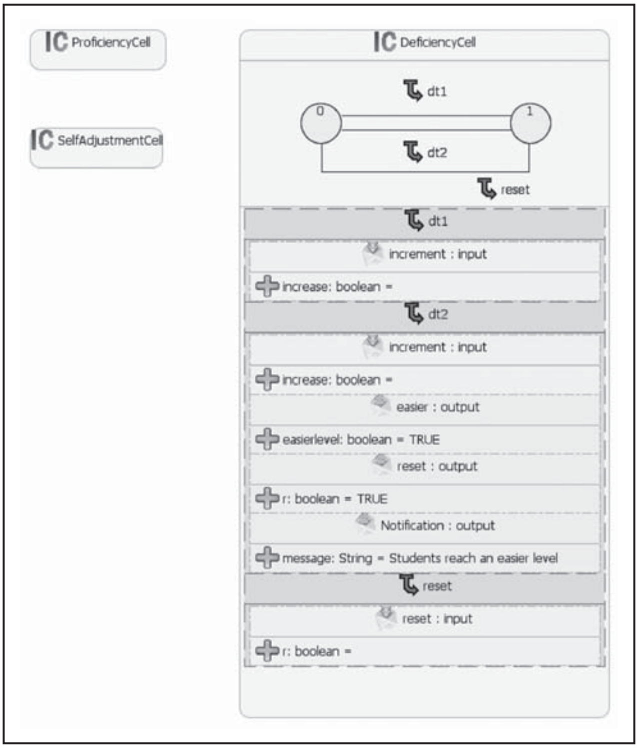

Figure 1 Deficiency Index cell detail insidea generic ICs network.

3. Index cells and e-learning

Index cells could be used in order to manage e-learning activities in e-learning courses (Arndt 2002,2003,2007), (Maresca2003).

An e-learning system is a distributed intelligence system, where the instructors and students are intelligent human beings. Some kind of *intelligent behavior* can be identified and synthesized into index cells. Particularly managing e-learning activities some *intelligent behavior* could be the followings: (i) proficiency, (ii) deficiency. For the sake of the brevity we will discuss only the first two *intelligent behavior*. The proficiency and deficiency definitions will be given in the next paragraph while discussing an example.

Index cells are also useful to express non functional requirements.

3.1 The proficiency-deficiency behavior management example

This chapter is aimed to give a design-oriented solution to the exercise 2 of the CS2310 course (Chang2006a,2006b). The problem can be synthetized as follows.

Let us consider an e-learning adaptive system. Lessons are organized through one hypermedia structure. Such structure remains passive until it does not come visited from the students. Such structure can be rendered active associating the index cells with multimedia documents. The idea is to construct a special document that, if visited from some students, give us notification that they have caught up a sure level of proficiency and therefore the learning materials would have to be modified in order to become more difficult. In the same way, when some students approach to a special document that indicates deficiency, it means that they have found problems and consequently the learning materials would have to be rendered simpler.

The following type of Index Cells have been specified in order to solve the problem:

Proficiency-level index cell (PLIC): This index cell is associated with a specific multimedia document (reachable only from the students well prepared). When it comes primed, the level of proficiency comes increasing of 1. When the level of proficiency has caught up a predefined threshold (as an example 3), the Index Cell will send to the professor a message, that will inform him that a sufficient number of students has caught up this level of proficiency. The *PLIC* will send also messages to some multimedia documents, to the aim of increasing the level of difficulty.

Deficiency-level index cell (DLIC): This index cell (see also figure 1) is associated with a specific multimedia document (reachable only from the students with deficiencies). When it comes primed, the level of deficiency comes increasing of 1. When the level of deficiency has caught up a predefined threshold (as an example 2), the Index Cell will send to the professor a message, than will inform him that a sufficient number of students has caught up this level of deficiency. The *DLIC* will send also messages to some multimedia documents, to the aim to reduce the level of difficulty.

Self-adjustment index cell (SAIC): This Index Cell is associated to multimedia documents containing e-learning material. When it receives the message *harder*, it increases the difficulty of the learning material. In the same way, when *SAIC* receives the message *easier*, it reduces the difficulty of the learning material to the aim to render them simpler.

The istances of Index Cells are associated to multimedia documents.

The example is composed of one multimedia lesson (fig.4) containing 5 various levels of difficulty. The system distributes a more difficult lesson when three students approaches to a multimedia document named *Proficiency Document*. The system distributes a simpler lesson when two students approaches a special document named *Deficiency Document*.

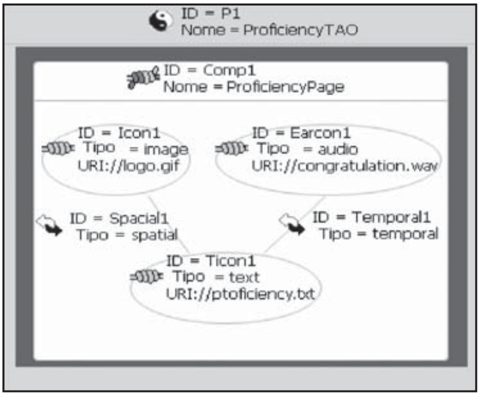

Figure 2 Proficiency TAO.

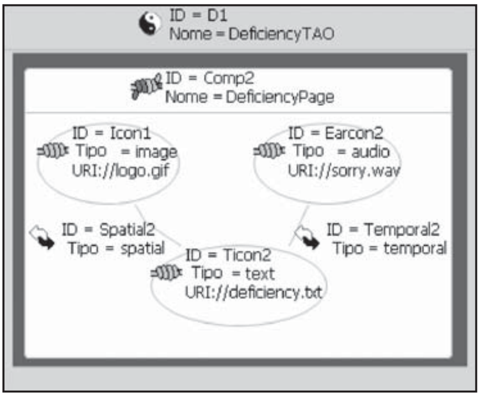

Figure 3 Deficiency TAO.

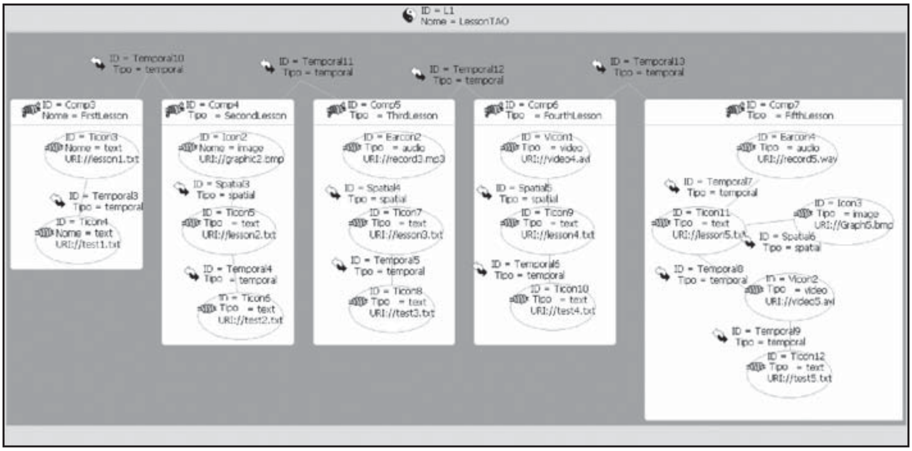

Figure 4 TAO Multimedia Lesson.

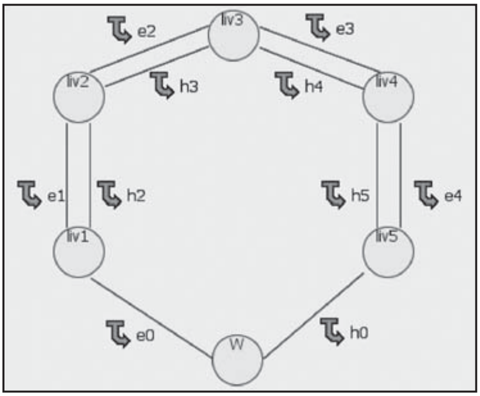

Figure 5 Self-Adjustment Index Cell.

In these hypotheses, the hypermedia structure of the e-learning application is composed of:

(i) *Proficiency Document*: it is a special document (see fig.2), which can approach only the students who have exceeded the annexed verifications to the multimedia lessons with profit. The document communicates to the student its result.

(ii) *Deficiency Document*: it is a special document (see fig. 3), which can approach only the students who have not exceeded the annexed verifications to the lessons with a sufficient result. The document communicates to the student its result.

(iii) *Multimedia Lesson*: it is complex a multimedia document (see fig.4) , containing the e-learning material. It is divided into five lessons on the same argument with increasing difficulty.

Only a lesson at once must be accessible depending on the proficiency of the virtual class.

All these three documents are expressed in terms of TAO (Chang1995b, Guercio 1998,2002).

As example the TAO hyper-graph of fig. 2 is composed of a macronode, to the whose inside is defined a *Ticon*, containing a text of congratulations that is shown to the customer, one *Icon*, containing logo of the department and one *Earcon* content an audio message of congratulations. The *Earcon* is tied to the *Ticon* with a temporal link, in order to synchronize the audio execution with the reading of the text. The *Icon* is connected to the *Ticon* using a spatial link that defines the mutual position of the two generalized icons.

The described objects, represent the hypermedia structure of e-learning application. They do not constitute a multimedia system, because it lacks the mechanisms that regulate dynamics of the application. In other words the hypermedia structure need to react to the user input so it is necessary that the static structure of the system will be associated to a knowledge structure. In fig. 6 the knowledge network associated to the described multimedia object is showed.

The IC Level1-Level5 represent the knowledge structure associated to multimedia documents representing the lessons. Their task are to send an output increment message, with the parameter increase: boolean=TRUE, to the IC Proficiency, if the student has obtained a positive result from the test. The IC Proficiency will send a message to the IC Deficiency (Boolean=FALSE), if the Student has obtained insufficient score. The IC Professor, receives the notification messages sent from both the IC Proficiency (ICP) and IC Deficiency (ICD). The ICP and ICD have the tasks to notify the Teacher that the level of difficulty of the distributed multimedia lesson is, respectively, increased or diminished; and it receives messages of *Easier Lesson* or *Harder Lesson* from the Self-Adjustment IC (fig. 5), when the contents distributed are, respectively, too much difficult or too much simple. Both static structure and knowledge structure are mapped together into an xml (Young 2000) file produced by a Multimedia Knowledge Environment for Index Cell (*MKE*^{2} 4*IC*) (Scarfogliero, Sorrentino 2006).

4. Conclusion

Working on projects, it is easy to understand how fluent can be the work using IC. It is like applying mathematical induction: step by step, starting from the particular problem you can obtain general rules, so that, quite immediately you can discover other specifications omitted or implicit in problem domain and

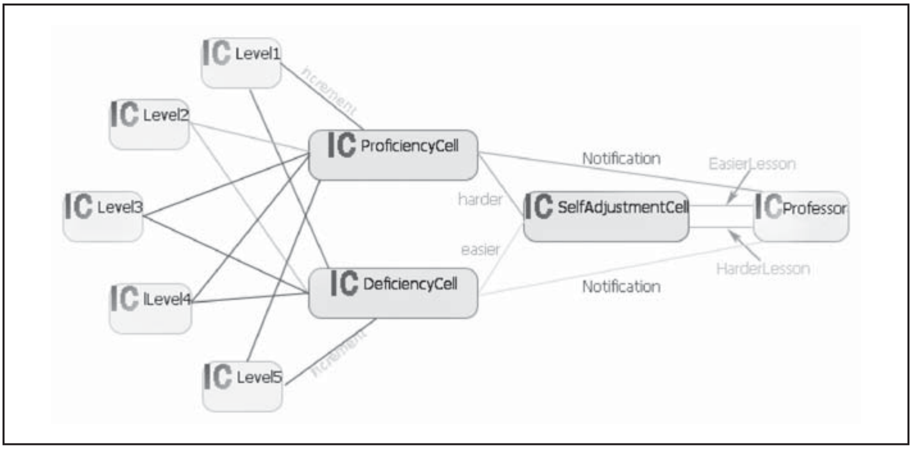

Figure 6 Knowledge structure associated to multimedia objects.

then add further solution. IC Systems have many powerful features: Flexibility, scalability, portability. All of that are key factor

Working on projects, it becomes clear that IC Systems have many powerful features: Flexibility, scalability, portability that are essential in Software Engineering and then in Multimedia Software Engineering.

In conclusion we have demonstrated in this paper how to augment human intelligence by an active index. Further research will demonstrate how sensors, mobile communications and search engines can be incorporated into the distributed intelligence system for e-learning.

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We would like to express our thanks to Scarfogliero Giuseppe Marco and Sorrentino Lorenzo for their effort in the designing and implementing a Multimedia Knowledge Environment for Index Cell (*MKE*^{2} *4IC*) , which is an eclipse environment for modelling a TAOXML private knowledge.

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Applications

Knowledge Management Integrated with e-learning in Open Innovation

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Abstract

This paper presents a framework aiming to support an «innovation chain» in an Open Innovation (OI) perspective. In order to transfer research results from producers to users, it is necessary to develop a Knowledge Management System supporting formalization, packaging and characterization to be able to select, understand and collect research results and/or innovations deriving from them. Suitable skills are required to transfer and collect innovation. Since in OI the knowledge producer and final users are by definition geographically distant, the required specialist skills have to be acquired through an e-learning system. This system must offer Learning Objects that can be combined within a course that also takes into account the user's past experiences. This work proposes an approach based on the integration of these two systems, and presents PROMETHEUS, a tool supporting this approach. The results of preliminary experimentation highlighted the strengths and weaknesses of the approach. They will be used to plan further experimentation and initiatives serving to facilitate the transfer of research results from state of the art to state of practice.

1. Introduction

The ever increasing competitive stress to which firms are subjected has made product and process innovation a crucial issue. In turn, this requires ever shorter innovation execution times and a greater cooperation between the adopted innovation and training in its use (Figure 1).

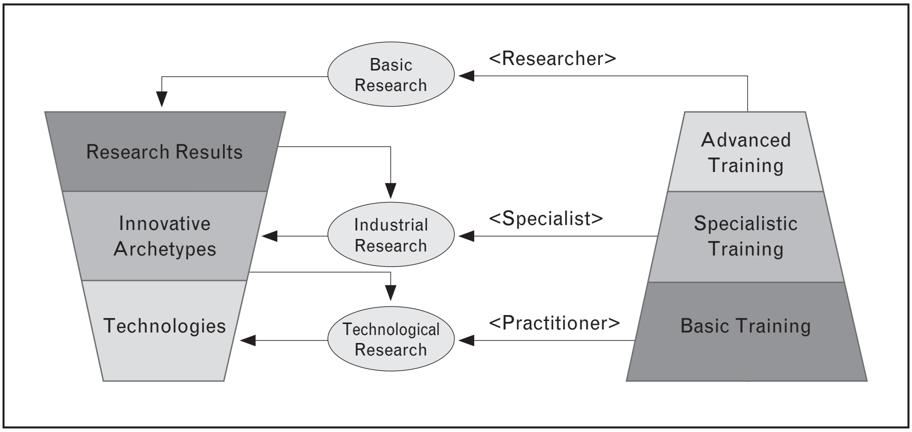


Figure 1 Innovation and training cycle.

In the innovation cycle the results generated by basic research are suitably selected, integrated and transformed into innovative archetypes. The latter constitute an operative body of knowledge that is applicable in the productive processes, together with the demonstration prototypes made to facilitate the use of the new knowledge during operations. Once the archetype has been refined and shown to be fully efficacious, it is transformed into technology, i.e. a set of practices derived from the body of knowledge, and of tools derived from the demonstration prototypes. The technologies are introduced in the production process, ending the innovation cycle.

Like the innovation cycle, the basic training process must provide for acquisition of the skills needed to apply the practices and tools in the productive processes, as well as specialist skills enabling analysis of when, how and where the research results can best be used to transform them into innovative practices. Advanced training is needed to produce resources able to create new knowledge through basic research. The training process must be able to keep pace with the continuous changes of the innovation cycle.

This growing need to carry out rapid innovation processes, as well as the high cost of research, have given rise to so-called Open Innovation processes (Chesbrough 2003; Ardimento, Cimitile, Visaggio, 2003; O'Reilly, Tushman, 2004;

Edquist 1997). If a company or research institution is unable to use the results of research straight away, they are made available for use by other companies or institutions. The institution supplying the results can, if it so desires, sell them and reinvest the returns in further research. The advantage for the institution purchasing the results is that it can bypass the research risks: at an agreed price it acquires research results serving to improve its business processes.

However, the notorious dichotomy between researchers and practitioners poses a barrier to the spread of Open Innovation (Reifer 2003; Glass 2005). The former complain that their research results build up but are not used by industry. The latter lament the strong need for innovation and lack of support by research results (Xiangyang, Linpeng, Dong, 2004; Joshi, Sarker, Sarker, 2005). Another barrier to Open Innovation is the need for adequate training in the use of the knowledge contained in research results. In fact, resources may undergo general training but to apply a specific research result, an archetype or a technology, specific education and training will be needed.

The approach presented in this work aims to mitigate these two problems by managing the knowledge/experience package with the relative information tool. The Authors use the term knowledge package to refer to an organized set of: knowledge content, teaching units on the use of the demonstration prototypes or tools and all other information that may strengthen the package's ability to achieve the proposed goal. The knowledge package must be usable independently of its author or authors and for this purpose, the content must have a particular structure: distance education and training must be available through an e-learning system. In short, the proposed knowledge package contains knowledge content integrated with an e-learning function.

The rest of the paper is structured as follows: related works and research activities are discussed in section 2; section 3 presents the proposed approach, focusing particularly on the relative Knowledge package, Metadata and Life Cycle; section 4 introduces the Knowledge Base set up by the SERLAB research team and outlines some preliminary experimental results serving to validate and facilitate the process, and describing a test sample. Finally, in the conclusions some observations are made about the preliminary results obtained, and possible future research pathways are identified.

2. Related works

The problem of knowledge packaging for better usage is being studied by many research centers (Jedlitschka, Pfahl, 2003; Malone, Crowston, Herman, 2003) and companies (Jedlitschka, Pfahl, 2003; Schneider, Schwinn, 2001). The knowledge bases produced sometimes have a semantically limited scope. This is the case of the Daimler-Benz base (Malone, Crowston, Herman, 2003; Schneider, Schwinn, 2001), that collects lessons learned or mathematical prediction models or results of controlled experiments in the automobile domain only. In other cases the scope is wider but the knowledge is too general and therefore not very usable. This applies to the MIT knowledge base (Malone, Crowston, Herman, 2003), that describes business processes but only at one or two levels of abstraction. There are probably other knowledge bases that cover wider fields with greater operative detail (Schneider, Schwinn, 2001) but we do not know much about them because they are private knowledge bases. Another solution being examined by the research community is ontologies (Tao, Millard, Woukeu, Davis, 2005; Huang, O'Dea, Mille, 2003; Chen, Wu, 2003), but these currently lack tools for creation and management (Klein 2001). Much attention is being focused on these issues but the available experimental evidence is not yet sufficient for large-scale use.

Our approach focuses on a knowledge base whose contents make it easier to achieve knowledge transfer among research centers; between research centers and production processes; among production processes. The knowledge base must be public to allow one or more interested communities to develop around it and exchange knowledge. In particular, it must be possible for small and medium sized businesses (SMB) to become members of these communities. In fact, we believe that only membership of these special interest communities can allow SMB to adopt Open Innovation and reap the benefits.

The knowledge base must cooperate with an e-learning system. Cooperation between these two tools aims to achieve knowledge transfer from the senders to the addressees of the knowledge. Thus, our approach intends to use e-learning in cooperation with knowledge bases, as a means of linking conceptual knowledge to the operative knowledge needed to transfer the content of the knowledge package to practitioners, specialists or other researchers.

3. The Proposed Approach

3.1 Knowledge/Experience packages

In the proposed approach, the knowledge/experience package must include all the elements shown in Figure 2. A user can access one of the package components and then navigate along all the components of the same package according to her/his training or education needs. Search inside the package starting from any of its components is facilitated by the component's Metadata.

It can be seen in the figure that the Knowledge Content component (KC) is the central one. It contains the knowledge package expressed in text form, with figures, graphs, formulas and whatever else may help to understand the content. The content is organized as a tree. Starting from the root (level 0) descent to the lower levels (level 1, level 2, …) is through pointers (Figure 3). The higher the level of a node the lower the abstraction of the content, which focuses more and

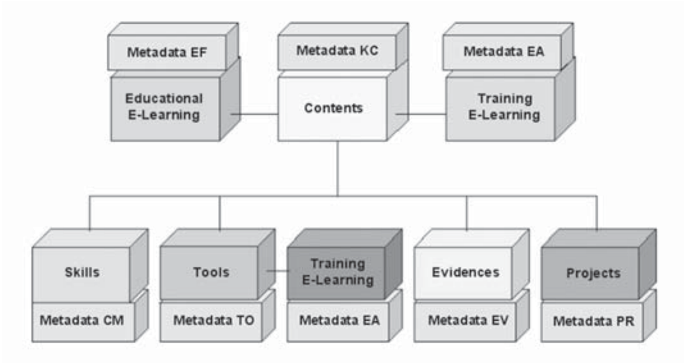


Figure 2 Diagram of a Knowledge/Experience package.

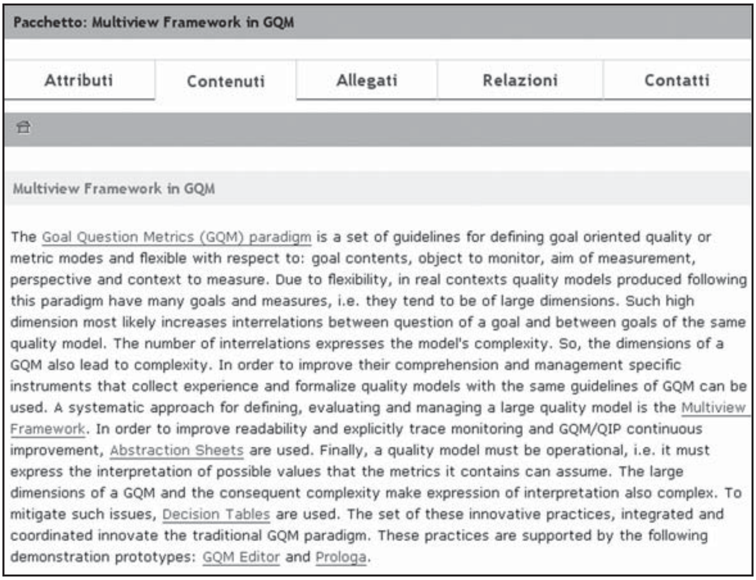
more on operative elements. The root and each intermediate node contain the reasoned index of the underlying components (Figure 3). The content consists of the following: research results for reference, analysis of how far the results on which the innovation should be built can be integrated into the system; analysis of the methods for transferring them into the business processes; details on the indicators listed in the metadata of the KC inherent to the specific package, analyzing and generalizing the experimental data evinced from the evidence and associated projects; analysis of the results of any applications of the package in one or more projects, demonstrating the success of the application or any improvements required, made or in course; details on how to acquire the package.

