Enhancing Enterprise Resource Planning users’ understanding through ontology-based training

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**Abstract**

An ERP system is a set of highly integrated and parametric applications, designed to fit to a variety of business. Because of this inherent complexity its implementation can be very demanding and the users involved must undertake extensive training, using sophisticated training materials. Existing training materials present major weaknesses, that the current paper aims to overcome, such as (1) semantic inconsistencies, (2) lack of explicit definition of constructs and (3) lack of knowledge reusability. This paper proposes a prototype model for the design and development of ERP training material, where both multimedia objects used in training scenarios and the knowledge built into them are captured and fully reusable. The proposed approach helps trainees understand: (i) which are the building blocks of an ERP application, (ii) how they relate with each other and (iii) how they can be used in order to solve business specific problems.

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1. Introduction

An ERP system is a set of highly integrated applications, consisting of applications modules, which can be used to manage most of the business functions within an organization. An ERP system is designed in a way that will fit to a variety of different types of business. This is achieved through the extensive use of multiple levels of parameters, which when set properly, can adapt the ERP system to the specific needs of the organization implementing it (Soffer, Golany, & Dori, 2003).

A common theme in ERP literature is the inherent complexity of ERP systems (Bingi, Sharma, & Godla, 1999), and extensive training is needed in order to help managers and users solve problems within the framework of the system. Computer-based training via Intranets and/or through the Internet has been found to facilitate ERP implementations (Mahapatra & Lai, 1998) and therefore ERP vendors are using extensively the Web as their preferred environment in order to provide ERP users’ education and training (Macris, 2004).

Most of the existing automated training aids for ERP applications only provide for manipulating and restructuring multimedia objects and not for externalizing the underlying logic for the knowledge domain under consideration, making it explicit and therefore diffused and reusable. To accomplish this, a method that considers the fundamental building blocks of the perception process is needed. Perception is the process of building a working model that represents and interprets sensory input (mosaic of percepts) into a more abstract part (conceptual graph) (Novak & Go win, 1984; Sowa, 1984, chap. 3). A conceptual graph is made of concepts (the simplest possible self-contained entities) and the relations between them. Therefore, when a trainee is asked to understand the training material accompanying a training process, the act of consuming this material can be modeled as a two stage process: (i) the analysis process, where the material is broken down into concepts and (ii) the synthesis process where concepts are linked to other concepts (found in the training material on hand and other related material that the trainee has already analyzed before) in order to form more complex structures (conceptual graphs).

The term “semantic web” encompasses efforts to build a WWW architecture that enhances content with formal semantics (which are stored in the form of meta-data, or data explaining the meaning of content) in order to enable better possibilities for navigating through the cyberspace and accessing its contents. That means semantic web content is made suitable for machine, too, consumption, as opposed to traditional WWW architectures where content is only intended for human consumption (Stojanovic, Saab, & Studer, 2001). Therefore semantic web constitutes an environment where human and machine agents are able to communicate on a semantic basis and automated agents (web services) are able to reason about web content and produce an intelligent response to unforeseen situations (Berners-Lee, Hendler, & Lassila, 2001; Sycara, 2004). Shared understanding, one of the primary characteristics of the semantic web architecture, uses ontologies as its key backbone that enable the organization of domain knowledge around small pieces of

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This paper describes a methodology for developing ERP training materials, both for use in the classroom and in actual companies, that represents the knowledge found interspersed throughout existing material for ERP training applications in the form of knowledge networks (collections of educational scenarios serving specific educational needs) that will stimulate the process of analysis and synthesis of knowledge discussed, based on the principles of the semantic web and that will help the user decode and comprehend: (i) which are the building blocks of an ERP application, (ii) how they relate with each other and (iii) how they can be used in order to solve business specific problems. Fig. 1 shows how the proposed approach transforms existing training materials by making explicit the knowledge found interspersed into these materials. Since the proposed approach is based on the principles of the
semantic web, the resulting knowledge network can be used in any form of training setup (internet, local intranet, stand-alone – DVD-based training etc.) and any form of training delivery (tutorial, reference manual, help etc.), both for in-class and actual ERP users’ training.

The hierarchical structure of an ERP system (consisting of integrated subsystems-modules, broken down to processes, tasks, sub-tasks, etc.) and the complexity of relations between them make it an excellent candidate for representing it as a knowledge network, as proposed in this paper.

1.1. The motivation: Organize ERP training courses for university students

After more than twenty years experience as an ERP consultant and system integrator, the author was requested to organize ERP-related training sessions to both undergraduate and graduate students at the Department of Business Administration of the University of Piraeus, in order to bridge the gap between traditional forms of accounting education and the real world (Holcomb & Michaelsen, 1996).