In line with Open Innovation, the research results integrated by a package may be contained within the same knowledge base or derive from other knowledge bases or other laboratories. If the knowledge package being read uses knowledge packages located in the same experience base, the relations will be explicitly highlighted.

When a knowledge of some concepts is a prerequisite for understanding the content of a node, the package points to an educational e-learning course (EF). Instead, if use of a demonstrational prototype is required to become operative, the same package will point to a training e-learning course (EA) (Figure 4). As stated above, the use of these courses is flexible, to meet individual user's needs.

To integrate the knowledge package with the skills, KC refers to a list of resources possessing the necessary knowledge, collected in the Skills component (CM).

When a package also has support tools, rather than merely demonstration prototypes, KC links the user to the available tool. For the sake of clarity, we point out that this is the case when the knowledge package has become an industrial practice, so that the demonstration prototypes included in the archetype they derived from



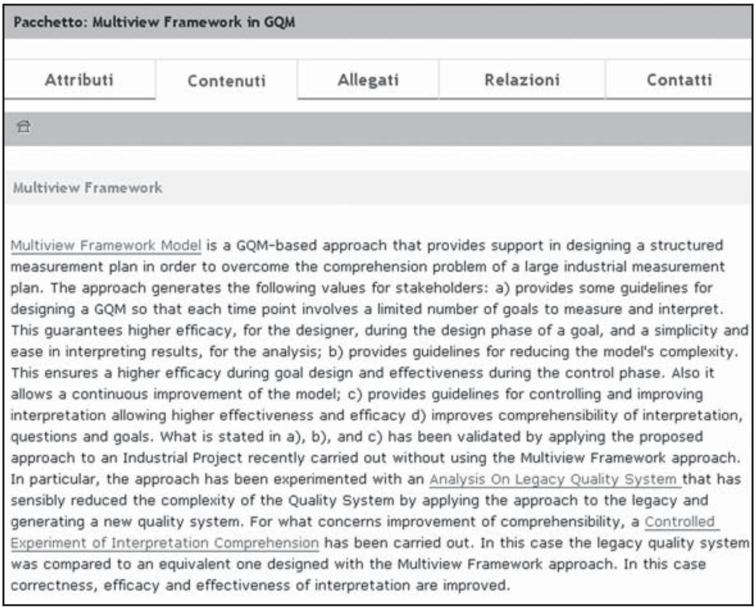
Pacchetto: Multiview Framework in GQM

Attributi | Contenuti | Allegati | Relazioni | Contatti

Multiview Framework in GQM

The Goal Question Metrics (GQM) paradigm is a set of guidelines for defining goal oriented quality or metric modes and flexible with respect to: goal contents, object to monitor, aim of measurement, perspective and context to measure. Due to flexibility, in real contexts quality models produced following this paradigm have many goals and measures, i.e. they tend to be of large dimensions. Such high dimension most likely increases interrelations between question of a goal and between goals of the same quality model. The number of interrelations expresses the model's complexity. So, the dimensions of a GQM also lead to complexity. In order to improve their comprehension and management specific instruments that collect experience and formalize quality models with the same guidelines of GQM can be used. A systematic approach for defining, evaluating and managing a large quality model is the Multiview Framework. In order to improve readability and explicitly trace monitoring and GQM/QIP continuous improvement, Abstraction Sheets are used. Finally, a quality model must be operational, i.e. it must express the interpretation of possible values that the metrics it contains can assume. The large dimensions of a GQM and the consequent complexity make expression of interpretation also complex. To mitigate such issues, Decision Tables are used. The set of these innovative practices, integrated and coordinated innovate the traditional GQM paradigm. These practices are supported by the following demonstration prototypes: GQM Editor and Prologa.

Figure 3 Sample of content of a Knowledge/Experience package.



Pacchetto: Multiview Framework in GQM

Attributi | Contenuti | Allegati | Relazioni | Contatti

Multiview Framework

Multiview Framework Model is a GQM-based approach that provides support in designing a structured measurement plan in order to overcome the comprehension problem of a large industrial measurement plan. The approach generates the following values for stakeholders: a) provides some guidelines for designing a GQM so that each time point involves a limited number of goals to measure and interpret. This guarantees higher efficacy, for the designer, during the design phase of a goal, and a simplicity and ease in interpreting results, for the analysis; b) provides guidelines for reducing the model's complexity. This ensures a higher efficacy during goal design and effectiveness during the control phase. Also it allows a continuous improvement of the model; c) provides guidelines for controlling and improving interpretation allowing higher effectiveness and efficacy d) improves comprehensibility of interpretation, questions and goals. What is stated in a), b), and c) has been validated by applying the proposed approach to an Industrial Project recently carried out without using the Multiview Framework approach. In particular, the approach has been experimented with an Analysis On Legacy Quality System that has sensibly reduced the complexity of the Quality System by applying the approach to the legacy and generating a new quality system. For what concerns improvement of comprehensibility, a Controlled Experiment of Interpretation Comprehension has been carried out. In this case the legacy quality system was compared to an equivalent one designed with the Multiview Framework approach. In this case correctness, efficacy and effectiveness of interpretation are improved.

Figure 4 Sample of 2nd level content of a Knowledge/Experience package.

have become industrial tools. The tools are collected in the Tools Component (TO). Each tool available is associated to an educational course, again of a flexible nature, in the use of the correlated training e-learning course (EA).

A knowledge package is generally based on conjectures, hypotheses and principles. As they mature, their contents must all become principle-based. The transformation of a statement from conjecture through hypothesis to principle must be based on experimentation showing evidence of its validity. The experimentation, details of its execution and relative results, are collected in the Evidence component (EV), duly pointed to by the knowledge package.

Finally, a mature knowledge package is used in one or more projects, by one or more firms. At this stage the details describing the project and all the measurements made during its execution that express the efficacy of use of the package are collected in the Projects component (PR) associated with the package.

3.2 Metadata

As shown in Figure 2, each component in the knowledge package has its own metadata structure. For all the components, these allow rapid selection of the relative elements in the knowledge base. The focus in this work is on the metadata in the KC. In fact, these have been defined during research conducted by the authors and by other authors. To facilitate the research, we used a set of selection classifiers and a set of descriptors summarizing the contents. The classifiers include: the key words and the problems the package is intended to solve. The summary descriptors include: a brief summary of the content and a history of the essential events occurring during the life cycle of the package, giving the reader an idea of how it has been applied, improved, and how mature it is. The history may also include information telling the reader that the content of all or some parts of the package are currently undergoing improvements.

The package also provides the following indicators: skills required to acquire it, prerequisite conditions for correct working of the package, acquisition plans describing how to acquire the package and estimating the resources required for each activity. To assess the benefits of acquisition, they contain a list of: the economic impact generated by application of the package; the impact on the value chain, describing the impact acquisition would have on the value of all the processes in the production cycle; the value for the stakeholders in the firm that might be interested in acquiring the innovation. There are also indicators estimating the costs and risks. Thus, all these indicators allow a firm to answer the following questions: what specific changes need to be made? What would the benefits of these changes be? What costs and risks would be involved? How can successful acquisition be measured?

3.3 Life cycle

The knowledge package is inserted by its administrator, or by an expert belonging to the special interest community developing around the knowledge base, having the requisite knowledge and skills. Initially, a knowledge package may be only a research result, in which case it will only have descriptive parameters in the metadata and may lack any other linked information apart from the name/s of the expert resource/s listed in the Skills component. Instead, if it is an innovation it will have an archetype which must include both the knowledge derived from the results and demonstration prototypes. The metadata will be validated as above, and education and training e-learning courses may also be included to learn how to use the prototypes.

Experimentation of the archetypes present in KC may have been made, and at its conclusion, the description of the experiment, the metrics and the results may be inserted in EV. KC will also contain the indicators of the metadata that can record the results of the experiment, a history of the new event and, in the content, comments and a consideration of the significance of the new indicators, as well as a description of analysis of the results of the experiment and their relative values in terms of the indicators. If the experiment yielded any negative results, suggestions for improvement of the package may be included. These are recorded in detail in KC and summarized in the history.

In general, the knowledge base administrator or perhaps a stakeholder may carry out industrialization of an archetype considered to have been adequately validated. In this phase, the acquisition plans are formalized, validated by the summarized metadata and the detailed descriptors in the KC. Demonstration prototypes are thus transformed into industrial tools, stored in TO and linked to the knowledge package in KC. Also in this phase, if they are not already present, EA and EF e-learning courses must be inserted. The history of the package must be updated.

Application of the package is by use in a project. PR records a description of the project, the model and the metrics plan, as well as the measurements made. Statistical analysis is made of the latter, and a brief summary of the results is included. The corresponding KC will validate the indicators of the metadata serving to record the results of the project, the new event will be recorded in the history and comments will be added in the contents, as well as the significance of the new indicators, a description of the analysis of the project results and their connection with the values inserted in the indicators. Again, if the project has yielded any negative results, improvements may be hypothesized, recorded in detail in KC and summarized in the history.

The package is subject to continual improvements as a result of the initiatives suggested by the experiments, of use or of an autonomous decision taken by the administrator if new knowledge appears in literature or internal/acquired research yields new results.

4. Experimentation

The demonstration prototype of the knowledge base, named PROMETHEUS (**P**ractices p**RO**cess and **M**ethods **E**volution **T**hrough **E**xperience **U**nfolded **S**ystematically), has been created using J2EE technology. The e-learning platform is an open source suited to our needs.

We carried out a first investigation by transforming some of the results found in literature into knowledge/experience packages. Our first results are shown in table 1, demonstrating that 56% of the papers analyzed had a relation m-1 with the packages (6 papers in package 1 and 2 papers in package 4). This means that the contents of a knowledge package are disseminated in literature. Moreover, the effort for reading and transforming the contents of the papers into a package were relatively high. In short, the literature is not a good tool for acquiring research results to be integrated in business processes.

Table 1

TRANSFORMING THE ARTICLES INTO KNOWLEDGE PACKAGES.

ID. Publication	*Reading time in minutes*	*Transformation time*	*ID. Package*
[17]	165	185	1
[23]	130	225	1
[24]	154	125	2
[25]	254	130	3
[26]	140	170	4
[27]	145	160	4
[28]	195	215	1
[29]	125	225	5
[30]	160	265	6
[31]	150	200	1
[32]	140	290	1
[33]	180	265	7
[34]	130	240	1
[35]	165	205	8

Table 2 shows the validated indicators for all the packages extracted from the articles examined above.

Table 2
INDICATORS EXTRACTED FROM THE EXAMINED ARTICLES

Indicators	Packages							
	1	2	3	4	5	6	7	8
History	–	–	–	–	–	–	–	–
Prerequisites	–	–	–	–	–	–	–	–
Economic Impact	–	–	–	–	–	–	–	–
Impact on the Processes	x	–	x	x	x	x	–	–
Impact on the Products	x	x	x	x	–	–	x	–
Value for the stakeholders	–	–	–	–	–	–	–	–
Risks of Application	–	–	–	–	–	–	–	–
Planning	–	–	–	–	–	–	–	–
Evidence	x	–	x	x	–	x	–	–

Table 2 shows that much of the information serving to foster reuse of the knowledge package is not present in the papers examined. Thus, the available knowledge is incomplete, likely due to a disparity of interests between researchers and practitioners.

We then carried out a further experiment: we inserted a Quality Management package as an archetype, based on the Goal Question Metrics paradigm, with the following innovative practices: structuring the interpretation of the metrics; inserting Abstraction Sheets for validating quality models and representing them, improving their readability, together with an approach to quality system structuring named Multiview Framework, and Decision Tables to make interpretation operative. The package also contains the following demonstration prototypes: GQM-Editor; Prologa. The components PK, EV and CM in the package were adequately populated. It also contains training and education courses on the PK contents and demonstration prototypes, for a total of 54 Learning Objects. The package does not include validated indicators concerning metadata.

The package was made available to university students following the course on Assessment Models in the third year of the Degree Course in Information Science. They were asked to acquire a knowledge of the innovations and their use. The exercises set at the examination showed that 83% of the students had applied the innovations satisfactorily, solving the problems set. Of these students, 95% had used all the innovations correctly. These data show that the knowledge package was correctly learned in the classroom and with the e-learning function contained in the package. In this case, the absence of indicators did not affect the results because the students did not need the business case, but had to acquire the innovation as a part of their study plan.

5. Conclusions

Our work addresses innovation transfer inside business processes. Starting from the observation that the innovation cycle is affected by limitations as regards collection and divulgation of the results of research and the resulting archetypes, it was found that one of the causes of this is the extreme dissemination of research results in different papers, books and other publicly available resources. We propose a Knowledge Management System that collects knowledge packages featuring localized research results, linked to the resulting archetypes and technologies they generate. The system includes methods for structuring the contents, guidelines for linking the primary knowledge content to other data assisting acquisition and use of the innovation. Finally, the system makes use of descriptors and indicators that help to trace the knowledge package/s that can solve the potential user's problems and to convince her/him of the efficacy of use of the candidate package/s.

The educational and business sectors need to be linked to the information cycle. For this reason, the system includes an e-learning System teaching knowledge of the packages and training the user in the use of the demonstration prototypes or tools supporting an innovation. We propose PROMETHEUS, a demonstration platform that integrates a Knowledge Management System and a Learning System, allowing navigation among all the components. Thanks to this platform, we experimented the proposed approach, and found that:

- the system allows consolidation of a knowledge package disseminated in many different articles;
- quite a lot of man time is needed to transform the knowledge expressed in articles and books into a knowledge package;
- for many packages, it was not possible to validate all the metadata shown by previous experiments to be useful to convince business administrators to acquire the innovation;
- the knowledge base was able to transfer the innovation to students carrying out a study project focusing on real industrial case studies.

Much experimentation has still to be done. In particular, we must pass on from classroom experimentation to in-field experimentation in a real business. The efficacy of the structure of the knowledge/experience package needs to be validated, as well as the approach's ability to achieve continuous improvement of the knowledge package contents and relative e-learning courses.

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Applications

Managing concepts inside e-Learning systems

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Abstract

In this paper we introduce an update of our work on developing a distance learning environment based on a collaborative bookmark management system approach. We introduce EasyInfo, an hybrid recommender architecture extension, which processes resources to extract concepts (not just words) from the documents using semantic capabilities. Then, the classification, recommendation and sharing phases take advantage of the word senses to classify, retrieve and suggest documents with high semantic relevance with respect to the student and resource models.

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1. Introduction

The Semantic Web will add meaning, or semantics, to Web contents in order to make it easier finding and using information for both humans and machines. Adding formal semantics to the Web will aid in everything from Web searching to resource discovery, till the automation of all sorts of tasks (Koivunen, Miller, 2002). The paper will outline about how the Semantic Web can be used as a fitting technology inside sophisticated distance learning scenarios.

In (Bighini, Carbonaro, 2004) we introduced the InLinx (Intelligent Links) system, a Web application that provides an on-line bookmarking service. InLinx is the result of the integration of three filtering components, corresponding to the following functionalities:

1. bookmark classification (content-based filtering): the system suggests the more suitable category which the user can save the bookmark in, based on the document's content; the user can accept the suggestion or change the classification, selecting another category that he considers best for the given item;
2. bookmark sharing (collaborative filtering): the system checks for newly classified bookmarks and recommends them to other users with similar interests. Recipient users can either accept or reject the recommendation when they receive the notification;
3. paper recommendation (content-based recommendation): the system periodically checks if a new issue of some on line journal has been released; then, it recommends the plausible appealing documents, according to the user profiles.

Over the years we have introduced several extensions of the original architecture such as personalized category organization and mobile services (Andronico, Carbonaro, Colazzo, Molinari, 2004). Most recently, we have introduced concepts for classification, recommendation and document sharing to provide a better personalized semantic-based resource management. Generally, recommender systems use keywords to represent both the users and the resources. Another way to handle such data is using hierarchical concept categories. This issue will enable users and the system to search, handle or read only those concepts of interest in a more general manner, providing a semantic possibility. For example, synonymy and hyponymy can reveal hidden similarities, potentially leading to better classify and recommend. We called the extended architecture EasyInfo.

The advantages of a concept-based document and user representation are: (i) ambiguous terms inside a resource are disambiguated, allowing their correct interpretation and consequently a better precision in the user model construction (e.g., if a student is interested in computer science resources, a document containing the word 'bank' in the financial context will not be relevant); (ii) synonymous words belonging to the same synset can contribute to the user model definition (for example, both 'mouse' and 'display' brings evidences for computer science documents, improving the coverage of the document retrieval); (iii) finally, classification, recommendation and sharing phases take advantage of the word senses in order to classify, retrieve and suggest documents with high semantic relevance with respect to the user and resource models.

The Semantic Web appears as a promising technology for implementing distance learning environments. One of its primary characteristics, shared understanding, is based on ontologies as its key element. Ontologies enable the organization of learning materials around small pieces of semantically annotated (enriched) Learning Objects (LOs) (Nejdl, 2001). Items can be easily organized into customized learning courses and delivered on demand to the user, according to her/his profile and business needs.

Filtering and recommending relevant LOs can be useful to address issues like trying to determine the type or the quality of the information suggested from a personalized learning environment. In this context, standard keyword search is of very limited effectiveness. For example, it cannot filter the type of information (tutorial, applet or demo, review questions, etc.), the level of the information (aimed at secondary school students, graduate students, etc.), the prerequisites for understanding the information, or the quality of the information.

Sometimes, the traditional model implemented inside distance learning systems demonstrated some limitations and inconsistencies, assigning fixed roles to subjects participating into educational processes. These roles are normally included in a vision of the training process that we could define «transfer model»: the teacher owns the knowledge and this is transferred to students via a sequence of lectures. The student learns from references or books while guided by the teacher's lectures. Moreover, if we consider a technical course, where more practical skills must be acquired and demonstrated, very often students have to develop a project. This could be an individual work, but more frequently it is a joint effort among students of a group. It would be more fruitful to let students work together also using cooperative tools that allow them to interact among themselves and with teachers / tutors, but this kind of collaboration «freedom» (with all the administrative problems behind the scenes) is very often extraneous to a typical e-learning system. This latter aspect is particularly relevant in teaching technological disciplines, and specifically, computer science topics.

The architecture of InLinx and of its specialized components presented in the following pages is based on a student-centered approach. We present tools for personalized distribution of educational resources, as important technology to adapt and personalize e-learning system on the basis of the effective user needs and modifiable user behaviour and interests, addressing to the above cited collaboration and active role requirements.

Generally, recommendations are generated by using two main techniques: content-based information filtering, and collaborative filtering (Belkin, Croft, 1992). If, by one hand, a content-based approach allows to define and maintain an accurate user profile, that is particularly valuable when a user encounters new content, on the other hand it has the limitation of concerning only the significant features describing the content of an item. Differently, in a collaborative approach, resources are recommended according to the rating of other users of the system with similar interests. As there is no analysis of the item content, collaborative filtering systems can deal with any kind of item, not just limited to textual content. This way, users can receive items with content that is different from the one received in the past. Since a collaborative system works well if several users evaluate each one of them, new items cannot be recommended until some users have taken the time to evaluate them and new users cannot receive recommendation until the system has acquired some information about the new user in order to make personalized predictions. These limitations often referred to as the sparsity and start-up problems (Melville, Mooney, Nagarajan, 2002). By adopting a hybrid approach, a recommender system is able to effectively filter relevant resources from a wide heterogeneous environment like the Web, taking advantage of common interests of the users and also maintaining the benefits provided by content analysis.

The paper is organized as follows. Section 2 provides a summary of related works. Section 3 introduces how to extract and to use senses from the documents, proposing word sense disambiguation and similarity measure processes. Following, the paper introduces the learning object recommendation process, obtained considering student and learning material profiles and adopting filtering criteria based on the value of selected metadata fields. Some final considerations and comments about future developments conclude the paper.

2. Related works

Several related research projects intend to filter and recommend interesting Web pages to user, but few of them tackle with the problem of collaborative bookmark management.

The most similar approach to our recommendation module are RAAP (Research Assistant Agent Project) (Delgado, Ishii, Ura, 1998) and CoWing (Collaborative Web IndexING system) (Kanawati, Malek, 2001), even if, none of them introduce the paper recommendation component.

Usually, this idea has been widely and successfully developed for specific domains, like movie or film recommendations, and it's been rarely used for recommending LOs on E-learning environments. Our system uses a hybrid approach and suitable representations of both available information sources and user's interests in order to match user informative needs and available information as accurate as possible.

Current research in the Semantic Web area is very dynamic. The scientific literature and industrial services offer various tools and applications in the Semantic Web scenario that have been developed and are currently used by different communities.

The eXtensible Markup Language (XML)[1] and the Resource Description Framework (RDF)[2] languages are used for adding structure and meaning, along with relationships between Web information sources. Web Ontology Language (OWL)[3] is providing a standard for ontology preparation. Protégé[4] and Ontology Editor (OntoEdit) (Sure, Erdmann, Staab, Studer, Wenke, 2002) are examples of ontology editors; Ontobroker (Fensel, Decker, Erdmann, Studer, 1998) is an ontology server; TextToOnto (Maedche, Staab, 2000) is a tool suite supporting the semi-automatic construction of ontologies by NLP and text mining procedures; Melita (Ciravegna, Dingli, Petrelli, Wilks, 2002) allows the annotation of textual data interactively by users and makes use of a separate training phase to learn annotation rules that are used to make suggestions to the user for subsequent texts. Moreover, some tools are able to cluster or map the inter-relationships among major websites or concepts in a graphic form as a network of nodes of different sizes; see Clusty[5], Kartoo[6] and Mooter[7] as examples. KAON (Karlsrude Ontology)[8] provides a common framework for Semantic Web. SNOBASE[9] is an ontology management environment developed by IBM Alphaworks that provides a mechanism to query ontologies and a programming interface to interact with ontologies, written in RDF Schema and OWL.

The research on e-learning and Web-based educational systems traditionally combines research interests and efforts from various fields, in order to tailor the growing amount of information, to the needs, goals, and tasks of the specific individual users. Semantic Web technologies may achieve improved adaptation and flexibility for users and new methods and types of courseware compliant with the Semantic Web vision. Adaptive Web-based Educational Systems form the basis of the emerging Educational Semantic Web. Among the promising experiences in Educational Semantic Web we would like to mention (Denaux, Dimitrova, Aroyo, 2005) proposing adaptive task recommendations and resource browsing on the Semantic Web, (Muna, Haider, Ramadan Neagu, 2005) reporting on the work

[1] http://www.w3schools.com/xml/default.asp
[2] http://www.w3schools.com/rdf/default.asp
[3] http://www.w3.org/2004/OWL
[4] http://protege.stanford.edu/plugins/owl/
[5] http://www.clusty.com
[6] http://www.kartoo.com
[7] http://www.mooter.com
[8] http://kaon.semanticweb.org/
[9] http://alphaWorks.ibm.com/tech/snobase

to develop a framework for Semantic Web mining and exploration, (Woukeu, Wills, Conole, Carr, Kampa, Hall, 2003) an ontological hypertext framework for building generic web-based educational portals, (Porto, Moura, da Silva, 2004) presenting ROSA, a data model and a query language to access LOs, based on their semantic properties, (Henze, Dolog, Nejdl, 2004) showing how rules can be enabled to reason over distributed information resources in order to dynamically derive hypertext relations.

The following paragraph describes both implemented word sense disambiguation process and the ontology used to retrieve the exact concept definition and to adopt some techniques for semantic similarity evaluation among words.

3. Semantic capabilities

We have improved our previous version of InLinx by introducing the EasyInfo module exploiting semantic abilities. The sense extraction from documents is based on the following tools.

WordNet (Fellbaum, 1998) is an online lexical reference system, in which English nouns, verbs, adjectives and adverbs are organized into synonym sets. Each synset represents one sense, that is one underlying lexical concept. Different relations link the synonym sets, such as IS-A for verbs and nouns, IS-PART-OF for nouns, etc. Verbs and nouns senses are organized in hierarchies forming a «forest» of trees. For each keyword in WordNet, we can have a set of senses and, in the case of nouns and verbs, a generalization path from each sense to the root sense of the hierarchy. WordNet could be used as a useful resource with respect to the semantic tagging process and has so far been used in various applications including Information Retrieval, Word Sense Disambiguation, Text and Document Classification and many others.

GATE (Cunningham, Maynard, Bontcheva, Tablan, 2002) provides a number of useful and easily customizable components, grouped to form the ANNIE (A Nearly-New Information Extraction) component. These components eliminate the need for users to keep re-implementing frequently needed algorithms and provide a good starting point for new applications. These components implement various tasks from tokenization to semantic tagging and co-reference, with an emphasis on efficiency, robustness, and low- overhead portability, rather than full parsing and deep semantic analysis.

The general architecture of the developed semantic module consists of two levels. The first one is a Java level that manages the user interaction, the documents to analyze and GATE functions. The second one is a C level that enquiries WordNet and stores document representation. More detailed, the Java level is able to:

- interact with the users to obtain a new document to process;
- retrieve and analyse the document using specified parameter setting;

- extract document information using a multithread architecture;
- transmit obtained information to C level, using Java Native Interface (JNI) to integrate Java code and native code. We implemented an ad hoc function to interface WordNet libraries and JNI.

We want to find a subset of words related to each document that the system manage, which helps to discriminate between concepts. In such a way, two documents or two users characterized using different keywords may result similar considering underling concept and not the exact terms. Web documents are the collection text written in natural language. To extract important information from documents, we use the following feature extraction pre-process. Firstly, we label occurrences of each word in the document as a part of speech (POS) in grammar. This POS tagger discriminates the POS in grammar of each word in a sentence. After labelling all the words, we select those ones labelled as noun and verbs as our candidates. We then use the stemmer to reduce variants of the same root word to a common concept and filter the stop words. Figure 2 shows an example of parsing process result.

A vocabulary problem exists when a term is present in several concepts; determining the correct concept for an ambiguous word is difficult, as is deciding the concept of a document containing several ambiguous terms. To handle the word sense disambiguation problem we use similarity measures based on WordNet. Budanitsky and Hirst (Budanitsky Hirst, 2001) give an overview of five measures based on both semantic relatedness and semantic distance considerations, and evaluate their performance using a word association task.

We considered two different similarity measures; the first one is proposed by Resnik (Resnik, 1995) while the second is proposed by Leacock-Chodorow (Leacock, Chodorow, 1998).

The Resnik similarity measure is based on the information content of the least common subsumer (LCS) of concepts A and B. Information content is a measure of the specificity of a concept, and the LCS of concepts A and B is the most specific concept that is an ancestor of both A and B. The Leacock and Chodorow similarity measure is based on path lengths between a pair of concepts. It finds the shortest path between two concepts, and scales that value by the maximum path length found in the is–a hierarchy in which they occur.

We propose a combined approach based on the two described measures considering both a weighted factor of the hierarchy height and a sense offsets factor.

Generally, similarity measures applies to the hyponymy relations (the IS-A or HAS-PART relation in WordNet), that is to the syntactic categories of noun and verb. After the nouns and verbs sense disambiguation, our documents are represented using a matrix storage format containing a row for each WordNet subject code and a column for each WordNet object code. The position i, j of the matrix maintains a list containing the WN verb code that relates the subject i and the object j and the number of times the triple is present in the document. For example,

SUBJi - LIST{VERBi,j#occurrences} - OBJj
After this process documents are represented as vectors of triples: (concept i, list of WN verb codes and their occurrences, concept j).

4. E-learning recommandation

In the context of an e-learning system, additional readings in an area cannot be recommended purely through a content analysis in order to fit learners' interests, but also pick up those pedagogically suitable documents for them. Recker, Walker and Lawless (Recker, Walker, Lawless, 2003) present a web-based system where teachers and learners can submit reviews about the quality of web resources, without considering the pedagogical features of these educational resource in making recommendation. Tang and McCalla (Tang, McCalla, 2005) propose two pedagogical features in recommendation: learner interest and background knowledge. They also study two pedagogy-oriented recommendation techniques, content based and hybrid recommendations, arguing that the second one is more efficient to make «just-in time» recommendations. The following paragraphs describe how we consider the resource content to propose a fitted technique in a hybrid recommendation framework.

The automatic recommendation of relevant learning objects is obtained considering student and learning material profiles and adopting filtering criteria based on the value of selected metadata fields. Our experiments are based on SCORM compliant LOs. For example, we use the student's knowledge of domain concept to avoid recommendation of highly technical papers to a beginner student or popular-magazine articles to a senior graduate student. For each student, the system evaluates and updates his skill and technical expertise levels. The preprocessing component developed to analyze the information maintained in LOs is able to produce a vector representation that can be used by the collaborative recommendation system.

In SCORM, the organization and learning resources must be included with the course and placed in an XML file with the name imsmanifest.xml. The structure required for this file is detailed in the SCORM content aggregation specification.[10] We analyze the imsmanifest.xml file in order to extract .htm and .html files and examine the content, to obtain the loading of some didactical source and its classification. We consider the following metadata to provide the corresponding technical level:

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[10] http://www.adlnet.org

- difficulty: represents the complexity of the learning material, ranging from «very easy» to «very difficult»;
- interactivity level: represents the interactive format, ranging from «very low» (only static content) to «very high»;
- intended end user role: represents the user type (for example student or teacher);
- context: represents the instructional level necessary to take up a LO.

The difficulty level is explicitly loaded into our database (in most cases, LMSs use this value). Difficulty and the other above cited values are combined to characterize technical level of learning material ranging from 0 to 1 and representing how demanding is the LO. If some of these fields are not present in the manifest file (they are not required), we consider their average value.

Our system also considers the user's skills to express cleverness as regards different categories. This value ranges from 0 to 1 and it initially depends on the context chosen from the user during his/her registration (primary education, university level, and so on). During the creation of a new category (for example, when a lesson is saved) we consider the user's skill value equal to the resource technical level, presuming that if a user saves a learning material then he could be able to make use of it. The user's skill level is updated when a new resource is saved, taking into account its technical level and the user's skills in that category. Starting value for user's skills parameter, its update frequency, the increment or decrement value and the difference between technical level and user's skills necessary to obtain a recommendation outcome from the following experimental tests. They are easily adaptable, though.

We use artificial learners to get a flavour of how the system works. We have created a SCORM compliant learning material using the abstract of several papers in .html version from scientific journals published on the web. We have linked an *imsmanifest* SCORM file to each paper. Then, we have simulated ten users with different initial profiles (based on the field of interest and the skill level) and saved, in four turns, ten learning resources for each user, obtaining 400 LOs. The main advantage of the described approach is the semantic accuracy growth. To give a quantitative estimation of the improvement induced by a concept based approach, we are executing a comparative experiment between word-based user and resource models on one side and concept-based user and resource models on the other one.

5. Considerations

Te paper addresses a key limitations with existing courseware on the Internet. Humans want immediate access to relevant and accurate information. There has been some progress in combining learning with information retrieval, however, these advances are rarely implemented in e-learning courseware. With this objective in mind, we described how to perform automatic recommendation of relevant learning objects considering student and learning material profiles, adopting filtering criteria based on the value of selected metadata fields and capturing not only structural but also semantics information. The proposed method uses hierarchical concept categories, enabling users and system to search, handle or read only those concept of interest to them in a more general manner, providing semantic possibility. Our experiments to test the system's functionality are based on SCORM compliant LOs.

Summarizing, the key elements of the described system could be highlighted as follows. The system provides immediate portability and visibility from different user locations, enabling the access to personal bookmark repository just by using a web browser. The system assists students in finding relevant reading material providing personalized learning object recommendation. The system directly benefits from existing repositories of learning material providing access to open huge amount of digital information. The system reflects continuous ongoing changes of the practices of its member, as required by a cooperative framework. Exploiting a word sense based document representation, the system proposes resources and student models based on word senses rather that on simply words.

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Adaptive Item Language Assessment Based on Students' Cognitive Abilities

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The promotion of multilingualism, communication, mobility and cross-cultural awareness among EU member-states has created the demand for easily-administered, self-paced, time-effective, multilingual, and internationally accredited foreign language assessments (FLA). The Common European Framework of Reference (CEF) has paved the way by setting internationally certified standards for formal testing as well as self-assessment in all European languages and describing in detail the productive and receptive skills needed to attain a specific level of competence. CEF is based on the communicative, action-oriented and skill-based approach to language learning which is the essence of linguistic competency (Council of Europe, 2001, 2004).

Cross-cultural education has created diverse, mixed-ability students. In terms of foreign language assessment (FLA), research in psycholinguistics has revealed that individuals process language differently, according to their overall intelligence, brain dominance, sex, inherent traits and cognitive skills (Akmajian, et al. 1998). There is an apparent relationship between language, thought and cognition (Chomsky, 1997) and educationalists also acknowledge the fact that there are mixed-intelligence students (Gardner, 1993, Armstrong, 1999). Research in first language acquisition has also revealed important relevent findings in human language development through the study of certain phenomena, such as hesitations, speech errors and language disorders that can also be applied in second/foreign language acquisition. Finally, cross-cultural FL examinees do not share a common first language, a fact that renders the administration of traditional assessments improper.

The new generation of assessments acknowledges the fact that there is no average student model with predetermined behavior and tests are adapted to students' diverse educational and socio-economic background, age, nationality, first language, motivation and temporal accessibility. In order to foster learners' success, we need to adapt FLA environments to accommodate learners' diversity accordingly. Any assessment in foreign language that does not adapt to the aforementioned mixed student abilities cannot be considered reliable and valid. Mixed abilities create mixed needs which result in mixed implementations in all educational settings. This paper will describe the development of AILA. a computer adaptive and adaptable placement test in English as a Foreign Language (EFL) for mixed-ability students that can measure productive and receptive foreign language awareness efficiently.

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1. Introduction

There is a perceived need for a new generation of FL tests, which should be adaptive and adaptable in nature, catering for diverse, mixed-ability students. FLA needs to adapt to individual student needs, abilities, backgrounds, strengths and weaknesses, giving emphasis to cognitive language skills, such as comprehension, production and use. Computer Adaptive Language Testing (CALT) should also incorporate the CEF standards in order to develop internationally accredited, valid and reliable assessments. The Adaptive Item Language Assessment (AILA) is an adaptive placement test, based on CEF standards, that is both adaptive and adaptable in that examinees are given the choice to select how to answer each item presented. The system adopts course content tailored to the student's needs, taking into account different difficulty levels as well as different knowledge levels. AILA will be shortly ready for pilot testing.

2. Adaptive Item Language Assessment (AILA)

2.1 The Problem

Traditional FLA implementations fail to cater for mixed-ability students, as they are linear and targeted to the average student. CALT technology can provide student-centered assessment, replacing traditional testing wherever possible. However, CALT is based on solid programming which is collective rather than individualized and fails to include crucial cognitive parameters of student language competence and performance. Such systems cannot replace the human examiner without detrimental consequences for its group of examinees. The new generation of assessment systems for cross-cultural examinees should not assess students horizontally as an equable lot but vertically as mixed-ability individuals with mixed-scoring options. Moreover, the new generation of assessments can motivate test-takers, as it is proven that the new technologies are prefered by students (Ali, 2001).

The majority of CALT systems use multiple-choice (MC), close-ended items to distinguish proficient, good and weak learners. This is mainly due to the fact that MC items are easily programmed and calibrated in Item Response Theory (IRT). The program can easily identify correct and wrong answers and move on to easier or more difficult items. This technique is also reliable and valid as long as items are adequately pre-tested and correctly calibrated, even though the validity of multiple-choice testing has been seriously criticized (Chapelle, 2001). However, MC items cannot allow active expression and language production. Examinees are passive viewers of the proposed answers and they only try to distinguish the correct answer from the distracters. This method is widely used by language testing organizations, such as the University of Michigan Certificates in English, while other organizations use a variety of MC and open-closed items, such as the Cambridge Syndicate and the State Examinations on Language Competence. Proficient learners answering MC items are not given the opportunity to seperate themselves from good learners by openly typing the correct answer. They have to choose from the four intended choices and receive the same mark as other learners who may have accidentally chosen the correct item. This limitation does not allow the proficient learner to be discernable from others by testifying active language production. Another problem is caused by the prohibition of item reviewing. In psycholinguistics there is a clear distinction between errors, made due to ignorance, and mistakes, made due to negligence. Examinees are prone to mistakes not only out of ignorance but also out of misunderstanding, anxiety, confusion, distraction or other physical reasons. Since item reviewing is impossible in CALT, adaptive systems may form false impressions and give low scores. To this end, CALT should become more «intelligent» and simulate the human examiner in order to produce more accurate and precise scores.

2.2 System Description and Adaptation

AILA measures the ability of non native speakers of English to use and understand English as a foreign Language for achievement and placement purposes. The test-takers who sit AILA can quickly assess their competence in English in the scale issued by the Common European Framework of Reference (CEF). The test measures competence in four out of the six CEF levels: A2 – pre-intermediate, B1 - intermediate, B2 – upper-intermediate, and C1 – advanced. Each level has an even number of Grammar, Vocabulary and Reading items.

We used a CPU Pentium III 800 MHz, with 2 GB RAM, and the Apache web server. The software can run on Windows NT 4.0, Windows 2000 Server or Advanced Server and the system software includes the required MySQL database software. For reasons of re-usability XML has been used to separate content from the way it is processed (i.e. presented) and avoids re-writing the same content that needs to be displayed in different formats. The software used is Windows 2000, My SQL (free), PHP, VB script, Javascript, HTML, XML.

AILA is computer-based, using adaptive technology in item selection. The system increases student motivation, by providing tailored content adapted to individual needs and level of competence. This maximizes the students' gain whilst reducing the time equivalent. The User Profile keeps standard information of each test-taker and is also updated each time the test is administered.

AILA is also adaptable in that the student defines his/her level of competence according to which the test will be administered. Secondly, as the test is administered, examinees are given the freedom to choose how to answer each item. They can either type an open answer,by typing their answer in the gap (OA) or choose the correct answer in MC mode. The proficient examinee can type the answer in the OA, demonstrating his/her advanced knowledge. A correct OA response receives a bonus in the total score (standard grade + 0.25) and updates the User Profile of the examinee. Then, the item selection algorithm proceeds to the next item of increased difficulty. A wrong OA response immediately directs the examinee to the MC mode of the same item and the score is dependent on the MC scale. When the MC mode appears, the examinee cannot go back to the OA mode. Wrong choices in the MC mode receive no mark and the next item is easier. This method does not affect the final score of the test or punish a wrong OA, but it promotes examinees to demonstrate productive FL use and active FL extraction from their long-term memory. The duality of the system is adapted to students' divergent cognitive strengths and weaknesses.

AILA also tries to distinguish between errors and mistakes, using a simple method. It is a fact that in most MC questions at least one destructor is so close in meaning or in grammatical resemblance to the correct answer that may puzzle even examiners. The MC destructor that bears a close resemblance to the correct option is regarded as «incorrect but acceptable», receives no mark on the total score and the next item is of equal difficulty, giving the examinee a second chance to demonstrate competency on the same level. In the OA mode the system can also understand common speech errors, known as «slips-of-the-key», such as anagrams (e.g. «nad» instead of «and»). These types of mistakes are very common both in first and foreign language production, especially under stressful conditions and time limitations. Bearing in mind the fact that language is a flexible, ever-changing, living entity used to communicate meaning and retrieve information, we should not severely punish answers that have a slight deviation from the standard form.

2.3 Item Bank and Stopping Rule

The item bank consists of 600 items divided in the four CEF levels of competence (A2, B1, B2, C1), signifying item difficulty (b1-4). In each broad level of competence, items are sub-divided in three discriminatory levels (a1-3): The first discriminatory level (a1) contains items that are expected to be answered correctly by all examinees having the given competence, the second (a2) contains items that can be answered correctly by the average examinee, while the items in the third level (a3) can only be answered by the most competent students in this level. Finally, each discriminatory level is seperated in 5 content areas (c1-5), in order to ensure that examinees will answer a wide variety of language items.

The test starts with a given difficulty specified by the test-taker (bx), low discrimination (a1), first content area (c1), and random item selection. If the test-taker answers in MC mode correctly, then the next item is of the same difficulty (bx), medium discrimination (a2), second content area (c2), and random item selection, otherwise the next item is one difficulty level lower. If the examinee answers in OC mode correctly, then the next item is of higher difficulty (bx+1), high discrimination (a3), fourth content area (c4), and random item selection. In this stratified way, we ensure that examinees will gradually attain their level of competence by answering different item types. AILA algorithm has a compulsory minimum number of 15 required items. Thus, the minimum test length is 15 items and the maximum is 40 items. The test stops when the examinee answers at least 15 items, having shown competence at one level of difficulty. There are no time limits per item; however, the maximum test time is 45 minutes.

3. Outcomes and Conclusion

FLA for mixed-ability students should be personalized, flexible, and sensitive to human cognition, language processing and error correction. AILA, an adaptive placement test which measures competence in EFL in terms of CEF levels, gives students the chance to show productive and receptive language use. The system also tries to discern errors from mistakes by evaluating students' answers. Thus, proficient learners will be able to excel, showing active language production. AILA has simple technological features that ensure ease of use and navigational transparency. The system provides on-line help in the examinees' native language on how to process every item during test administration, thereby minimizing possible confusion for the test takers. The test items examine basic language skills which focus on syntax, grammar, semantics and sociolinguistics, and use authentic language whenever possible. The test can be easily administered and updated by examiners, who can delete or add items whenever needed. An elaborate statistical itemisation and student analysis system collects information regarding items' administration and test-takers' performance. In future, AILA aims to more efficiently exploit the potential of the computer by adding multi-media elements to the application.

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Applications

Using Information Retrieval to Detect Conflicting Questions

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Although E-learning has advanced considerably in the last decade, some of its aspects, such as E-testing, are still in the development phase. Authoring tools and test banks for E-tests are becoming an integral and indispensable part of E-learning platforms and with the implementation of E-learning standards, such as IMS QTI, E-testing material can be easily shared and reused across various platforms. With the knowledge available for reuse and exam automation comes a new challenge: making sure that created exams are free of conflicts. A Conflict exists in an exam if at least two questions within that exam are redundant in content, and/or if at least one question reveals the answer to another question within the same exam. In this paper we propose using Information Retrieval techniques to detect conflicts within an exam. Our solution, ICE (Identification of Conflicts in Exams), is based on the vector space model relying on tf-idf weighing and the cosine function to calculate similarity. ICE also combines the hybrid recommendation techniques of the EQRS (Exam Question Recommender System) in order to propose replacements for conflicting questions.

1. Introduction

E-learning has advanced considerably in the last years. Today, there exist many E-learning platforms, commercial (WebCT, Blackboard) or open source (ATutor), which offer many tools and functionalities, some aimed towards teachers and developers, and others aimed towards students and learners (Gaudiosi, Boticario, 2003). Nonetheless, some of E-learning's aspects, such as E-testing, are still in their early stages. E-learning platforms offer E-testing Authoring tools and Test Banks, nevertheless, most of these tools are limited to the platform itself and to the best of our knowledge, Test Banks are limited to the teacher's private use. With E-learning standards and specifications, such as the IMS QTI (IMS Question and Test Interoperability), teachers can explicitly share E-testing material by using import/export functionalities, available only on some platforms. In order to encourage knowledge sharing and reuse, we are currently in the works of designing and implementing a web-based assessment authoring tool called Cadmus. Cadmus offers an IMS QTI-compliant centralized questions-and-exams repository for teachers to store and share implicitly E-testing knowledge and resources. Moreover, Cadmus offers tools such as the EQRS (Exam Questions Recommender System) (Hage, Aïmeur, 2005) to help locate required information. Nevertheless, selecting questions depending on the teacher's preference cannot guarantee a flawless exam with no conflicts. A conflict exists in an exam if two or more questions are redundant in content, and/or if a certain question reveals the answer of another question within the same exam. Such conflicts might be frequent typically when a teacher is using shared questions, and especially in the automation of the exam creation process. This paper introduces ICE (Identification of Conflicts in Exams), a module within Cadmus that uses IR (Information Retrieval) techniques to identify conflicts within an exam. ICE is based on the vector space model using the cosine function and tf-idf weighing technique (Singhal 2001). Furthermore, ICE combines the EQRS techniques in order to recommend replacements for conflicting questions. The paper is organized as follows: section 2 introduces E-learning, and E-testing; section 3 presents Cadmus; section 4 describes the approach of ICE; section 5 highlights the testing procedure and results; and section 6 concludes the paper and presents the future works.