The differences between knowledge required in the workplace and knowledge gained from learning experiences in institutions such as universities are well-documented (Holcomb & Michaelsen, 1996). The emphasis in formal educational institutions is on extracting essential principles, concepts and facts, and teaching them in an abstract and decontextualized form. The difficulty with this method is that the resulting learning is not retrievable in real-life, problem-solving contexts because it ignores the interdependence of situation and cognition (Herrington & Oliver, 2000). Hence, on top of formal instruction, appropriate and effective pedagogic techniques and practices must be developed to allow students to bridge the gap between concepts and application in real-life contexts (Collins, 1988). As students become more technologically aware and adept they demand the academic teaching staff to be able to utilize available technologies in the development and delivery of subject content in order to encourage student learning, especially in accounting education (Albrecht & Sack, 2000; Paisey & Paisley, 2005). Educational institutions’ capacity to respond to these pressures plays a critical role in determining their relative success (Albrecht & Sack, 2000; Frederickson & Pratt, 1995; Stanley & Edwards, 2005).

Therefore, in order to give to the students an overall understanding of what is an ERP system and how it is used to overcome business specific problems, business case studies were developed and detail instructions were written in the form of step-by-step tutorials for Microsoft Dynamics NAV ERP system. Additionally students are requested to analyze and design a complete business example and then apply it to the ERP system from scratch following the steps provided in the tutorial, in order to help them take an active role in their learning process and thereby increase the likelihood of enhanced learning outcomes (Adler & Milne, 1997; Becker & Dwyer, 1994). Through this problem-based learning (PBL) approach students are required to gather necessary information, acquire an understanding of new concepts and principles, develop a range of skills necessary to solve the problem and take responsibility for acquiring that knowledge (Mayo, Donelly, Nash, & Schwartz, 1993; Milne & McConnell, 2001; Potter & Johnston, 2006).

One of the major issues faced when teaching ERP systems is that the students are introduced with hundreds of new constructs, and they have problems understanding how each construct relates to the theoretical knowledge that they have already developed and how constructs relate to each other. The main objective of this paper is to describe a method for developing training materials that capture that knowledge in a way that will help the students understand the underlying structures and relationships between these constructs and hence communicate it and make it reusable, while still allowing hands-on context specific learning that will help students bridge the gap to practice. This method is also highly transferable to the development of training materials for actual systems and users, and can produce similar gains in learning and understanding in that domain.

1.2. Current methods used for designing and structuring ERP training material

In order to understand the benefits of the method described in this paper, it helps to better understand how training materials are currently structured. Hence, for the needs of this research, the training materials of three major multinational (SAP, Oracle and Microsoft) and two local ERP vendors was considered. Additionally more than 60 course and lesson authoring tools were examined.

Based on the assumptions so far, the author collected available training material from ERP vendors and evaluated it in order to assess their suitability for university training, in terms of the following characteristics: (1) Level of detail, in terms of granularity (proper level of abstraction) and semantic richness, (2) Composition (structure of material) and (3) Consistency in terms of semantic consistency (consistency of terminology and definitions) and structural consistency (consistency of constructs), (Lyytikäinen & Titiénen, 2001).

In terms of composition, as already discussed, current training materials essentially manipulate multimedia objects. These multimedia objects are grouped and combined in order to support various educational needs. This grouping of training material can be hierarchical in units, sub-units etc., so the user can select from the hierarchy a unit or sub-unit and then the system guides to the multimedia that explains it. The user can alternatively use the index or the search feature, search (textually) for one or more words, locate the relative units and, when selecting them, be guided to the multimedia explaining them. Alternatively multimedia objects can be also combined with the use of hyperlinks that allow the user, while browsing the contents of a specific node, move to another node or multimedia object and then return to the starting node. The underlying domain knowledge, although it is inherent in the training material and the ways it is structured, is not explicit and therefore it cannot be communicated and made reusable.

In terms of consistency, the majority of ERP training material is usually textual approaches when composing it, the result being semantic inconsistencies in the terminology and the definitions (especially when examining different subsystems’ training material of the same vendor composed by different writers). Relations between constructs do not usually appear explicitly in the training material and it is usually left to the user to discover them when studying the material. Therefore when the user of the training material, even the experienced one who is not familiar with the ERP system under consideration, is trying to discover what really takes place to the various ERP subsystems involved when posting a transaction, he/she has to go through many pages of training material, take specific training courses from experienced trainers or attend on-line courses, perform extended tests etc. The reason being that this knowledge is not explicitly available, but has to be discovered from the ERP training material (multimedia objects) by the trainee.