2. E-Learning

E-learning is the delivery and support of educational and training material using computers. E-learning is an aspect of distant learning, where teaching material is accessed through electronic media and where teachers and students can communicate electronically. E-learning is very convenient and portable, and involves a great collaboration and interaction between students and tutors or specialists.

There are four parts in the life cycle of E-learning: Skill Analysis, Material Development, Learning Activity and Evaluation/Assessment.

2.1 E-testing

E-testing is the development, delivery and support of testing and assessment material using computers. Research done on 908 volunteers from 25 different classes at Ball State University (Butler 2003) indicates that student taking exams on computers have a positive attitude towards a higher number of exams, and that E-testing promotes a higher sense of control within the students and less anxiety about taking exams. There exist many E-learning platforms that offer different functionalities, most offer only basic testing functionalities, and are limited to the platform itself . Furthermore, each E-learning platform chooses a different platform/operating system, its own unique authoring tools, and stores the information in its own format. Therefore, in order to reuse E-learning material developed on a specific platform, one must change considerably that material or recreate it using the target platform authoring tools. Standards and specifications help simplify the development, use and reuse of E-learning material (Mohan, Greer, 2003).

Currently, there are many organizations developing different standards for E-learning, each promoting its own standards. IMS QTI sets a list of specifications used in order to exchange assessment information, such as questions, tests, and results. QTI allows assessment systems to store their data in their own format, and provides a mean to import and export that data, in the QTI format, between various assessment systems.

3. Cadmus

Cadmus offers an IMS QTI-compliant centralized questions-and-exams repository for teachers to store and share E-testing knowledge and resources. A teacher using Cadmus may create his own questions using the Question Authoring Environment (Figure 1), has the choice to keep these questions private, or share them with other teachers. Furthermore, a teacher can use the Exam Authoring Environment (Figure 1) to access his questions, or shared questions from other teachers, in order to create exams. One of the Exam Authoring Environment functionalities is the EQRS (Exam Question Recommender System), a recommender system to help teachers in their search for exam questions. In order to create a proper exam, one must make sure there are no conflicts between the various questions of that Exam. A conflict exists between two questions in the same exam if one question reveals the answer to the other, and/or if the two questions are redundant. Such conflicts between questions within the same exam might be frequent, particularly when a teacher is using questions authored by others, and especially in the auto-

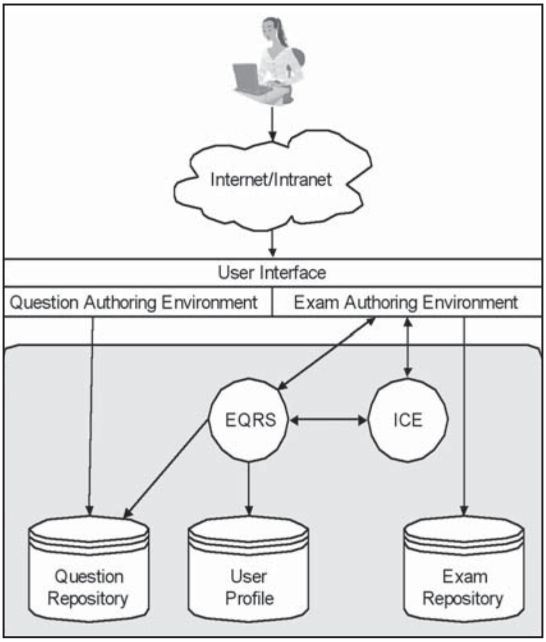

Figure 1 Cadmus Architecture.

mation of the exam creation process. ICE (Identification of Conflicts in Exams) is a new module imbedded into the Exam Authoring Environment; ICE uses IR (Information Retrieval) techniques, to detect conflicts between questions within the same exam. «Information retrieval (IR) deals with the representation, storage, organization of, and access to information items» (Baeza-Yates, Ribeiro-Neto, 1999). The aim of IR is to provide a user with easy access to the information of his interest, estimating the usefulness of a document to the user and rank them accordingly. IR systems usually assign documents a numeric score, used for ranking purposes. There are several models for this process (Baeza-Yates, Ribeiro-Neto, 1999; Salton, McGill, 1983); some of the most common models in IR are the vector space model and the probabilistic model (Maron, Kuhns, 1960).

4. ICE - Identification of Conflicts in Exams

ICE is a module within Cadmus that detects conflicts between questions within an exam. In order to detect these conflicts, ICE uses IR techniques based on the vector space model. Essentially, the vector space model relies on a similarity function to determine how identical the two documents are.

4.1 Similarity Function

In the vector space model, text or a document is represented by a vector of terms (Salton, Wong, Yang, 1975). The Cosine of the angle between two term vectors is used to evaluate the similarity between the respective texts or documents. If the Cosine = 1 then both documents are similar (angle between vectors = 0), and if the Cosine = 0, then the two documents are orthogonal (angle between vectors = 90). Equation 1 highlights the similarity function used to evaluate the similarity (the cosine) between the document vector and the query vector.

$$sim(\vec{d}_j,\vec{q}) = \frac{\sum_{i=1}^{n} w_{i,j} \times w_{i,q}}{\sqrt{\sum_{i=1}^{n} w_{i,j}^2} \times \sqrt{\sum_{i=1}^{n} w_{i,q}^2}}$$

Equation 1 Similarity Function.

In Equation 1 wi,j represents the weight of the term i in the document j and wi,q represents the weight of the term i in the query q. In an IR system a query represents what the user is looking for, and the documents represent the search domain. In ICE, the documents are the questions within a specific exam, and the query is one of the exam questions where ICE is trying to determine if any conflicts exist between this query question and the rest of the questions within that Exam. When an Author is creating a new question in Cadmus, he is required to specify one or more keywords relating to the content of that question. The terms that compose the query and document vectors are these, author specified, keywords. In order to specify the weight of the keywords (and) ICE uses the tf-idf weighting technique.

4.2 tf-idf weighting

The tf-idf weighting scheme relies on the tf (Term Frequency) and idf (Inverted Document Frequency) to determine the weight of a keyword in a certain document. The weight of a keyword i in a document j is calculated using the formula in Equation 2.

$$w_{ij} = tf_{ij} \times idf_i$$

Equation 2 tf-idf formula.

tfij represents the importance of the term i in the document j, and is calculated using Equation 3 where is the frequency of the term i in document j and is the maximum frequency of a term in document j. idfi represents the discriminating power of the term i and is determined using the formula in Equation 4, where N is the total number of documents, and ni is the number of documents in which the term i appears in.

$$tf_{ij} = \frac{freq_{ij}}{\max freq_j}$$

Equation 3 tf formula.

$$idf_i = Log_2\left(\frac{N}{n_i}\right)$$

Equation 4 idf formula.

4.3 ICE Process

Now that the similarity function and keyword weighing scheme is clear, let us put all the building blocks together. Figure 2 illustrates the ICE process. The first step of detecting conflicts in an exam is to select the Exam Questions. Since this process is already completed using the Exam Authoring Environment of Cadmus. There are three stages in the ICE process, preparation (tf-idf calculation), conflict detection, and conflict reporting.

```
Step1: Preparation
        Retrieve Exam data from the Exam Authoring Environment
        Set tf = 1
        Evaluate idf values for respective keywords
        Calculate w_ij = tf_ij × idf_i

Step2: Conflict Detection
        For i = 1 to Number of Questions in Exam {
                q □ Question (i)

                For j = i+1 to Number of Questions in Exam {
                        d □ Question (j)
                        Evaluate S = sim (q_i, d_j)
                        If S > Threshold then Mark conflict
                        }
                }

Step 3: Conflict Reporting
        Report marked conflicts
        Offer replacements for conflicting Questions
```

Figure 2 ICE process.

4.3.1 tf-idf calculation

The first step of the ICE process is to prepare the tf-idf values for the keywords. First, since exam questions are usually short, most keywords will appear only once, thus ICE assumes the tf of all the keywords to be 1. Furthermore, the Exam Authoring Environment keeps track of a counter for each of the various question's keywords; incrementing or decrementing the counter each time a question is added to, or removed from the exam. ICE iterates over the value of the keyword's counter applying Equation 4 to compute the respective idf values. Finally, ICE applies Equation 2 to evaluate the keywords' weights.

4.3.2 Conflict Detection

To detect conflicts within an Exam, ICE iterates the query vector (qi) on the questions of the Exam, such that i $\leftarrow$ 1 to N-1 (N is the total number of questions in the exam). Then, for each qi, ICE iterates the document vector, dj, on the remaining questions, where j $\leftarrow$ i+1 to N. At each iteration (i,j), ICE calculates S1 = sim(qi,dj). If S1 is greater than or equal to the threshold T, then ICE reports Qi and Qj as redundant questions. The value of T was determined through testing and is set at 0.45. Furthermore, at the same iteration (i,j), ICE will automatically extract the keywords of the correct answer(s) of Qi, and adds these keywords to qi, resulting in a new query qai. ICE then computes S2 = sim(qai,dj). If S2 is greater than or equal to the threshold T, then ICE reports the conflict between Qi and Qj: Qj reveals the answer to Qi. Moreover, at the same iteration (i,j), ICE will also automatically extract the keywords of the correct answer(s) of Qj, then adds these keywords to dj, resulting in a new document vector daj. ICE then computes S3 = sim(qi,daj). If S3 is greater than or equal to the threshold T, then ICE reports the conflict between Qi and Qj: Qi reveals the answer to Qj.

4.3.3 Conflict Reporting

When ICE detects a conflict between two questions, that conflict is reported. Both questions are specified with the option to view or replace each of the questions. To replace a question, the user can search for questions with the same criteria (Type, Difficulty ...) as the question to be replaced, or he can change one or more criteria to search for replacement questions.

In the first case, the search for the replacement questions is done through a simple content based filter. All the questions with the same criteria as the question to be replaced are retrieved. ICE will try first to retrieve all the questions with the same criteria as Qr (the question to be replaced) and none of its keywords. If no replacement questions were found, ICE will attempt a new search for questions with the same criteria and some of Qr's keywords. In order to know which keywords to allow in the replacement questions, ICE selects Qr's prohibited keywords with the highest weight, such that if a replacement question had all of Qr's remaining keywords, the similarity will remain less then the threshold T. ICE will perform the new search for all the replacement questions with the same criteria as Qr and none of the prohibited keywords.

In the second case, when one or more search criteria are specified by the user, the search for replacement questions is conducted using the EQRS (Exam Question Recommender System) technique. This approach consists of using a Feature Combination, Hybrid recommendation technique (Burke 2004; Burke 2002) to recommend questions. The recommender system is composed of two levels; a Content Based filter and a Knowledge Based filter (Burke 2002). The Content Based filter retrieves a set of candidate questions according to their content, using the same technique for the keywords as described in the previous paragraph. These candidate questions are then sorted by the Knowledge Based filter with regards to their relevance to the user's preferences.

5. Testing and Results

ICE was tested on a questions bank of 200 Java questions. The test generates an exam by selecting between 10 and 40 questions randomly. After the creation of the random exam, ICE will detect the conflicts. There were a total of 204 randomly created exams with conflicts. The random exams had an average of 28 questions. There were no undetected conflicts; and a total of 512 reported conflicts. Since the same conflict between two questions might appear in several exams, recurring conflicts were grouped into conflict case. Grouping the recurring conflicts into cases resulted in a total of 93 different conflict cases, out of which 77 (83%) were true conflicts and 16 (17%) were not actual conflicts. These results are illustrated in Figure 3. Most of the invalid conflicts reported are due to keywords selection and weighing. Different questions with very similar keywords, such that the difference in the context of the questions is defined by only one of the keywords have a similarity greater than the threshold. Increasing the value of the threshold will result in true conflicts being undetected. Nonetheless, testing proved that setting T to 0.458 (T was 0.45 originally) increased the accuracy of conflict reporting, although now, there are undetected valid conflicts (Figure 4). A further increase in the value of T reduced the number of invalid conflicts reported, but did not ameliorate the accuracy since more true conflicts were passing undetected. Table 1 summarizes the results of the tests.

Although ICE was tested only on Java questions, the accuracy of conflict detection will not suffer with subjects other than Java since ICE relies mainly on the keywords specified by the author of the question. Initial testing on sample Artificial Intelligence and Databases questions have resulted with a similar, high accuracy conflict detection.

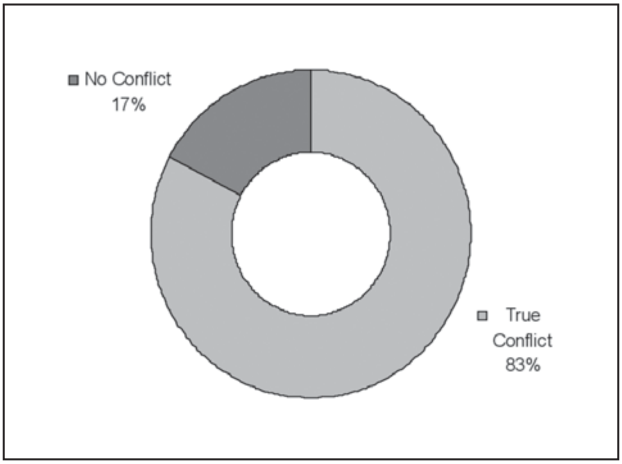

Figure 3 Preliminary Results.

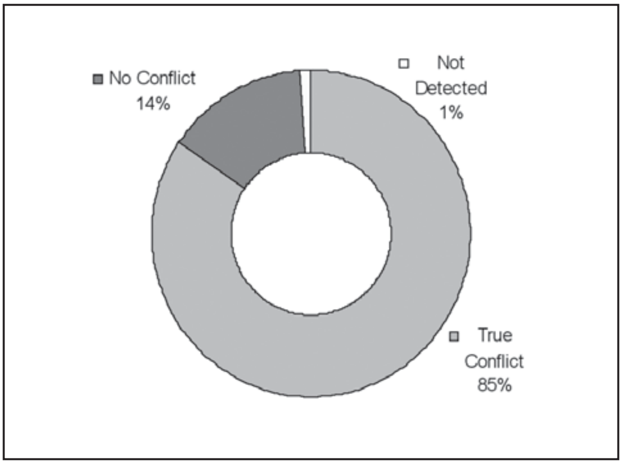

Figure 4 Results after increasing T.

Furthermore, testing on the available question base has revealed that whenever a question Qi is detected to reveal the answer of a question Qj, then both questions are similar enough in content to be detected by ICE as redundant questions. Although it is not a complete surprise (since it is logical to assume that for a certain question to reveal the answer of another question it should be similar in context), further testing on a bigger questions base, and searching for particular

Table 1
RESULTS SUMMARY

	Total	No Conflict		True Conflict		Undetected Conflict	
Preliminary Results	512	111	21.68%	401	78.32%	0	0%
Refined Results	93	16	17.20%	77	82.80%	0	0%
Results T = 0.458	90	13	14.44%	76	84.44%	1	1.11%

cases can help determine the need of testing for such conflicts (if Qi reveals the answer of Qj).

6. Conclusion

Today, many E-learning platforms offer E-testing authoring tools. These tools create E-testing material that will remain mostly confined to their author and the platform itself. Cadmus, an alternative solution, offers an independent IMS QTI-compliant platform to create and share E-testing material. Furthermore, to help the teachers in the exam creation process, Cadmus includes ICE, a module that detects conflicts between questions within an exam. ICE has been tested on a Question Bank of around 200 Java questions. Results show that ICE conflict detection is quite accurate. After testing ICE on 204 randomly created exams, with an average of 28 questions in each exam, all conflicts were detected, and the accuracy of the conflict reporting was at 83%. Slightly increasing the threshold improved the accuracy by 2%, although some conflicts remained undetected. Furthermore, thus far, testing has shown that whenever a question is detected by ICE to reveal the answer of another question, the two questions are similar enough in content to be reported as redundant. Additional testing, on a larger question bank, is required to decide on the necessity of checking for such conflicts.

The main focus for future work is to enhance the weighing scheme to further refine the accuracy of conflict detection, for instance: taking advantage of the tf, such that keywords related to content weigh more that other keywords. Moreover, further consideration on combining tools such as the EQRS (to select the questions) and ICE (to validate the exam) in order to automate the exam question selection, bearing in mind restrictions such as to include (and not exclude due to conflicts) questions to cover the exam domain.

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Application

Ricognizione sulle piattaforme di scambio per i Learning Object e implementazione di un portale – repertorio sul modello OpenCourseWare – Educommons per la raccolta di Learning Object

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Abstract

This paper is constituted by two rather distinct sections: in the first section we will summarize the overall situation of standards and formats applied to develop an «Exchange Platform« for Learning Objects, educational material and courseware. In the second section we will describe our activities in progress to implement an experimental CourseWare portal based on Plone and Educommons. Specifically we report our activities of Plone products testing within the Educommons platform and the developing of a couple of specific tools, «KMap Semantic Search» that should support Semantic queries on the courseware modules and «Web-Learning Object Reviewing tool» that should enable a web-assisted peer-reviewing activity in a «multi-body – multiportal» academic environment.

Web-Learning «Object reviewing» is a module developed for the Educommons LMS platform to facilitate and partially automate the job of classifying, validating and localizing Learning Objects.

«Object reviewing» uses a workflow, based on open standards, to support a collaborative process of validation, reviewing, publication and dissemination; it is addressed to small teams of reviewers serving a large community of end–users (subsrcribers/teachers) and an intermediate community of active users (authors-teachers, «Learning Objects» proposers). The validation process will be divided in three sub-processes, each one relating to a different point of view: the linguistic and communication point of view; the structure of the pedagogical program; the subject ontology domain. The second sub-process, concerning the pedagogical structure, and a related Semantic Search Tool, will be guided by an ontology that is being developed by a third party.

Our goal is to produce a model of such a tool and to prototype it on Educommons, a Learning Management System based on the Python/Zope/Plone stack, that recently made its appearance in the university environment; thanks to the development effort of the Utah State University, it is available under GPL-style license.

Within the framework of the Educommons initiative, we plan to experiment «Object reviewing» in collecting, classifying, and distributing reusable Learning Objects, in order to allow the end-user to build his/her own paths of investigation on a selected subject.

1. Origini e contesto evolutivo della iniziativa Educommons – USU-OCW

EduCommons™ è il nome assegnato dalla Università Statale dello Utah al progetto software di un portale di gestione di materiali didattici distribuito sotto licenza GPL. USU-OCW è il nome della implementazione di un portale OpenContentWare[1] presso la Utah State University (USU) sotto licenza Creative Commons. Creative Commons è una organizzazione no-profit nata nel 2001 dedicata alla missione di rendere accessibili al pubblico i prodotti di diverse attività creative (scrittura creativa; saggistica; musica; cinema); dal 2004 la licenza Creative Commons, completa dei metadati e dell'impianto tecnologico che facilita il reperimento in rete degli artefatti rilasciati sotto CC, è stata internazionalizzata a 21 paesi, tra i quali anche l'Italia.[2]

L'insieme dei due termini, USU-OCW identifica un insieme di software, di accordi legali di distribuzione, di accordi tecnologici e di standard condivisi tra Utah State University con altre istituzioni educative superiori con lo scopo di diffondere conoscenze scientifiche attraverso l'uso di Internet e del Web, massimizzando l' efficacia tipica del media e minimizzando la possibile interferenza di attriti ed inerzie generate da cause tecnologiche o commerciali (ad es: incompatibilità nel formato dei dati o dei metadati, contratti coperti da copyright per la distribuzione del software o del contentware, ecc.)

USU-OCW / Educomons si colloca a fianco di molte altre simili iniziative: è difficile elencarle tutte, ma citiamo le principali. La più notevole fra tutte è (anche se certamente non la prima in ordine temporale), di origine nordamericana: il Mit lancia nel 2001 l'OpenCourseWare, che raccoglie negli anni sino ad oggi intorno ad un progetto comune qualcosa come 1000 istituti universitari di diversa importanza (la cifra include alcune tra le principali università nordamericane, sudamericane e asiatiche); sempre del 2001 è Universitas 21 – U21Global online university – consorzio di 17 università dell'area Commonwealth (Europa, Nordamerica, Australia e nuova Zelanda, Asia); sempre del 1999 è il primo sviluppo del progetto Moodle, realmente distribuito nella sua versione attuale nel 2001, ad opera di Martin Dougiamas, Phd in Pedagogical Sciences; precedentemente a queste nasceva nel 1999, per iniziativa della Rice University, the Connexions Project; ulteriormente successiva è, sempre preso il MIT la Open Knowledge

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[1] OpenCourseWare, come si descrive più avanti, è il nome originale del progetto nato presso il MIT nel 2001 per la diffusione aperta e gratuita dei materiali didattici on-line. In conseguenza dell'impegno del MIT su questo progetto, il termine OpenCourseWare è diventato il nome «comune» di una iniziativa globale, che autonomamente è stata fatta propria da un grande numero di università nel mondo.

[2] Si sono occupati della localizzazione della licenza Creative Commons Marco Ricolfi (Politecnico di Torino) e Juan Carlos De Martin,, dell'Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni del Consiglio Nazionale delle Ricerca (IEIIT-CNR). Il sito e la relativa documentazione on-line sono gestiti dal IEIIT-CNR.

Iniziative; poi la Open Learning Iniziative; quindi abbiamo presso la Utah State University la USU-OCW / Educommons; in una diversa scala temporale si ha anche un serie di analoghe iniziative di origine europea: Claroline, Flee3, Free-Learningproject, Eduplone; nessuna di queste però ha raggiunto le dimensioni globali di MIT-OCW.

Mentre alcune di queste iniziative sono basate su software proprietario (è il caso ad es. del OCW presso il MIT, realizzato su piattaforma Microsoft) altre sono basate su software Open Source distribuito in licenza GPL; in questi casi dunque viene messo in distribuzione gratuita sia il ContenWare che il Software per gestirlo; alcune di quelle citate, un numero significativamente crescente, inoltre, condividono anche nel dettaglio la scelta della piattaforma Application Server su cui il software LMS Open Source è costruito: USU (OCW-USU), Rice University (Connexions), Uni Klagenfurt, ad esempio, riposano sull'application server e Content Management System Zope/Plone.

Molte di queste iniziative si propongono l'obbiettivo di creare un repository «federato» di unità atomiche di conoscenza condivisa, universale, che fornisca, in modo più o meno esplicito i seguenti «servizi funzionali»:

– un sistema di scambio (un «mercato» comune aperto) di unità interoperabili di apprendimento (Learning Objects) riutilizzabili e riassemblabili per diversi scopi didattici
– un sistema di classificazione standardizzato dei LO
– un sistema di validazione e revisione basato sui LOM (Learning Objects Metadata) e su SCORM, con estensioni e/o specificazioni
– feedback disponibile per i produttori di Learning Objects per perfezionare il proprio processo di produzione

È nostra intenzione inserirci in questo contesto di cooperazione, possedendo già alcuni anni di esperienza diretta di gestione di un portale italiano per il censimento di pratiche per il web-learning, tuttora accessibile on-line, www.web-learning.org,[3] ed alcuni anni di esperienza diretta di gestione di un portale LMS[4] con relativa produzione di corsi, basato su una piattaforma Open source, Moodle, sopra citata (Lariccia, 2003). Le azioni che intendiamo intraprendere a questo scopo sono finalizzate, a breve termine, alla implementazione di un portale sperimentale OCW-eduCommons, allo sviluppo di strumenti, basati sulla pila di software già esistente, che facilitino per docenti italiani ed europei lo sfruttamento della inizia-

[3] Il portale, <URL:http://www.web-learning.org>, realizzato per conto di un progetto CNR – MIUR, ha raccolto un certo numero di esperienze italiane nell'area dell'e-learning.

[4] Il portale, accessibile all'indirizzo <URL: http://web-learning.infn.pg.it> è basato su Moodle e raccoglie alcune decine di corsi tenuti da docenti della Università di Perugia e dell'Università di Roma.

tiva universale sull'OpenCourseWare; e quindi alla implementazione di un portale OCW al servizio di un consorzio aperto di università nazionali ed, auspicabilmente, europee.

Il nostro progetto prevede: a) implementazione di un portale basato sulla utilizzazione dell'OCW-MS (OpenCourseWare Management System) disponibile in GPL, eduCommons; b) la completa implementazione e nazionalizzazione dell'ambiente OCW-MS; c) la creazione, prototipale, di un repository di courseware con almeno alcune delle caratteristiche sopra esposte d) la creazione di un tool, operante nell'ambito Zope/Plone, idealmente a fianco del OCW-MS Educommons, per rendere parzialmente automatico, e quindi facilitare e rendere «affrontabile» il compito di una «revisione» a più mani di LO sottoposti all'attenzione di un comitato scientifico preposto;[5] e) la gestione concreta del repository e delle operazioni di valutazione e validazione rese possibili dal modulo Web-learning Objects Reviewing..

Le fasi a), b) e d) sono descritte nella loro concreta implementazione, con relativi commenti sulle difficoltà incontrate e con osservazioni circa la perfettibilità dei processi. Le fasi c) ed e) sono descritte come future implementazioni che si renderanno possibili con il convergere di altre forze e di altre squadre di lavoro, auspicabilmente altre università italiane ed europee.

1.1 L'esperienza internazionale: OpenCourseWare: verso un protocollo accademico

OpenCourseWare è l'iniziativa nata presso il MIT di Boston nel 2001 per realizzare la missione dell'Istituto per la distribuzione universale del sapere. OpenCourseWare ha avuto uno straordinario successo internazionale ed ha dato luogo ad una serie di accordi con organizzazioni universitarie in giro per il mondo (Giappone, India, Argentina, Cile, Brasile, Venezuela etc); si calcola che il numero totale delle istituzioni universitarie interessate, in lingua inglese, giapponese, indiana, spagnola e portoghese sia prossima a raggiungere le 1000 unità.

La scelta operata dal MIT nel 2001 fa seguito ad un laborioso processo di valutazione durato un intero semestre. Per il Mit si trattava di scegliere se operare come una delle tante istituzioni universitarie dedite in quegli anni (÷2000) al compito di far migrare gradualmente selezionate attività di didattica verso la gestione online del CourseWare (con eventuale redditività associata all'allargarsi del target proprio dell'istituto) oppure scegliere un modello orignale. Le opzioni possibili per il MIT erano diverse, e diversi i modelli economici possibili. Il Mit ha scelto di assecondare la propria mission specifica, quella della universalità del sapere, che gli deriva dallo statuto millenario delle Università. L'impatto che ha avuto questa scelta sul panorama mondiale sta gradualmente fornendo spiegazioni e materiale di

[5] Il comitato scientifico sarà inizialmente poco più che simbolico; ma dovrà essere dinamicamente estendibile in relazione alle proposte ed ai concreti progetti di web-learning da sostenere.

comprensione a chi in principio non comprendeva la razionalità possibile di quella scelta: noi vogliamo far notare come essa sia naturalmente correlata alla dinamica dell'OpenSource (iniziata, per inciso proprio nei laboratori di Computer Science del Mit circa 35 anni orsono) e allo studio delle opzioni e dei modelli economici correlati all'OpenSource. Molti studi sono comparsi in questo campo, molte sono le analisi da parte di economisti (Glass, 2004); (Lerner, 2004) e specialisti di diritto (Lessig, 2005).

In particolare, riguardo all'apparente antinomia tra Università / Conoscenza Scientifica e Università / Mercato, argomento che sta assumendo un sempre maggior peso nel dibattito contemporaneo,[6] a partire dal citatissimo articolo di Heller, «The Tragedy of Anticommons» (Heller, 1998), riferito all'altrettanto citato The Tragedy of the Commons» (Hardin, 1968), si fa strada la convinzione che non sia né necessario né utile imporre una scelta «integralista» e che sia piuttosto utile mantenere efficienti entrambe le opzioni, ciascuna applicata nell'ambito corretto: quindi che sia opportuna la convivenza dell' università come motore di conoscenza libera e collettiva, e al tempo stesso della università come attore nel mercato del 'technology transfer'.

2. Il modulo KMap Semantic Search Tool

La prima attività pratica che abbiamo condotto sul portale educommons.eu è stata la integrazione di alcuni moduli/prodotto per la piattaforma Plone, nati per il progetto europeo Interop, in particolare il prodotto KMap.

Interop KMap V. 1, include al momento attuale, un numero limitato di tipi di contenuto, appartenenti a 3 famiglie: 1) Entità organizzative, 2) Attività e 3) Risultati di Ricerca.

Le istanze di dati di KMap per ciascuno di questi tipi sono «classificate„ in relazione alla tassonomia di INTEROP, utilizzando le «reference» , cioè dei collegamenti relazionali, ciascuno avente come fonte una istanza di dati di KMap e come obiettivo un «dominio di ricerca» rappresentato da un concetto della Tassonomia.

In Interop KMap V.2, (primo trimestre 2007) la classificazione sopra descritta sarà perfezionata, fissando ad ogni riferimento di classificazione («reference») un «peso», di modo che ogni istanza di dato sarà virtualmente caratterizzata da un «vettore di classificazione» la cui dimensione corrisponde al numero di concetti in tassonomia e di cui gli elementi sono numeri reali nella gamma (0.0, 1.0).

Sarà possibile generare automaticamente il vettore di classificazione, «estraendo» i concetti ed i pesi collegati con software specifico, ma sarà anche possibile creare/rivedere manualmente questo vettore.

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[6] Soprattutto in seguito ad alcune clamorose vicende brevettuali che hanno avuto luogo nel campo della ricerca genetica, come la registrazione sotto brevetto, da parte di società private, e poi, con intenti difensivi anche da parte di università pubbliche, di interi geni del DNA umano

In linea di principio, la ricerca semantica sarà effettuata nei seguenti modi:

- rappresentando una domanda («query») come «vettore di ricerca»
- confrontando il vettore di ricerca ai vettori di classificazione delle istanze dei dati. In pratica, il confronto di vettore potrebbe richiedere un elevato numero di accessi e una elevata potenza di calcolo così che:
- dovrebbe avere la priorità un possibile filtraggio basato su criteri di ricerca non semantici
- potrebbe rivelarsi necessario generare indici ad-hoc per i vettori di classificazione.

2.1 Integrazione di KMap/Interop con gli altri contenuti della piattaforma Educommons

Il prodotto KMap può essere integrato in linea di principio con gli altri contenuti della piattaforma Plone e, nel caso specifico, intendiamo integrarlo con i contenuti di Educommons usando lo stesso metodo di classificazione. Più specificamente:

- la stessa Tassonomia utilizzata da KMap sarà la risorsa di base per la classificazione
- omologhi vettori di classificazione dovrebbero essere costruiti e mantenuti
- funzioni simili saranno disponibili per la classificazione e la ricerca.

La piattaforma di INTEROP già include dati che appartengono a molti diversi tipi di contenuto: alcuni di questi dati appartengono a tipi «nativi» di Plone, altri sono stati definiti installando «prodotti» che costituiscono le estensioni alla piattaforma per la gestione dei contenuti Plone (come ad esempio è nel caso di Educommons).

Quindi, anche in Educommons, sarà possibile specificare:

- quali tipi di contenuto saranno disponibili per la classificazione basata sulla tassonomia
- per ogni tipo di contenuto, quali campi dovrebbero essere analizzati per l'estrazione di concetti nella classificazione automatica.

Noi proponiamo inoltre di aggiungere uno o più tipi di «reference» da utilizzare per collegare il contenuto classificabile ai concetti della tassonomia.

Batch classification

È possibile, per gli utenti con diritti di accesso sufficienti, lanciare una procedura automatica di classificazione per tutti i tipi di contenuto conforme alla classificazione, o un loro sottoinsieme, a partire dal «pannello di controllo» del «SemanticClassificationTool» accessibile dal «pannello di configurazione del portale» della piattaforma Educommons.

Configurazione della classificazione

È possibile, per gli utenti con diritti di accesso sufficienti, regolare/modificare i parametri di configurazione della funzionalità semantica di classificazione, usando il «pannello di controllo» del «SemanticClassificationTool«. Come detto precedentemente, l'utente Administrator potrà:

- specificare quali tipi di contenuto saranno disponibili alla classificazione basata sulla tassonomia e, per ogni tipo di contenuto
- quali campi dovranno essere analizzati per l'estrazione di concetti, usando quali «accessor methods»
- possibilmente, quali metodi di conversione del testo dovrebbero essere applicati prima dell'estrazione dei concetti
- possibilmente, come i differenti campi d'informazione dovrebbero avere effetto sul calcolo del «peso» associato ad ogni concetto nella tassonomia nel «vettore di classificazione» associato ad ogni oggetto di contenuto.

Noi proponiamo una struttura modulare di classificazione in cui 1. la funzionalità di classificazione sia altamente indipendente dal modello dei dati da classificare e 2. abbia dipendenza bassa dalla struttura della tassonomia dei concetti. In relazione al 1. obiettivo, seguiremo un metodo simile a quello di PloneOntology, un interessante prodotto di terzi, in cui tuttavia viene effettuata soltanto una forma molto approssimativa di classificazione e non esiste quasi nessuno strumento di ricerca. L'applicazione V1.3 di KMap si compone dai dati v.3 di KMap e da 2 prodotti di Plone:

- P1oneSaurus 0.2, un'estensione del prodotto che è sviluppato per lo sviluppo del glossario di INTEROP (P1oneSaurus 0.1)
- KMAP 1.3.

Per raggiungere anche l'obiettivo 2. e cioè per supportare in modo flessibile la classificazione semantica in Educommons, come attualmente in INTEROP, abbiamo ritenuto conveniente aggiungere alla suite di applicazioni propria di KMap, un terzo prodotto, che abbiamo chiamato KMapClassification, in cui:

- siano implementati tutti i metodi di classificazione semantica e parte della funzionalità di ricerca
- siano gestite tutte le informazioni di configurazione, riguardo ad es. ai tipi di contenuto classificabili (sia tipi di KMap che non-KMap).

3. Il modulo Web-Learning Object Reviewing

Oltre ad eseguire test di installazione di integrazione e di applicazione abbiamo proceduto a progettare per grandi linee un prodotto specifico che ritenevamo di interesse prioritario per il «mercato» italiano di questa piattaforma per migliorare le condizioni di utilizzazione e di diffusione degli ambienti OpenSource di Web-learning.

Il prodotto, denominato Web-learning Object Reviewing si propone l'obiettivo di facilitare la recensione, la classificazione la validazione, il rating dei Moduli (LO) che ci si augura verranno proposti dai contributori permettendo di editare, ed estendendo, l'uso dei metadati già proprio di eduCommons. Allo stesso tempo si facilita la traduzione di moduli esistenti in altri repository facilitandone la gestione in ambiente italiano per mezzo di uno specifico modulo adattato e derivato da LinguaPlone.

Come accennato in precedenza, nell' ipotesi di sperimentare con i Learning Objects e la loro riutilizzabilità, consideriamo come obbiettivo prioritario quello di creare una «piattaforma di scambio», nel senso che a questo termine hanno dato gli economisti Laffont, Lerner e Tirole (Laffont, Tirole 2001; Lerner, Tirole 2004) una «piattaforma di scambio», secondo questi autori, è un modello economico nel quale almeno due classi di utenti sono in grado di negoziare regole di «impegno» convenienti e sostenibili, non necessariamente simmetriche. Piattaforme di questo tipo ad es. sono la Playstation2 della Sony e la Xbox della Microsoft: in questi casi, come in ogni altra piattaforma con sistema operativo proprietario, i competitori devono attrarre, per generare un mercato ed avere successo, da una parte gli utenti dei giochi e dall'altra gli sviluppatori dei videogiochi. Se non esistesse una vasta collezione di videogiochi disponibile la console sarebbe destinata a sicuro insuccesso; se non esistesse la console gli autori di videogiochi non potrebbero sviluppare i loro prodotti.

Il caso in discussione, quello della generazione del «mercato» dei Learning Objects, condivide le descritte caratteristiche delle piattaforme di scambio: si devono attrarre da un lato i discenti (che dal punto di vista dell'ente universitario sono il mercato finale) e dall'altro i docenti/autori. I docenti autori hanno in questo caso alcune caratteristiche atipiche rispetto alle altre categorie esaminate nei modelli studiati sinora da Laffont e Tirole; ma non poi così distanti dal modello in generale per non poter essere oggetto di studi ed analisi previsionali. Dunque è in conseguenza di queste considerazioni che riteniamo fondamentale almeno tentare, anche nel campo dell'interscambio dei Learning Objects, la strada diretta alla costruzione di una piattaforma di scambio, o «mercato di scambio», per i materiali didattici validati.

3.1 Le funzioni progettate

Le funzioni che assolve il modulo sono quelle immaginate per un sistema di revisione distribuito:

– form per la sottomissione del modulo/dei moduli o del corso strutturato
– notifica ad un sottogruppo del gruppo utenti «comitato dei revisori», selezionata sulla base dei metadati del modulo (ai fisici per un modulo sulla teoria dei campi,

ai biologi per un modulo sul DNA, agli storici per un modulo sul Rinascimento)
– inclusione del modulo in un repository temporaneo, in attesa della validazione
– strumenti di esame della correttezza della sintassi SCORM e LO
– meccanismo di raccolta dei voti da parte dei componenti del comitato
– accettazione e pubblicazione o notifica di necessità di revisione da parte dell'autore/proponente con messaggi parzialmente automatizzabili

3.2 Il prototipo Educommons.eu

Il prototipo WLOR dovrebbe essere pubblicamente visibile, a partire dal dicembre 2006, all'indirizzo <URL:http://www.educommons.it> e <URL:http://www.educommons.eu>; sono al momento implementate solo le funzioni principali e non è ancora stato completato il processo di ingegnerizzazione e di pacchettizazione (che ne rende possibile l'eventuale distribuzione).

3.3 Altri moduli Plone integrabili con KMap e WLOR

L'architettura dello stack Python/Zope/Plone garantisce un elevato livello di modularità e di integrazione di diversi prodotti sviluppati nel rispetto delle linee guida documentate dalla comunità. Tra i numerosi prodotti Plone già esistenti molti si prestano ad integrare un ambiente di apprendimento, rendendolo di volta in volta più 'aperto', più dotato sul piano comunicativo, più dotato nei confronti sul piano della integrazione con il Semantic Web, ecc. In particolare per quanto riguarda questo aspetto della integrazione con gli sviluppi del Semantic Web Plone può offrire numerose opportunità. Oltre agli sviluppi in corso da parte degli autori di questo articolo, esistono in Plone diverse esperienze di sviluppo di prodotti per l'interfacciamento di Ontologie: PloneOntology, Kmap, ecc.

Gli sviluppi futuri nel campo del web-learning sono a loro volta intrinsecamente correlati all'evoluzione del Web verso il Semantic Web; il modello di apprendimento come «costruzione cooperativa di conoscenza» è perfetto per integrarsi nel modello più ampio del Semantic Web, dove la gestione delle ontologie e delle mappe confluisce, nei recenti sviluppi, nell' Ontology Learning (Maedche, 2002; Hai Zhuge, Yanyan Li, 2005).

4. Creazione ed incentivazione della comunità Web-Learning

Tra le considerazioni che ci muovevano a sviluppare e ad adottare un sistema in cui la priorità fosse chiaramente posta sulla facilità di interfaccia per il docente, figurava in primo luogo la difficile situazione in cui si muovono molti dei «reali» docenti accademici italiani: stretti in una morsa tra precarietà dei contratti, scarse risorse, inconsistenti aiuti da parte di giovani collaboratori.

Nella situazione italiana si diceva, il docente dovrebbe godere di alcuni minimi benefici basilari per essere portato a dare il proprio consenso ed il proprio impegno alla preparazione di materiali didattici on-line: a) poter fruire a sua volta, di materiali da importare, in abbondanza e con facilità; b) godere di gratificazioni esplicite di qualche natura nel caso in cui il proprio materiale venga selezionato e adottato da altre istituzioni e/o altri docenti; c) godere di un sistema di supporto tecnico metodologico (tipo call center o centro di supporto centralizzato locale o remoto) sia per l'attività di reperimento che per l'attività di caricamento dei propri moduli didattici d) avere la possibilità di esprimere i propri desiderata alla comunità degli autori. Questi elencati rimangono probabilmente un set di obbiettivi ineludibili da conseguire per creare una vera community di docenti contributori. E, come nella generalità dei modelli sopra descritti delle «piattaforme di scambio», anche in questo caso per creare il successo nei confronti del pubblico finale è necessario creare la compagine dei docenti/contributori.

4.1 Le funzioni progettate allo scopo di incoraggiare la riutilizzazione dei LO

Avvertiamo come l'obbiettivo che emerge da questo lavoro, che è descrivibile come un tentativo di educare la comunità dei docenti universitari e secondari italiani ed europei alla «riutilizzazione dei materiali didattici» on-line, possa sembrare troppo ambizioso.

Non è questo il contesto adatto (siamo in un ambito di discussione tecnologica applicativa e metodologica) per discutere questo problema e probabilmente non siamo nella posizione adatta noi per farlo. D'altra parte, siamo allo stesso tempo coscienti di come questo sia un problema centrale per il contesto culturale nel quale agiamo.

I problemi che sotto questo giacciono, sono numerosi e di enorme portata, ne citiamo alcuni:

– la conservazione della lingua nazionale
– la conservazione del principio di autonomia dell'insegnamento
– la tutela della autonomia culturale nazionale nell'ambito europeo

4.2 Iniziative ed azioni di supporto ipotizzabili

Sulla base della ricognizione effettuata, e prese in considerazione molte opinioni significative riguardo alla economia dell'Open Source,[7] ci siamo convinti di quanto sarebbe opportuno per l'autorità pubblica, supportare secondo il principio della sussidiarietà lo sviluppo di contenuti in accordo con le caratteristiche indicate dal Mit-OCW. Ad esempio, sarebbe opportuno attivare un consorzio europeo

[7] In particolare (Lerner, 2004 #143), (O'Reilly, 1999 #153) (Baldi, 2003 #157)

che faciliti l' organizzazione degli istituti di formazione superiore a competere sul piano dell'OpenCourseWare sul piano globale. Obbiettivi di un eventuale progetto Europeo potrebbero a nostro avviso essere, tra gli altri:

– incentivare la convergenza verso uno standard di fatto — OCW — in via di affermazione a livello globale
– creare, attraverso opportune incentivazioni, un mercato per i produttori di materiale riutilizzabile
– creare le condizioni per una autosostenibilità di questo mercato, creando le condizioni di «remuneratività sufficiente» con integrazioni, incentivi premi ecc. e creando regole di «armonizzazione» tra le licenze di tipo Educommons, GPL, e Creative Commons (gratutità per i fruitori) e la redditività dello stato e del ruolo del personale docente
– incentivare la produzione e la traduzione di materiali in ambiente multilingue europeo (italiano/inglese, francese/inglese, tedesco/inglese, olandese/inglese ecc.)

5. Conclusioni

Il mondo accademico internazionale si confronta da anni con le opportunità offerte dalle tecnologie che sul Web abilitano alle pratiche on-line di supporto all'apprendimento; da alcuni anni in particolare è apparso un nuovo standard, o un nuovo «format», OpenCourseWare (OCW), che sulla spinta propulsiva del MIT di Boston, è andato diffondendosi rapidamente su scala globale. Esso prevede, ribaltando in qualche modo il paradigma corrente, secondo cui ciascuna università provvede ad attivare corsi speciali che possono essere diffusi per mezzo di un sistema LMS (e-learning), la diffusione *universale*, aperta e senza vincoli, né tecnologici né legali, dell'intero catalogo dei contenuti di conoscenza che sono già alla base dell'attività didattica dell'università come istituzione.

La ricognizione di cui diamo conto nel presente lavoro ha rilevato numerosi ambienti che già operano nel mondo accademico sulla base di software Open Source. Tra queste abbiamo citato come caso particolarmente interessante la Utah State University che ha scelto Python/Zope/Plone come ambiente di base per il suo eduCommons, che implementa il primo vero e proprio OCW-MS, OpenCourseWare Management System, distribuito su base di licenza GPL.