A significant problem when examining the training material from different ERP vendors is the terminology they use for the same constructs. It usually takes considerable time, even for the experienced user, to uncover how a term used by one vendor relates to terms used by another one. The result being semantically poor material, as it is difficult to uncover the abstraction applicable for each term used, since the ERP specific construct (term) is not...
defined in a hierarchy of constructs, showing at a higher level con- structs (terms and synonyms) that are globally accepted in the sci- entific literature to best define the term under consideration.

Therefore the major weaknesses of the existing methodologies, from the designer’s point of view, that the current paper aims to overcome are: (1) semantic inconsistencies, (2) explicit definition of each construct used and of the relations between constructs (through construct hierarchies) and (3) Knowledge reusability, since the knowledge is not readily available, and hence not easily reusable, but is hidden into volumes of training material and has to be discovered by the trainee. On the other hand content reusability is currently achieved by most tools, since the training mate- rial in various multimedia forms is reusable.

From the user’s point of view, the training material developed using the existing approaches discussed above, although it allows the user to examine specific constructs making up an ERP system or subsystem, is not designed in a way that will allow him/her to understand the underlying structures and relationships between these constructs. The reason being that most training aids only provide for manipulating and restructuring multimedia objects and not for externalizing the underlying logic for the knowledge domain under consideration.

2. Design of an ontology-based training aid, following semantic web principles

In philosophy, an ontology is a theory about the nature of existence, about what types of things exist, and ontology, as a disci- pline, studies such theories. For Artificial Intelligence and Semantic Web researchers, the term ontology describes a formal, shared conceptualization, of a particular domain of interest. There- fore ontologies are specifications of the conceptualizations and the corresponding vocabulary that is used in order to describe a do- main of knowledge with machine-understandable meta-data (data about the data) (Gruber, 1993). It is vital that any semantic on the web will be based, for the definition of shared and common do- main theories, on an explicit ontology that helps both human and machine agents to communicate concisely, supporting the ex- change of semantics and not only syntax. Thus, producer and con- sumer agents can reach a common understanding through ontologies, which provide the conceptualizations and the vocabu- lary needed for discussion (Stojanovic et al., 2001).

2.1. Ontology, content and knowledge repositories

The approach proposed in this paper enables experts in the knowledge domain of ERP applications’ training (domain experts) to externalize the domain knowledge in the form of ontology-based knowledge networks (collection of training scenarios serving specific training needs) and, hence, better communicate it and make it reusable.

Thus, domain experts record their knowledge on the particular field under consideration, in terms of an ontology which is re- corded in the ontology repository. Hence, each ontology construct is recorded only once and can be made available to every training scenario using it.

In addition, relevant supportive material (either existing or cre- ated) in the form of multimedia objects is used in order to develop a collection of reusable multimedia objects that are related to the ontology constructs of the knowledge domain under consideration (Chebotko, Deng, Lu, Foutouhi, & Aristar, 2005; Steinmetz & Seeberg, 2003). This collection of multimedia objects comprises the content repository.

The ontology and content repositories are then used to create training scenarios, which are recorded in the knowledge repository. Thus, training scenarios combine ontology constructs with sup- portive multimedia objects helping trainees acquire an in-depth understanding of the knowledge domain. Training scenarios serv- ing similar needs are grouped together as ontology-based knowl- edge networks.

2.2. Ontology-based knowledge networks

Ontologies are collections of concepts (universals), instances of concepts (particulars) and relations among them. The two basic relations are: the super/sub-concept relation and the instance-of relation. But a more comprehensive listing aimed at linking con- cepts and instances thematically is sure to require additional rela- tions. Ontology constructs (concepts, relations and instances) can be enriched with attributes, terms, definitions, axioms and con- straints that are expressed at the desired level of format and that are deemed to be important in characterizing the knowledge do- main, under consideration, at the desired level of detail (Grenon, 2003; Gruber, 1993; Sowa, 2000).

For example the General Ledger subsystem of an ERP system deals primarily, from the accounting point of view, with Account- ing Entities, such as GL Accounts and GL Transactions (that update the accounts). From the technical point of view an ERP subsystem deals with Informational Entities, such as Menus, Data Entry Screens, Lists of Values etc. All these entities can be defined in an ontology. Therefore when an agent (human or machine) deals with an instance of a concept (such as the General Journal, which is an instance of the Data Entry Screen concept that belongs to the Infor- mational Entities hierarchy) the agent will have all the information available in the ontology, such as hierarchies, attributes and the relations defined between Informational and Accounting Entities (e.g. the General Journal Data Entry Screen is used to post GL Transactions to the GL Accounts).