Tuttavia, la diffusione, di per sé molto promettente per il futuro, di queste «piattaforme di scambio» costituite, a vari livelli, da software e da formati di contenuto e di modalità di licenza dello stesso, non è ancora così elevata (e in Europa lo è meno che negli Stati Uniti, e in Italia lo è meno che in Europa).

Questo stato di cose, a parere degli autori, è da addebitarsi a diversi fattori: a) difficoltà del multilinguismo (ovvero della necessità di adattamento del Courseware alla lingua nazionale); b) necessità di validazione istituzionale dei materiali; c) capacità / volontà da parte dei docenti di sostenere direttamente e autonomamente la produzione, l'adattamento o il riutilizzo di materiali educativi di qualità.

Abbiamo progettato ed implementato un portale basato su software OS prodotto da Utah State University per il suo OCW, e lo abbiamo integrato con alcuni strumenti, pre-esistenti, o realizzati ad hoc, che possono migliorare questa situazione. Una delle attività svolte ha riguardato i test di compatibilità tra ambienti eduCommons e Plone 2.1 e tra eduCommons e diversi moduli Plone pre-esistenti o sviluppati in parallelo con altre applicazioni, in particolare PloneSaurus, KMap, e KMap Semantic SearchTool. Altra parte rilevante dell'attività è stata finalizzata allo sviluppo di moduli, sia con l'intenzione di valutare le differenze e le difficoltà specifiche dello sviluppo nella nuova piattaforma, sia per dare un contributo iniziale ad una attività di catalogazione e classificazione affidata ad un pool di università confederate.

Queste attività sono state svolte con attenzione alla realtà specifica del nostro paese, ma con un occhio a tutte le realtà europee che hanno simili problemi di frammentazione linguistica, di difficoltà di finanziamento delle attività di didattica superiore, di difficoltà ad aggregare i contributi educativi che i diversi attori del sistema educativo superiore propongono su base spesso volontaristica e informale, e proprio per questi motivi in modi e quantità non sufficienti a dare luogo ad un repository riconosciuto di conoscenze su base nazionale o europea.

Si ringraziano: Paolo Lariccia, per l'INFN di Perugia, che ha sostenuto la opportunità di sperimentazione di nuovi ambienti web-learning; e, per il contributo in conoscenze, tutti membri della comunità di sviluppo Plone: in particolare Alan Ruyan e Alexander Limi di Plone Foundation e John Delhin della USU, che hanno mostrato interesse per la diffusione in ambiente educativo della piattaforma Plone, ospitando strumenti di collaborazione.

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eSCM: a web-based institute for sharing knowledge and competencies in the educational area of supply-chain management

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Abstract

The paper presents a web-based institute proposed for sharing knowledge and integrating competencies in the educational area of supply-chain management (SCM). The institute is being implemented as an Internet based portal and addresses both students and teachers on university educational level and employees in the industrial sphere. The methodology of the institute as well as the web portal architecture, enabling the implementation of the methodology, are presented. Thereafter, a demonstration of course delivery in the e-Learning environment of a virtual class is eventually provided.

1. Introduction

According to EU documents, e-Learning can be defined as follows: «the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration».

The definition may find application in 2 particular educational contexts: on university educational level and in a life learning scheme for employees in the industrial sphere (Ilie-Zudor et Al., 2005). This definition is, in fact, particularly consistent in the case of the employees, supposed to work in the context of an extended enterprise, where means of ICT integration are clearly required between collaborating enterprises, to enact collaboration in the day by day execution of the supply chain relationships (vendor managed inventory, continuous replenishment, etc.) as well as in processes situated at an higher level of supply chain tactical and strategic planning (collaborative forecast and production planning, collaborative product development, etc.). The adoption of e-Learning tools in supply chains can be intended as another collaborative practice, selected by the extended enterprise in order to improve awareness of the supply chain relationships and cultural integration. When e-Learning is applied in the context of improved remote exchanges on university educational level, the adoption of new multimedia technologies and the Internet may be intended in different ways. The main concern of this paper is that the e-Learning serves to improve the collaboration between experts in the field of SCM, in order to develop a common knowledge library (common repository) where resources (materials to be learnt) may be accessed for course deliveries in diverse educational settings. Henceforth, e-Learning is intended, by the authors, basically as an e-Teaching method enabling the integration amongst educational partners coming from different real institutes. On the other hand, the use of e-Learning for students is fostered in a more traditional way: the students may access the Internet resources as an aid to supplement and complete their face to face learning.

These two strategies — e-Learning for employees in the industrial sphere and e-Learning for teaching to students in diverse educational settings — are now being experimented in the framework of Leonardo da Vinci program, as a part of an international project funded by the European Union (project title: 'An internet-based education/training platform in the field of supply-chain management, for students, teachers and industrial employees'; acronym: eSCM). This paper will present the e-Learning methodology and the web portal features adopted to enable the e-Learning for teaching to students in diverse educational settings (see sections 2, 3, 4 and 5). The common knowledge framework, achieved in the Consortium as a base ground for a common understanding and development of the materials to be learnt on SCM, is shortly presented (see section 6), together with a description of the course delivery initiating from it. A demonstration of course delivery (section 7) is eventually shown, as a follow up of the knowledge framework commonly agreed.

2. The methodology

The e-Learning methodology can be defined by considering the user profiles and their perspectives of the eSCM platform. Four user profiles have been defined for eSCM: student, teacher, content provider / editor and project worker.

(i) The project worker is the specific profile adopted to carry out project task activities in industrial contexts (e Project section of the portal), it will be out of the paper scope.

(ii) Teachers and content providers / editors are the actors required for the generation and organisation of the materials to be learnt (e Teaching section of the portal).

(iii) The e-Learning tasks of students in eSCM (e Learning section of the portal) is eventually a follow up of the learning path built by their own teacher whilst organising the courses and composing the materials to be learnt therein. Besides lectures, some practical activities and games may be also organised in laboratories (Ilie-Zudor et Al., 2005).

The Figure 1 summarises the concept of the profiles in the eSCM platform.

Looking now more closely to the profiles of the content providers / editors and teachers, content providers / editors develop contents in a modular way and upload the materials to be learnt in a common repository of learning objects (eSCM content). Thereafter, teachers can develop and administer their own courses wherein to deliver the eSCM material to be learnt. The course development and administration is enabled with different types of flexibility offered by the platform.

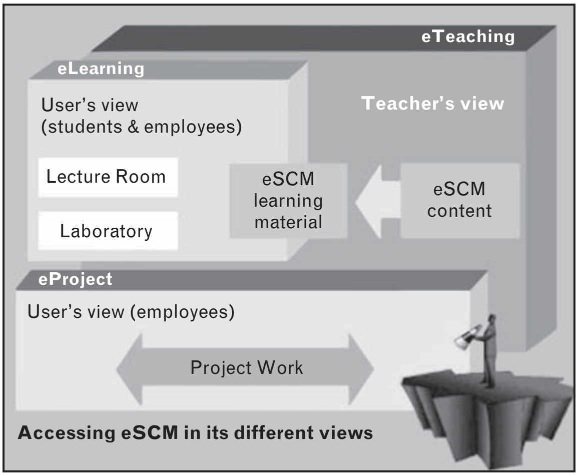

Figure 1 Accessing the eSCM platform in different profiles.

(i) Teachers may structure freely the contents of own courses or inherit a structure of contents commonly agreed by the eSCM consortium in order to organise the SCM knowledge arena (flexibility of course organisation).

(ii) They may build own courses by assembling the learning objects already available in the eSCM common repository, upload own learning objects specifically developed for their course, or, eventually, adopt a mix of learning objects in between (flexibility of content composition).

(iii) They may administer the course delivery to students by means of a set of support services enabling communication (blackboard, agenda), interaction (forum, messenger, chat, …) and testing activities with students (flexibility of course administration).

3. Teaching with different styles: a co-design approach

One of the most relevant key-point of the eSCM project is about different teaching styles to be used for selected target group of students. Different teaching styles are possible as a follow up of the flexibility offered by the eSCM platform.

In particular, the eSCM staff planned for two different learning scenarios, wherein to apply different styles. The first one (scenario A) is for students on university educational level, the second is for employees in the industrial sphere (scenario B).

As far as the scenario A, an higher education courseware is made of sequential units to be learnt according to a step by step approach. The core elements of this approach are: teaching notes section and modules composed of a collection of learning objects. In teaching notes, students can have both a brief description of topics and format files associated, as shown, as an example given, in the following figure 2.

Figure 2 shows the teaching note of a course now active on the eSCM platform. The course is built up as a mix of learning objects, some developed for the course itself and others inherited from the eSCM common repository. The materials to be learnt (animated or not, integrated with voice or not, written in textual formats) is accessed in a sequential way by students.

As far as the scenario B, the materials to be learnt are more suitable for updating job competencies. Henceforth, more relevance should then be given to: case studies as learned lessons; simulations and role playing — that is: in different professional scenarios, problems to face are set-up and a solution is required similarly to what usually happens in the real work places –; emphasis to opinion leaders experience, in order to collect expertise and best practices in supply chain management.

In this scenario B, 2 case studies from industry (one in Italy and one in Rumania) are now being used as test benches. The case study from Italy, for example, is run in the context of a medium enterprise in the automotive sector and one of

SCENARIO A

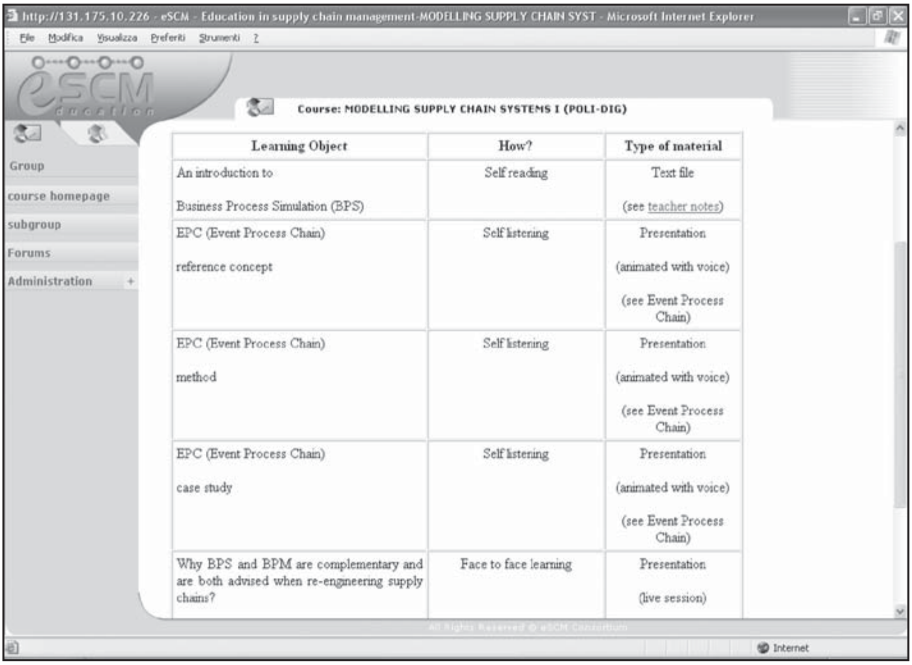

Figure 2 An example of a teaching note developed according to Scenario A.

its supplier (small enterprise). The supplier will be involved in a simulation and role playing of the real activities that are usually done during its order fulfilment process. The role playing will allow to simulate existing practices and to prove some improvements of these practices. Indeed, the order fulfilment process is being integrated with some new collaborative activities (such as anticipating plans of order fulfilment based on capacity plans). The e-Learning methodology will be an enabler to lead to a smooth change management.

In any case, either in scenario A or B, the instructional design and production of all materials to be learnt have to be tested and evaluated by users before their final release (co-design approach). To this end, the eSCM staff designed and realised a questionnaire as follow-up about:

- user-friendly functionalities and interface of the eSCM as learning environment;
- quality of materials to be learnt, edited as learning objects in the eSCM catalogue.

This questionnaire is composed by three main sections: user profile section, platform section and course materials section; in each section some items can be found and selected with relative ranking scores; in addition to them , spaces for free comments/notes suggested by students are available.

The first outcomes of the questionnaire are very interesting to consider. These outcomes regards, at this moment, only the scenario A, being the scenario B under development. In the context of this scenario, all the student testers, although they have different nationalities, education, language and culture, are suggesting similar improvements: they would like to have a more interactive materials to be learnt, that is they want some more learning activities to face as active players (simulations) and try all they need in very simple and quick manner.

In relation to these suggestions, the eSCM staff is effectively re-designing and implementing its own learning environment according users supervision, who are getting co-designers involved in very useful way. The co-design approach seems again a result made possible by the flexibility of the eSCM platform. This, in fact, helps to plan for partial redesigns (for the platform and contents) according to the feedback from co-.designers.

4. The web portal architecture

The eSCM platform has been developed in Java technology server side (Locatelli et. Al., 2001), following specifics of the standard J2EE (Java 2 Enterprise Edition). The adaptation to the standard J2EE allows that the platform is executed from any application server in compliance with the standard (from JRun to Bea Weblogic, from Tomcat to IBM WebSphere). This server side structure is supported by different browser platforms, therefore users can easily access the platform through Internet Explorer, Opera, Firefox by simply browsing www.e-scm.org. The architecture overview depicted in the following figure 3 is showing the four main parts of the platform:

(i) the content editing side (up-left);
(ii) the learning management system (LMS) engine (up-central);
(iii) the administration side (down);
(iv) the user side (up-right).

The content editing side is the environment for content development. In the platform, it is possible to develop and publish two kinds of contents: structured and informal contents.

(i) Structured contents are SCORM 1.2 compliant contents developed through a specific tool for content editing. In this project, the CMS (Content Management System) provided is Macromedia Breeze. This tool enables to start from a power point presentation in order to develop a multimedia learning object (LO). In order to be visualised and available in the common repository of the eSCM platform, the LO has to be finally uploaded by the system administrator.

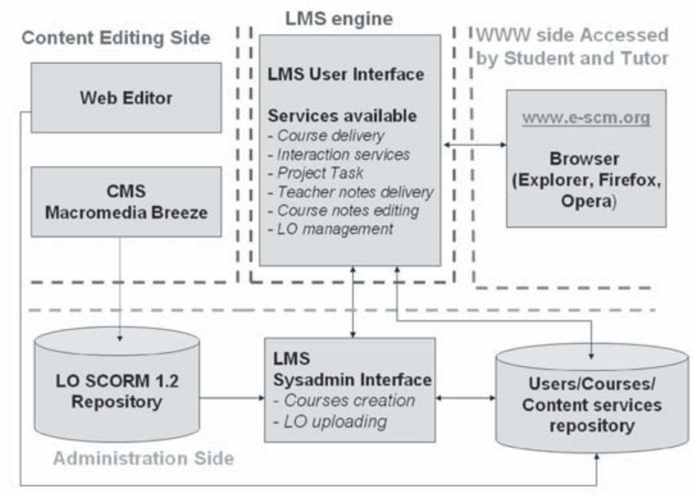

Figure 3 Architectural overview of the e-SCM web portal.

(ii) On the other hand, informal contents are normally uploaded directly by a teacher through a Web Editor interface. These contents are mainly constituted by different kinds of format like ppt., pdf., doc., xls. etc. and they are connected by means of a hyper textual interface created by the teacher him/herself.

The LMS engine is the core of the platform characterised by a collection of different interaction and communication services. This part is thoroughly described in the next section. The administration side plays a very important role for user, group, course creation and content management, in particular it allows the system administrator to upload the structured contents. This should be done only after a phase of quality review by the quality management team of the project. Eventually, the user side is the user interface delivered to students and teachers browsing the platform at www.e-scm.org. Each user is then provided with his / her username and password through a subscription procedure that is possible from the portal home page. After the login phase the user can customise his / her own profile and subscribe the different contents made available in the platform.

5. The learning management system

The LMS system is the engine of the web portal and it is constituted by a series of services allowing the community interaction and the content delivery to students.

The following figure 4 represents 2 captures where it is possible to identify the logical hierarchical structure of the LMS in terms of services. This hierarchy is structured in 2 levels. At the community level, users can access to a series of services in order to interact with the whole community. These services are forum, blackboard and chat. At the course/group level, users can adopt the same services only for interacting with the members of the same course/group which they belong to. Furthermore, users subscribed to a course/group can access the structured or informal contents associated to the course/group itself.

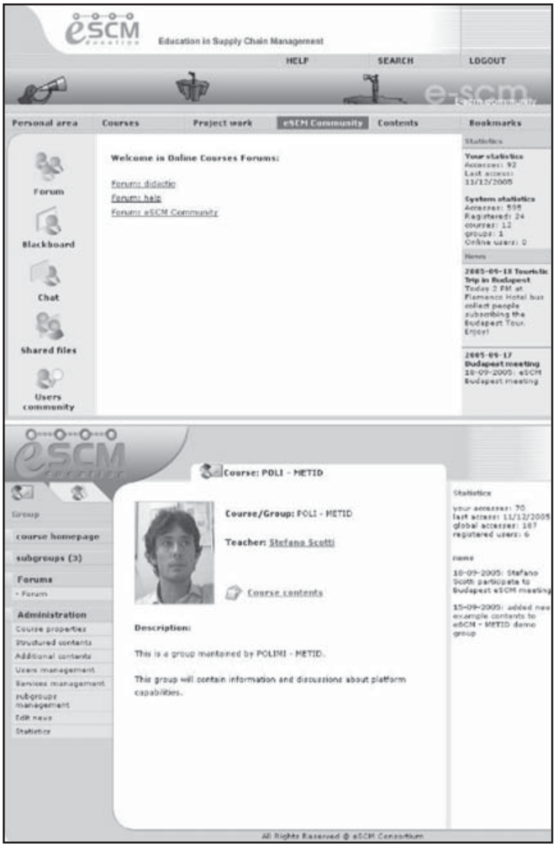

Figure 4 Community services (left capture) vs. course/group services (right capture).

A series of other services are characterising the LMS. In particular:

(i) a personal area where the user can modify his / her profile in terms of personal information like password, picture, address, etc.;

(ii) a table of structured contents available in the platform; in this table, a list of LOs is available and its described with information about the time of LO delivery and the author;
(iii) a frame containing general statistics on the use of platform and personal statistics;
(iv) a frame containing the latest news at the community and course/group level.

Eventually, some services are specifically provided to teachers for course delivery. In particular, some services allow a teacher to create the didactical structured and informal contents in the course. The Web Editor is, as said, the tool for editing the informal contents. It is connected directly with the course/group lead by the teacher, this allows to the teacher an easy and fast creation of informal didactical contents. Conversely, concerning the structured contents, the teacher can access an easy interface called Content Area. This is the common repository of LOs previously developed by the content providers / editors using Macromedia Breeze. In this Content Area, the teacher can select one or more LOs and create a didactical path that will be provided to all the users subscribed to the course/group that he / she is leading. Some other services allow to track the activities of the virtual classroom and the usage of the services by the students belonging to the course/group.

6. From the knowledge framework to the course delivery

The common repository of eSCM learning objects (LOs) is structured according to a list of topics of the materials to be learnt around SCM. The topics were defined after the achievement of a common understanding of the SCM scope and processes, tools and systems falling therein. This achievement was based on the consortium competencies over well known references from SCM literature Fox (Chionglo, Barbuceanu, 1993; Hieber, 2002; Supply Chain Council, 2006; Stadtler, Kilger, 2000). The short list of topics comprises the following items: fundamental issues in SCM, strategic planning, tactical planning, operations and execution, event management, network information management, collaboration methodologies, performance measurements and business process modelling.

An eSCM teacher may then exploit the LOs therein available for content composition: he / she may include them in the learning path designed in the context of his / her own course. He / she may also inherit directly the structure of the knowledge framework for his / her own course organisation.

7. A demonstration of course delivery

A demonstration of course delivery is hereby simulated by using the structured contents accessible from a teacher from his / her own course/group (Colorni et.

Al., 2005). The attention is mainly paid on how it is flexible to organise a course for a teacher by using structured contents previously built (through Macromedia Breeze). Once the teacher enters the Content Area, he / she is provided with the possibility to create folders and associate to the folders different LOs previously collected in the eSCM common repository.

By using a simple interface (see Figure 5) the teacher can organise the course structure, adding folders, sub-folders and associate LOs to these folders.

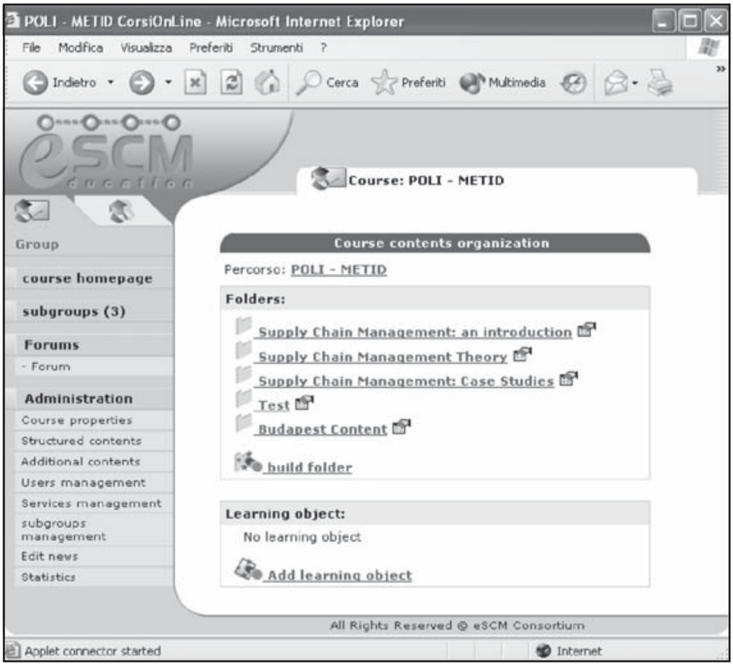

Figure 5 Defining the course structure – teacher interface.

The figure 6 is now representing the user interface provided to the student accessing the course. Therein, the student finds the structure created by the teacher. He/she finds it as a hierarchical structure of LOs created by the teacher according to a certain methodology (sequence) of contents required to achieve a determinate didactical path. By clicking on a single LO, the user is provided with a streaming of multimedia content with text, audio and animation (a capture of a demo is represented in Figure 6).

8. Conclusions

The eSCM consortium is now developing the common repository of the eSCM platform. A set of learning objects is, in fact, being developed by each partner after

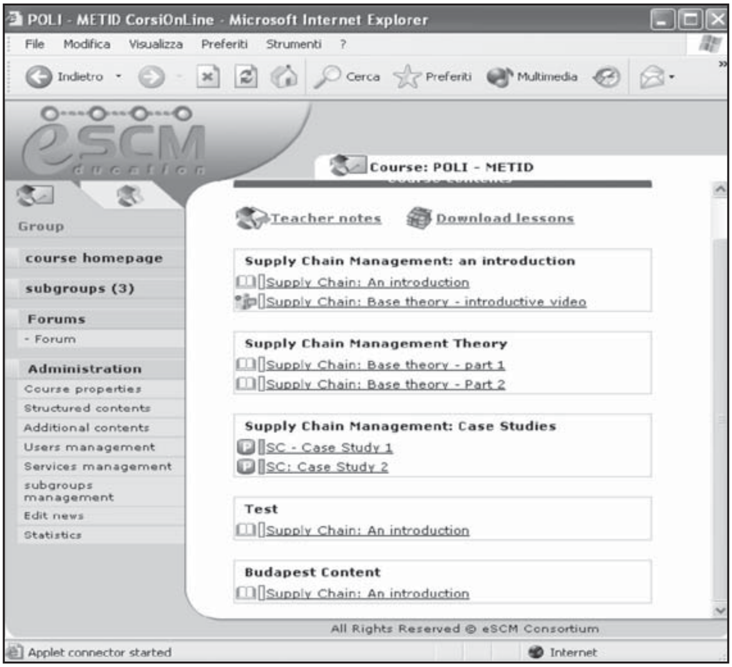

Figure 6 Accessing the LO in a course — student interface.

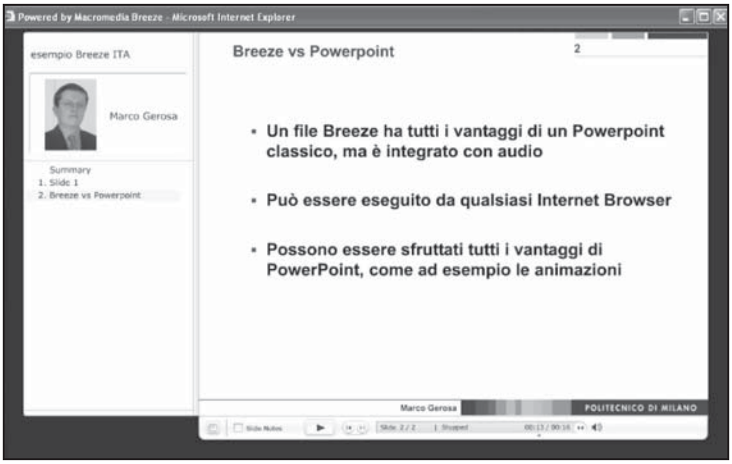

Figure 7 The LO interface provided to the user through multimedia streaming.

agreements regarding a standard format for learning objects. The testing phase with students on university educational level started since the first semester of 2006 and will end at the beginning of 2007. In the mean while, a parallel development and testing is planned in order to extend the knowledge sharing in industrial settings. Therein, the e Project section of the portal will be specifically adopted, to test, in project tasks, some targeted problems of co-operation and integration in supply chains. In this case, rather than a lecture or a gaming activity, which is the case of a course delivery to students, it will be adopted a more practical approach, in order to come close to the needs of the industrial practitioners of the e-Learning tool. Simulation and role playing will be the main teaching style adopted to this end.

9. Further information about eSCM

The Consortium working on the eSCM project comprises five active partners and five so-called passive partners represented by small and medium-size enterprises contributing to the evaluation of the eSCM platform in their business context.

The active partners are the: Computer and Automation Research Institute, Hungarian Academy of Sciences (SZTAKI), Politecnico di Milano (POLIMI), Fraunhofer Institute for Manufacturing Engineering and Automation (IPA), University of Bergamo (UNIBG), Politehnica University of Bucharest (UPB).

The eSCM project is still ongoing; the development period of the project is of 30 months (October 2004 - March 2007). Responsibility for the information presented falls on the authors and not on the European Commission and the National Agency of the Leonardo da Vinci Program either. Further information on the project is available on the eSCM web portal at http://www.e-scm.org.

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Applications

Validation criteria for a GQM plan in e-learning platforms evaluation

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The GQM methodology (Basili 2002) is a top down approach that proceeds from the goals to the metrics of a paradigm of measurement and introduces the advantage to be completely independent from the dominion of application, allowing to get extremely specific results for the context in examination.
The basic principles respond to the following questions:

> What do we want to measure? *(Goals)*
> Which factors do they engrave? *(Questions)*
> Which data have I to pick up and with which metrics have I to appraise them? *(Metrics)*
> What are the points of view through which can I look my measure activity? *(Quality Focus)*

Once defined, the scheme of measurement with the methodology GQM, it must have submitted to a validation in order to check the syntactic and semantics correctness of it among the various levels of the method. The validation responds to the question: are we building (or has it been built) the correct GQM? It serves to determine if the offered final product satisfies the use for which has been created, in short The GQM satisfies the requisite for which it has been created .
The paper shows as the validation of the GQM, used for the comparative evaluation of some bases of and-learning open source, has been conducted. To the moment the document is constituted of 13 clusters (macro goals), 48 goals, 79 quality focus, 495 questions and 91 metrics.
The experimenta is still in progress both at laboratories of e-learning of the DIS of University of Naples Federico II and at DAUIN of polytechnic in Turin.

1. Introduction

The e-learning platforms evaluation can be performed from several points of view, and by several actors. This activity requires both the evaluation of implementing software package, the process we use in order to produces the formative act, the process you use in order to evaluate the contents, and the process you use in order to check the achieving of yours goals.

In this environment it is mandatory identifying several indicators to measure and to quantify in order to able evaluating a formative process. Several methods are proposed, among other we mention (Basili 2002, Basili 1980, Fuggetta 1998), which focuses on the formative method, but it doesn't consider the validation and the representation of the collected data. In this context we need a quantitative approach to quantify the whole formative process.

The GQM methodology is a top town approach starts from the goals to the metrics used to measure. It is independent from the application dominion and it allows you to get very specific results for the context under test.

It is based on the following questions:

– What do we want to measure? (Goals)
– Which factors do they engrave? (Questions)
– Which data have I to pick up and with which metrics have Ito appraise them? (Metrics)
– What are the points of view through which can I look my measure activity ? (Quality Focus)

So, we must define the formative process' goals, get some questions or hypothesis from each goal, to quantify the goal and we must collect the data answer the questions with our data and/or validate our hypothesis.

It is important considering that the questions must cover all the goal.

Therefore from the answers we must get measures (the Metrics). These metrics, when compared with threshold values (if available), gives you the goals satisfaction.

In (Fadini B., Maresca P., and others 2005) the concept of cluster is thus introduced. A cluster is a macro goal assemble a set of goals about the same argument.

For instance, in the cluster Communication Tools all the goals about communication tools (synchronous and asynchronous) are joined.

The cluster concept is useful to «slice» the platform and focus on a specific part of it, as we'll see later it is also useful to make comparison between the platforms and to analyze better the collected data.

The GQM methodology present a model that specifies the general goals for a measuring process. This model can be modified by the evaluator, and it must be validated before his application. This document is the GQM Plan, an official document of the GQM process (fig. 1)

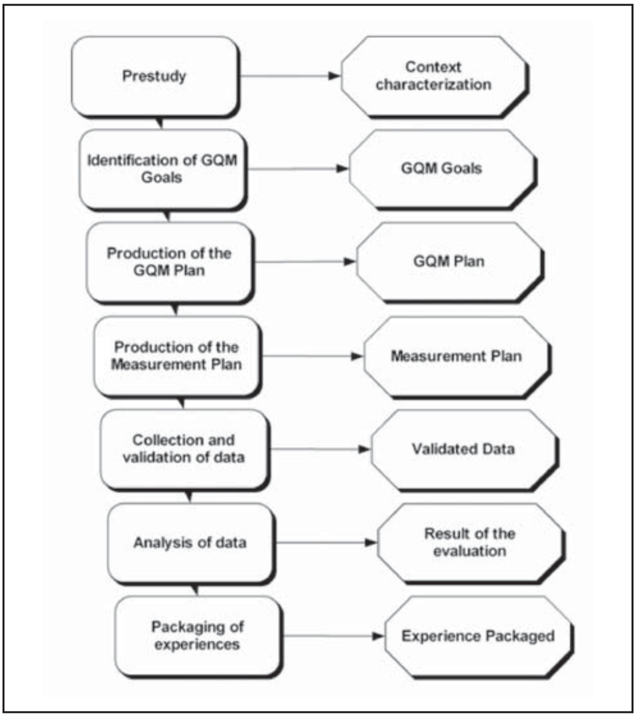

Figure 1 The GQM Process.

In the next section we will explain how a GQM plan is arranged. In section 3 we will consider his validation and in the section 4 the experimental results of the first phase of the project will be reported.

2. GQM Organization

The document is developed in 3 sections:

1. Purpose of the measuring plan,
2. Point of view adopted in the evaluation,
3. Context (Environment in which the goal is considered).

Following the main model guidelines you can create several templates.

The template choosen for this work is the following:

Purpose of the measuring plan: to (define, analyze, validate,…) the (product, process,…) to (understand, evaluate, improve)

Point of view adopted for the evaluation: to analyze (cost, process, product, user satisfaction)

Context (Environment in which the goal is considered): characterized by problem factors, people factors (manager, users, experience), process factors (methodologies, standards) tools, methods, etc.

A GQM plan example has been given in (Fadini B., Maresca P.,and others 2005a, 2005b,2005c). From this example it is possible to see it is a complex and dynamic document, and it is possible to introduce many types of errors, for this reason the validation process is very important.

3. GQM Plan Validation

When the measuring schema is defined it must be validated to check the semantic and syntactic correctness through the levels (Fadini B., Maresca P.,and others 2002).

The validation process is composed of 2 phases: semantic and syntactic phase. The first one monitors if it follows the original plan, the second one controls the respects of the measure plan. The 2 phases are important to discover bugs that can invalidate all the GQM process.

GQM Plan Validation: syntactic analysis

In our work we used the following check list:

1. Are the questions classified with goals?
2. Have the questions its metric?
3. Are the goals and metrics description clear?
4. Is the derivation method for each metric shown?
5. Is the measure unit for each metric shown?
6. Is a threshold value for each metric shown?

GQM Plan Validation: semantic analysis

In our work we used the following check list:

1. Are all the questions relevant for the selected goal?
2. Is the connection goal-question evident?
3. Are the metrics valid for the questions?

The validated GQM model define which metrics must be collected in order to evaluate the product and the process, and them will be compared with the threshold values.

The threshold values, are, usually got from the rules or from the customer requests.

If these values are not defined you can take them from the technical literature.

4. Experimental results

Experiences are so far very satisfactory, mainly thanks to the easiness of the in-the-field data gathering campaigns, regardless the intrinsic complexity of the target problem. The actual GQM plan for an e-learning platform includes (Fadini B., Maresca P.,and others 2005) so far 48 goals, 79 quality focuses, 495 questions and 91 metrics.

At the University «Federico II» in Naples and at the Politecnico di Torino, in Turin, Italy we performed a comparative analysis of a set of open-source e-learning platforms. The Platforms are: Moodle, A-Tutor and Dokeos, which are the best three in the GQM rough's ranking.

In the following table there are the scores got by the platform in each cluster of goal. All the data are normalized to 10.

Table 1

SCORES GOT BY THE PLATFORM (DATA ARE NORMALIZED TO 10)

	Moodle	*Dokeos*	*A-Tutor*
Installation and Standards Compliance	9.12	8.25	7.75
SCORM Compliance	4.07	9.17	7.98
General Characteristics	8.5	7.25	6.375
Content Management	7.11	7.2	7.33
Curses and Users Management	6.33	6.14	5.83
Communication Tools	7.17	8.88	7.1
Learning Tools	8.33	4.66	4.83
Co-working tools	8.87	5.1	0
Tracking e Reports	8.02	8.5	4.5
Help and Documentation	9.5	8	5.5
ISO 9216	9.18	8.17	8.17

Using, the kiviat diagrams you can easily see the weak points and the strong point of each platform and choose the best one.

For instance you can see what is the best platform in terms of SCORM Compliance Morrison 2006, SCORM 2006), or you can just compile the GQM Cluster regarding Learning Tools and choose the best learning tools platform according to the qualities characteristics (IEEE98, IEEE97, IEEE99).

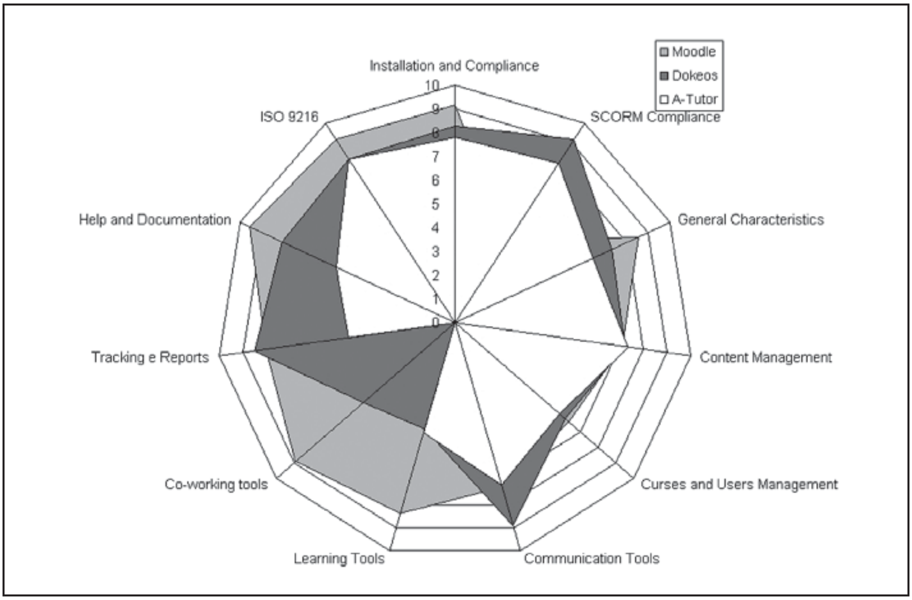

Figure 2 A kiviat diagram of the data in tab 1.

5. Conclusions

The measuring activity of a complex system, such as an e-learning platform can be controlled during his path. The GQM helps to generate a structured approach, but the system can degenerate quickly if you don't follow some validation criteria.

This criteria are useful to monitor the GQM growing. During the validation phase would be useful to have some automatic or semi-automatic checkers in order to speed up the activity. In this way the GQM construction can proceed side by side with the validation, however the validation should be performed by a different team.

In our experience the use of this process allowed us to find out many contradictions between the goals, and to be more accurate in the choosing of the quality focus, and of the metrics.

As future development we will require a tool to perform the evaluating phase.

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Applications

E-knowledge e oltre

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Abstract

«The nature of knowledge is that it makes itself obsolete». Drucker così avverte chi gli pone la domanda su come gestire il cambiamento in una situazione in cui conoscenza, apprendimento e lavoro fondono simultaneamente le loro esigenze di qualità. La nostra riflessione parte dalla considerazione che il knowledge-conoscenza, in una società che pur si definisce *Knowledge Society,* è tuttavia estremamente deteriorabile. Il suo valore si sgretola, la sua «vita di scaffale» è brevissima, a meno di un continuo rinnovamento che si ottiene attraverso scambi e trasformazioni.

Il concetto di *e-knowledge,* introdotto nel 2003 da Mason, Nelson & Lefrere nell'ampio saggio *«Transforming e-Knowledge: A Revolution in the Sharing of Knowledge»,* ha attecchito rapidamente. Gli autori, appoggiandosi ad un neologismo, hanno catturato i cambiamenti in corso e le prospettive dell'»esperienza del conoscere» in una società, come la nostra, molto legata alla tecnologia come digitalizzazione spinta dell'informazione in tutti i suoi supporti.

Percorreremo, seguendo questi autori, la distanza tra conoscenza comunemente intesa, ed e-knowledge come «conoscenza a componente digitale». Osserveremo inoltre i processi di conoscenza/apprendimento emergenti. Nello *«Zeitgeist»* del 2005 percepiamo una nuova curvatura, una trasformazione ulteriore. In modo irregolare, ma progressivamente, appoggiate ad avanzate tecnologie software e *wireless,* si instaurano modi informali di condivisione della conoscenza, fuori del controllo dei canali e dei sistemi istituzionali. Sono forme nuove, molto avanti negli aspetti sociali, ma non prive di incrinature.

1. E-world ed e-knowledge

È una moda espressiva quella di utilizzare il prefisso *e-* per molte cose del nostro tempo dense di elettronica: concetti e oggetti, ambienti e strumenti intrisi di una certa qualità che li rende «virtuali», intriganti e, non di rado, alquanto misteriosi. Così chiamiamo questo mondo *e-World,* un concetto-immagine che ci accompagnerà, accanto a quello dell'*e-knowledge.*

L'e-world è lo sfondo sul quale si sviluppano i fenomeni turbolenti che trovano radici nella tecnica contemporanea: il cyberspazio ancora e sempre, poi i *next media:* giornalismo partecipativo, *webcasting*, *podcasting*, blogging, *geomapping*, 3D browsing, ed oltre. Altri stili emergenti sono: la vita *on-the-move* grazie al *wireless*, il *computing* appoggiato alle nanotecnologie, il tribalismo telematico dei giovani. Ogni quadro di questa scenografia è in evoluzione. Nell'e-world la trasformazione più importante, tuttavia, è quella che riguarda la «conoscenza», o «knowledge»,[1] nome-ombrello inglese tra i più popolari dei nostri tempi.

«*The nature of knowledge is that it makes itself obsolete*». Drucker (Drucker 2000) così avverte chi gli pone la domanda su come gestire il cambiamento quando conoscenza, apprendimento e lavoro fondono simultaneamente le loro esigenze di efficacia e qualità. La nostra riflessione parte dalla considerazione che il knowledge-conoscenza, in una società che si definisce *Knowledge Society*, è tuttavia estremamente deteriorabile. Il suo valore si sgretola, la sua «vita di scaffale» è brevissima, a meno di un continuo rinnovamento che si ottiene attraverso scambi e trasformazioni.

Utilizzando tecnologie già sviluppate o che diverranno mature a breve, vengono ideate e si diffondono rapidamente in molti campi nuove pratiche di gestione della conoscenza. In questa trasformazione gioca fortemente l'effetto *push* dei concetti e delle realizzazioni, sebbene sperimentali, della cosiddetta Ambient Intelligence (Riva et al., 2005). Il campo dell'istruzione, in particolare, si trova in posizione privilegiata per trarne i maggiori benefici e assumere una posizione di primo piano.

Tutto ciò viene chiamato «*e-knowledge»,* parola nuova, coniata apposta per meglio caratterizzare le nuove forme di conoscenza che si intravedono.

2.1 Il cambio di paradigma

«*Paradigm shift*» (cambio di paradigma)[2] è l'espressione favorita — e molto abusata — con cui, nella letteratura anglosassone che si occupa di tecnologie o

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[1] In italiano *knowledge* si può rendere sia con «conoscenza» sia con «sapere». Abbiamo scelto di rendere il «knowledge» del nostro discorso con «conoscenza». Quello che ci interessa qui maggiormente è l'aspetto dinamico, attivo del concetto (gli atti del conoscere), piuttosto che l'aspetto fattuale del risultato (i saperi).

[2] L'espressione «*paradigm shift*», alla sua origine, racchiude un concetto notevole, dovuto allo scienziato Thomas S. Kuhn e alla sua opera «*The Structure of Scientific Revolutions*» (Kuhn 1996). Vedi anche (Farioli 1999).

di scienze organizzative, gli autori denotano un cambio radicale di modello o di sistema.

Norris, Mason e Lefrere, nell'opera da cui traiamo spunto, «*Transforming e-Knowledge – a Revolution in the Sharing of Knowledge*» (Norris et al., 2003), sono andati molto oltre l'osservazione, ormai alla portata di tutti, circa la straordinaria estensione delle risorse d'informazione rappresentate dal web e favorite dalla connettività di Internet. L'e-knowledge, come scrivono NM&L,[3] inventori del termine, è un *paradigm shift*, anzi un *jump shift*, un cambio di marcia «senza usare la frizione», a significare l'improvviso salto a scalino nell'accelerazione dei processi di conoscenza.

Nell'affrontare l'ampio tema del *knowledge* e del *Knowledge Management* gli autori rilevano la situazione di «arcipelago culturale» delle grandi sedi del sapere — scuole, università ed accademie — piuttosto insensibili ad una condivisione sistematica del sapere e, quanto alla ricerca, impegnate in analisi approfondite, ma in isolamento. Invece di elaborare teorie esistenti o proporne delle nuove, NM&L raccolgono una vasta base di fatti, pensieri e testimonianze, e su questa, producono proposte e provocazioni, ossia un «manifesto«, «*a manifesto for the e-Knowledge Industry*, come viene appunto presentato *Transforming e-Knowledge*.

L'opera esprime un autorevole pensiero plurale, quello di una squadra internazionale di autori, accademici, esperti ed esponenti politici, appoggiati da una delle più ampie sponsorizzazioni nell'area del *learning*.[4] A loro fu chiesto di riflettere sulla seguente questione: la drammatica necessità, da parte dei singoli individui, delle imprese e delle istituzioni, di migliorare la capacità di acquisire, assimilare e condividere la conoscenza, data la costante pressione di un regime di cambiamenti dirompenti.

La risposta è immersa nel denso e complesso materiale prodotto (un libro di oltre centottanta pagine), che si potrebbe riassumere in una parola: innovazione. Un nuovo vocabolario è richiesto da ogni trasformazione, come nel caso del termine «e-knowledge». Le vecchie parole portano il fardello di significati stabiliti, una nuova terminologia e metafore fresche sono necessarie per descrivere come la conoscenza e l'»ecologia della conoscenza» si sviluppano all'interno delle organizzazioni. Occorre adottare una «*revolutionary vision*», una «*expeditionary strategy*»: davanti all'immagine di un futuro caotico e sostanzialmente imperscrutabile, si procede come in una spedizione di esploratori, mantenendo aperte tutte le scelte, per individuare i sentieri di migrazione più sicuri.

2.2 Knowledge ed e-knowledge a confronto: significati e valori

Knowledge Management. Knowledge Society. Knowledge Engineering. Knowledge Industry. Knowledge Theory. Knowledge Worker, … Il termine «knowledge» è alla

[3] Abbreviazione che adottiamo per designare il gruppo di autori Norris, Mason e Lefrere.
[4] Vedi (Norris et al, p. 165). Da rilevare tra gli sponsor il grande progetto MOBIlearn Project (www.mobilearn.com).

base di molte locuzioni frequentemente usate nel lessico contemporaneo, nonostante che «knowledge-conoscenza» sia un concetto non facile da puntualizzare.[5]

Seguiremo principalmente, ma non solo,[6] la traccia dei nostri autori NM&L, condivisa anche da Nathan Shedroff, studioso di *information architecture* e originale *experience strategist* (Shedroff 1994). Interpretiamo la conoscenza come un anello intermedio di una *value chain* (catena del valore) che vede ad un estremo i «dati» e all'estremo opposto la «saggezza», come in fig. 1.

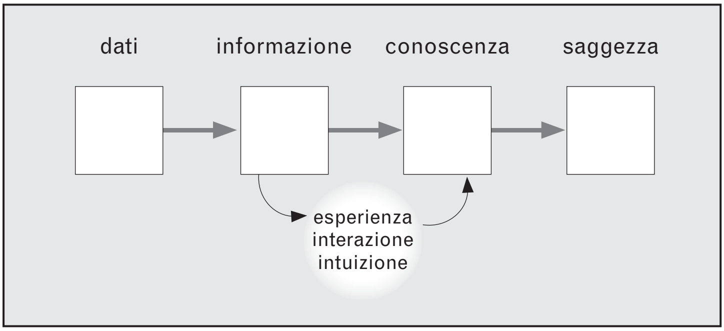

Figura 1 La «catena del valore» della conoscenza (rielaborazione da Shedroff, 1994).

Dati

Che cosa sono i dati? Sono la materia prima di cui ci serviamo per comunicare, tuttavia in sé sono entità prive di significato e di messaggio. Come possiamo spesso verificare, i dati sono «noiosi» e, senza trasformazioni ulteriori, essi sono privi di valore. Osserva argutamente Shedroff, i dati «fanno bene» solo a chi li produce, non sono veramente intesi per i consumatori, travolti da un diluvio di «fatti» e lasciati soli a ritrovarne il senso.

Informazione

L'informazione consiste in dati che sono stati organizzati in modo da acquistare un significato. Ciò ne richiede l'interpretazione, cioè la creazione di relazioni reciproche, l'evidenziazione di un *pattern*, la sistemazione in una presentazione.

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[5] Le discussioni epistemologiche sul *sapere-conoscenza* sono innumerevoli ed irrisolte - se ne discute dal tempo dei Sofisti. Anche il KM (Knowledge Management) è un tema dibattuto e sovente controverso. Per noi il KM ha significato, certamente nei termini molto creativi e sociali di NM&L, e se inteso simultaneo al LM (Learning Management).

[6] Oltre agli autori citati, e a parte i molti «classici», noi prediligiamo John Seely Brown e Paul Duguid che trattano,i n armonia con quanto sopra, di «*knowledge and learning ... in relation to practice and information*», in «*Learning – in Theory and in Practice*», il capitolo 5 del magistrale libro «*The Social Life of Information* (Brown et al., 2003, p. 112-146).

Conoscenza

La conoscenza infine è «informazione presentata in un contesto specifico, tale da generare nei membri di una comunità una comprensione applicativa di quel contesto» (Norris et al., 2003, p. 2). Rileviamo sono messi in risalto i concetti di «applicazione», quindi di esperienza, di «comunità» e di «contesto», rivelando l'importanza che viene data ai passi della *pratica*, della *condivisione* e dell'*ambiente*. Come ci arriva la conoscenza? Quello che si trasferisce è informazione, mentre la conoscenza non esiste al di fuori di un «conoscente umano».[7] Possiamo affermare che alla conoscenza (come concetto generale) approdiamo:

- attraverso l'esperienza: «*All doing is knowing and all knowing is doing*» (Maturana e Varela)[8]
- attraverso l'interazione (e, per estensione, la comunicazione) con altri: «*Global knowledge … relies on such heavy levels of shared understanding and agreements about communication*» (Shedroff 1994, p. 5)[9]
- molto spesso con un processo mentale, l'intuizione.

Più avanti contrapporremo i due concetti, knowledge-conoscenza a *e-knowledge*.

Saggezza

All'estremo destro di fig. 1 è posta la saggezza. Che cosa costituisce veramente saggezza? NM&L suggeriscono che saggezza è «vista penetrante» *(insight),* il risultato di una riflessione (o constatazione) circa un'applicazione di conoscenze coronata dal successo o il risultato di una sintesi di conoscenze. La saggezza si colloca su di un livello di astrazione più alto rispetto alla conoscenza, è conoscenza distillata dall'intuizione e dall'esperienza. «La saggezza è un livello molto intimo del comprendere, una specie di meta-conoscenza di processi e relazioni, ottenuta attraverso l'esperienza» (Shedroff 1994, p. 5). Essa non si può creare e nemmeno condividere come la conoscenza ed è, in ultima analisi, un livello di comprensione che deve essere ottenuto solo attraverso se stessi.

2.2.2 L'effetto del digitale

Nel momento in cui la materia bruta dei dati diventa *digitale,* l'intero ecosistema della conoscenza si trasforma rispetto al suo assetto precedente, quello, per così

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[7] Solomon Sorin (University of Jerusalem) dice: «*No knowledge outside mind*». Lo illustra in modo avvincente con una serie di schemi grafici in una sua presentazione all'IST Event 2004 (Sorin 2004). Il sapere non si trasferisce - avverte Sorin - ciò che è possibile è: «contrarre» il sapere in un'interazione sociale, «come si contrae un'influenza».

[8] Citati in (Bond 2005, p. 5). Il riferimento è (Maturana et al., 1992, p. 27).

[9] «Una conoscenza di tipo globale si appoggia a livelli molto alti di comprensione condivisa e di accordi sui modi della comunicazione»

dire, di pre-rivoluzione digitale[10]. La trasformazione di cui trattiamo è rappresenta nel diagramma della fig. 2, modificato rispetto al precedente in fig. 1.

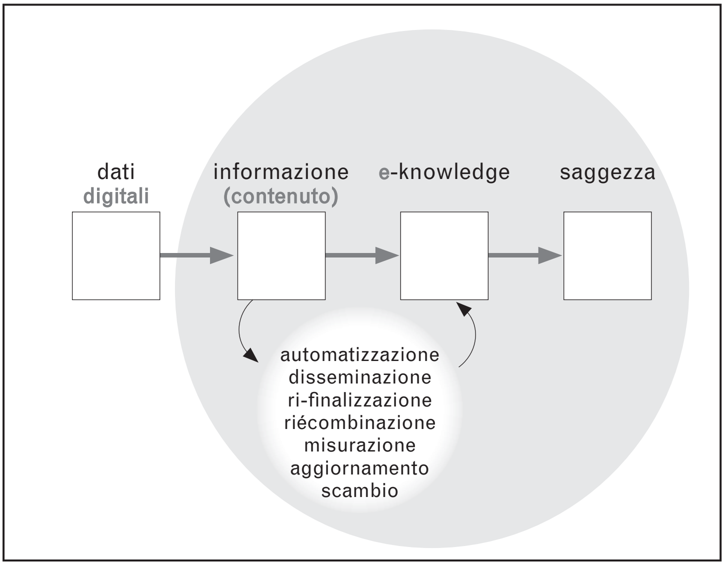

Figura 2 La «catena del valore» dell'e-knowledge.

Quando i dati assumono una rappresentazione digitale, a «informazione» si affianca il termine meno astratto e più specifico di «contenuto», ossia informazione associata ad un determinato canale elettronico. L'e-knowledge, come nuovo aspetto della conoscenza, diventa centrale alla sfera dell'apprendimento. Conoscenza e apprendimento si integrano, sostenute da sistemi informatici la cui architettura recentemente[11] va assumendo un profilo di «*Knowledge and Learning Management Systems*» (Educause 2005).

Le azioni che «trasformano» l'informazione in e-knowledge sono più numerose e articolate che nello schema precedente. Il transito tra i due nodi, in fig. 2, rappresenta le seguenti possibilità:

- atomizzazione, un neologismo per indicare che l'informazione si presta ad essere ridotta a frammenti ricombinabili

[10] Come data di confine potremmo prendere l'apparizione di *being digital* di Negroponte (Negroponte 1995). Oppure l'Agosto 1991, con Tim Berners-Lee che inventa il WWW.

[11] Questa tendenza è confermata dall'evento, nell'Aprile del 2005, del 1° Workshop internazionale intitolato, significativamente, *Learner-Oriented Knowledge Management & KM-Oriented E-Learning,* LOKMOL 2005, (http://wm2005.iese.fraunhofer.de/workshop3-en.html)

- disseminazione, il raggiungere un numero elevatissimo di destinazioni con basso rischio di corruzione del significato
- ri-finalizzazione (*repurposing*) di contenuti, l'utilizzo di materiale digitale preesistente sul quale si modella una nuova finalità (es. un nuovo obiettivo didattico)
- ri-combinazione, come per i *learning objects* e gli *SCO* (*Sharable Content Object*)
- misurazione, ad esempio per fini commerciali
- aggiornamento: eseguibile con grande flessibilità, al fine di mantenere elevati il valore e la *currency*[12] dell'informazione
- scambio e condivisione, attraverso le reti e i media digitali: sono le azioni più forti, e dagli effetti più profondi, tra le dinamiche umane applicate alla conoscenza.

L'immagine nella fig. 2 va interpretata come una scala di valori, non come una progressione lineare. Ciò che avviene è una tessitura complessa e una trasformazione continua dei bit, o elementi digitali, che si combinano con l'apporto della nostra intuizione e il cui significato cambia secondo il contesto e l'interazione con i partecipanti.

Se l'interpretazione analitica dell'e-knowledge appare complessa, possiamo avvalerci della magistrale sintesi di John Seely Brown che rileva la qualità condizionale esibita dalla conoscenza, al nostro tempo:«*What do we know that we didn't know ten years ago? That learning and knowledge are the result of multiple, intertwining forces:* content, context, and community»[13] (Brown 1999, p. ix).

2.3 Prospettive essenziali

La distanza tra knowledge ed e-knowledge potremmo esprimerla, in immagini di pittura, come la distanza tra un composto e luminoso Klee e un vibrante ed intricato Pollock, ventinove anni dopo (fig. 3). Le previsioni di *Transforming e-knowledge* «scadono» nel 2010. Dobbiamo domandarci, ad oggi, qual è la distanza percorsa, dov'è arrivata la «spedizione» dei saggi della Knowledge Society.

La tecnologia è diventata più trasparente, più accessibile? Da un lato continua ad ostacolarci il *nonsense* di certo linguaggio informatico che, sempre più fitto, si avvicina allo *Jabberwocky*[14] delle storie di Alice. Dall'altro, con una facilità incredibile, tutti possono creare in pochi secondi un *knowledge repository* personale

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[12] *Currency*: lo stato di essere aggiornato ed accettato, comunemente conosciuto e usato in molti luoghi.

[13] «Che cosa conosciamo che non conoscevamo dieci anni fa? Che apprendimento e conoscenza sono il risultato di forze multiple e interlacciate: *contenuto, contesto e comunità*»

[14] *Jabberwocky* è la nota filastrocca in *Attraverso lo specchio* di Lewis Carroll, fatta di parole inglesi portmanteau (*twas brillig and the slithy toves* …), resa anche in italiano (Crespi, 2005).

sul web condividendo migliaia di *tag* e centinaia di migliaia di pagine,[15] qualcosa d'impensabile nel 2003.

Alla domanda «Come ci arriva la conoscenza?» oggi potremmo anche rispondere: «con i k-blog».[16] Alla domanda «Come diamo significato all'informazione?» oggi potremmo rispondere: «Tutti insieme», con gli strumenti di *social bookmarking* (Lomas 2005), un approccio che sta facendo scricchiolare le nostre idee su come si organizza la conoscenza. L'*aboutness*[17] di un elemento (tipicamente digitale) di conoscenza viene deciso socialmente, togliendo agli esperti dei motori di ricerca e di biblioteconomia l'appannaggio esclusivo della classificazione e significazione del sapere.

In questo stato di cose è certamente aumentato il rischio di proporre abbondanza di informazione e comunicazione digitale come sistema per realizzare la conoscenza, sostituendole alla variegata esperienza diretta del mondo. È ciò che Brown e Duguid segnalano come il pericoloso «*feticismo dell'informazione*» (Brown et al., 2003, p. xvi).

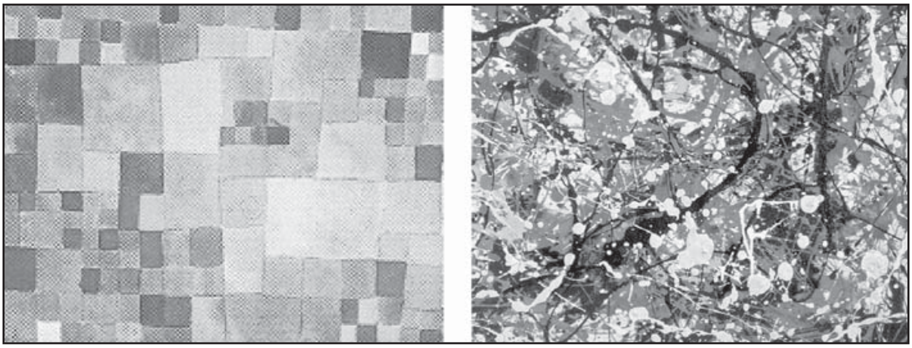

Figura 3 Knowledg e e-knowledge in immagini: *Flora auf sand,* Paul Klee, 1927, n. 8, Jackson Pollock, 1949.

2.4 Knowledge 2.0

Concludendo sull'e-knowledge, Norris, Mason e Lefrere suggeriscono persuasivamente che la *e-* sia superflua in «e-knowledge» e nelle varie e-locuzioni della

[15] *My Web 2.0 Beta* di Yahoo (Yahoo 2005).

[16] *K-blog* ovvero *Knowledge-blog* oppure *Personal Knowledge Blog*: un ricercatore dell'Università di Montréal ce ne offre un'introduzione ampia e chiara (Paquet 2002).

[17] «*essere-intorno-a*» o «*circalità*» di un soggetto/documento. Di *aboutness* nel contesto dei *social tools* si occupa espressivamente David Weinberger, uno dei più acuti analisti attuali di questa materia (Weinberger, 2005).

nostra era digitale. Le componenti digitali di queste entità e le loro dotazioni di tecnologia sono infatti divenute talmente intrinseche che non vi è motivo di fare delle distinzioni. Quindi non più e-knowlege, e nemmeno *e-learning*, *e-work*, *e-business, e-commerce*, ecc.

Nello «*Zeitgeist*» dell'anno corrente si percepisce una nuova curvatura, il segno di un'ulteriore trasformazione nei modi della conoscenza, non ancora precisata e alla ricerca di un'interpretazione. L'evoluzione del knowledge-conoscenza non è arrivata a regime, al contrario: congelarla sotto un «vecchio» lemma non è conveniente. Per questo adottiamo termine *Knowledge 2.0*, come fanno gli editori di software quando annunciano la seconda release, immancabilmente instabile, di un prodotto di recente lancio.[18]

La qualità dinamica della conoscenza, già compresa nell'e-knowledge, è in continua crescita e assume una dimensione preponderante: il navigatore del web non è più costretto solo ad atti di prelievo di informazione statica, ma oggi crea, incrementa in ogni istante lo spazio digitale con milioni di pezzi di testo, di immagini, di video su pagine dinamiche. Con strumenti come Blogger (Blogger 2005) e un qualsiasi *wiki* scompare ogni barriera tecnologica, tutti possono creare un proprio contributo e introdurre la propria presenza nell'universo digitale. I digerati[19] chiamano ciò *Web 2.0*,[20] o web dinamico o *social computing*, o *ambient knowledge* o, ultimamente, *continuous computing,* secondo l'autorevole *Technology Review* del MIT (Roush 2005).

Negli Stati Uniti si parla di *frenzy*, frenesia.[21] Attinenti all'»era» del Knowledge 2.0 ci sono le improvvise grandi acquisizioni: Groove da parte di Microsoft, Skype da parte di eBay, Flickr! da parte di Yahoo. Il primo, una straordinaria soluzione peer-to-peer per la collaborazione professionale a distanza; il secondo, celeberrimo *IP-phone*, uno strumento di interazione sociale per eccellenza; il terzo, popolarissimo sistema per la gestione e condivisione di fotografie. Anche Google, rapidamente, ha messo in campo applicazioni nettamente «sociali», come Gmail e Google Earth.[22] Un'intera nuova generazione di *social software* e *social networking*[23] è apparsa con funzione di potente attrattore dei giovani di tutte le nazioni. Negroponte del MIT, tecnocrate e grande mediatico, progetta e sbandiera l'HDL, il portatile-da-

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[18] In realtà, per la saggistica, è stata Esther Dyson con il libro *Release 2.0* (Dyson 1997) che spiega le trasformazioni di Internet, ad iniziare lo «stile» delle release numerate.

[19] *Digital* (en)+*literat*i (lat), neologismo per identificare le persone protagoniste della nuova cultura informatica e del web.

[20] Non si tratta beninteso di Web Semantico. Web 2.0 rappresenta uno sviluppo del tutto ortogonale al Web Semantico.

[21] Il fenomeno include Cina, Giappone ed altre nazioni.

[22] Gmail: http://mail.google.com/mail/help/about.html; Google Earth: http://earth.google.com/.

[23] La lista non potrà essere esaustiva, vista la vivacità del settore. Ad oggi possiamo contare Friendster, LinkedIn, Flickr!, De.li.cious, Technorati, Yahoo My Web 2.0, Wikipedia, Google Orkut, ecc.

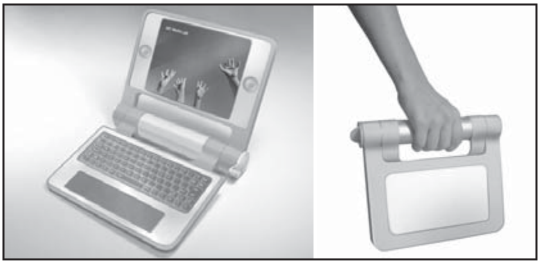

Figura 4 Il progetto HDL del MIT (fonte http://laptop.media.mit.edu/images).

cento-dollari (*Hundred Dollar Laptop*), gratuito per i ragazzi di tutto il mondo (MIT Media Lab 2005).

È in questione il concetto di conoscenza e interazione diffusa e globale che tanti hanno cercato di rappresentare, dall'»intelligenza collettiva» di Lévy alla *MultiSphere* del WWRF *Book of Visions* (WWRF 2001, p. 10). La nozione di cyberspazio, che ha tenuto fino ai nostri giorni, cede il posto a quella di «*information field*» (Roush 2005, p. 2), un campo portabile, invisibile: lo spazio senza confini e senza discontinuità divenuto l'habitat dell'uomo-con-cellulare.

L'etichetta «2.0» applicata o al *web* o al *knowledge* è, al tempo attuale, un segno che identifica un cambiamento ed una discontinuità, non uno status-quo. L'instabilità è una qualità intrinseca di questa nuova release del mondo dell'informazione e della conoscenza, essa non ci permette che un bilancio dove accanto agli aspetti positivi e di entusiasmo poniamo un certo numero di incognite. Partecipazione, comunità virtuali, spazi di socializzazione, strumentazione web di facile uso, da un lato ci invitano ad una visione illuministica della conoscenza digitale, dall'altro a verificare se non ci sono forse dei contro-argomenti rispetto a tutto ciò. Il livello crescente di *hype*[24] (specialmente nei forum e nei blog nordamericani) confonde ed è certamente uno degli aspetti meno felici del dibattito in corso. Negli USA serpeggia il timore che, favorita dalla presenza di tecnologie software dirompenti (Ajax[25]) l'instabilità dei modelli della nuova generazione induca un *dot-boom* che non aspetta altro che una *dot-bomb* come quella che fece scoppiare la bolla del web 1.0.

I termini di *memes*,[26] «2.0» significa: democratizzazione dell'informazione, contenuti generati amatorialmente piuttosto che professionalmente, metadati *bottom-up* creati dal basso (dove basso = utenti) anziché autorevolmente *top-down*, un «web leggi/scrivi» anziché un web *read-only*, interazioni sociali via rete senza limiti. In tutto ciò ci sono rischi, che si intravedono non solo da un'ottica *business*, come

[24] Quasi intraducibile, *hype* (affine a hyper- = iper-) è, nel mondo dei tecnologi e delle tecnologie, il fatto di rendere qualcosa o qualcuno molto importante ed eccitante, attirando in tutti i modi l'attenzione pubblica - una specie di isterismo.

[25] Ajax, acronimo per «Aysnchronous Javascript and XML» è un nuovo, molto dibattuto, approccio software al web (Masternewmedia 2005).

[26] Come definito da Richard Dawkins nel libro «The Selfish Gene» del 1976, un *meme* è un efficace concetto che rappresenta «un'unità di trasmissione culturale o un'unità di imitazione».

temono le nuove *start-up* americane, ma anche su di un piano concettuale. «Democratizzazione» può essere non distante da «anarchia» dell'informazione, del resto un tratto che è stato sempre presente nella filosofia di Internet. L'enorme produzione di notizie da parte di milioni di autori sconosciuti include un rischio di «banalizzazione» del sapere, una specie di effetto Caligola, l'imperatore che fece senatore il suo cavallo. Di fronte alla massa del fenomeno alcuni temono che anziché di «intelligenza collettiva» si debba parlare a lungo andare di «stupidità collettiva». Al bordo estremo del *knowledge sharing* si trova la «condivisione in anonimato», come è possibile in molti siti «sociali» (es. Myspace.com), aperti ad incontrollabili presenze mistificanti o maligne. *Wiki* e *blog*, i re del 2.0, offrono a chi vuole conoscere materia di un'attualità insuperabile, ma nulla ne verifica la qualità.

Forse neppure la release 2.0 ci basterà per interpretare correttamente la *Knowledge Society* dei prossimi anni.

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