So as a first step all concepts making up an ERP subsystem (such as a General Ledger subsystem) are recorded in the ontology repos- itory as ontology concepts (concepts that are common to the majority of ERP systems) together with the relations between them. All relative supportive multimedia objects (such as the doc- umentation available for the ERP system under consideration) are collected in the content repository. A training scenario recorded into the knowledge repository can be, for example, the menu hierarchy of a specific ERP subsystem showing to the trainee all the available selections a user has per menu screen. The training scenario con- sists of concept instances, each referring to a specific ontology con- cept and are related with relations (in the specific example the relation ‘choice’) showing the choices available per menu screen. Each concept instance is also associated to supportive multimedia objects, from the ERP system documentation, explaining to the user how each choice contributes to the overall functionality of the ERP subsystem under consideration. Each relation associating concept instances also refers to a higher level relation that is de- fined in the ontology repository and that is connecting the relevant ontology concepts.

Therefore the proposed approach helps overcome the major weaknesses of the existing methodologies which are: (1) Semantic inconsistencies. All ontology concepts, concept instances and rela- tions are defined once in the appropriate hierarchy and wherever used in training scenarios they are found with the same name and meaning. (2) Explicit definition of each construct used and of the relations between constructs (through construct hierarchies). (3) Knowledge reusability. Each ontology construct is defined only once, associated with other relating constructs and enriched with appropriate attributes and supportive multimedia. Knowledge reusability is achieved in two ways when using the proposed ap- proach: (i) ontology constructs reusability, since all Ontology Repository constructs are available to all scenarios and (ii) sce-
nario-defined instances are also reusable, as they become part of the knowledge stored into the Knowledge Repository which is reusable by newer scenarios.

From the users' point of view, contrary to traditionally designed training scenarios which are based on mere user navigation to multimedia objects, training scenarios that are based on the proposed approach are enhanced and empowered in that they allow users to navigate into the domain knowledge which has been represented in the form of a knowledge network. Thus, the user of the training scenarios is guided either through a semantic search followed by a navigation to the knowledge network, or directly through navigation to the knowledge network. This navigation capability into the explicit knowledge recorded into the training scenarios is a unique capability of the proposed approach and this capability is illustrated in the proposed scenarios. Therefore the user can navigate (1) into all the steps necessary before posting the first transactions into the General Ledger subsystem and (2) into the results of posting a group of balanced transactions into the General Ledger subsystem (in terms of journals, balances, accounts etc.). To enhance his/her understanding of each construct included in a scenario, the user can access relevant supportive material in the form of multimedia objects and identify the relation of any particular construct under consideration with other relevant constructs.

For illustrative purposes a sample ontology and two training scenarios were built based on the proposed approach. The scope of the training scenarios is to help trainees understand: (1) all the setup (parameterization) steps necessary before being able to post one journal entry into Microsoft Dynamics NAV General Ledger subsystem and (2) what is the meaning and use of each general ledger construct and how they relate to each other. The ontology-based knowledge network that follows was constructed using the SemTalk2 ontology editor for MS-Office 2003, a Visio 2003 add-in that provides all the modeling functionality needed to create ontologies complying with the standards set by W3C's (the World Wide Web Consortium) recommendation OWL2.

3. The ERP business ontology

The ontology built for the needs of this research is based on: (a) the ontological analysis of Sowa (Sowa, 2000, chap. 2), (b) the source-event-agent (REA) model for enterprise economic phenomena (McCarthy, 1982), (c) the work of Geerts and McCarthy (Geerts & McCarthy, 2002) on a domain ontology for business enterprises, based on the REA model and (d) the Enterprise Ontology (Uschold, King, Moralee, & Zorgios, 1998).

Table 1 lists the ontology concepts needed for the scenarios that will be designed later. The list shows all instances defined per scenario, associated with two levels of concepts (upper and lower). Therefore each instance belongs to a hierarchy of ontology-defined concepts, by relating directly to a lower-level concept.

<table>
<thead>
<tr>
<th>Ontology-defined concepts</th>
<th>Instance</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper-level concept</td>
<td>Lower-level concept</td>
<td></td>
</tr>
<tr>
<td>Accounting Entity</td>
<td>Account</td>
<td>GL Account</td>
</tr>
<tr>
<td>Accounting Entity</td>
<td>Transaction</td>
<td>GL Transaction</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>VAT Business Posting Groups</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>VAT Posting Setup</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>VAT Product Posting Groups</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>General Business Posting Group</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>General Product Posting Group</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>General Posting Setup</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>Data Entry Screen</td>
<td>General Journals</td>
</tr>
<tr>
<td>Informational Entity</td>
<td>List of Values</td>
<td>General Journal Template List</td>
</tr>
<tr>
<td>Measurement Entity</td>
<td>Record ID</td>
<td>Number of Series</td>
</tr>
<tr>
<td>Accounting Structure</td>
<td>Chart of Accounts</td>
<td>GL Chart of Accounts</td>
</tr>
<tr>
<td>Economic Document</td>
<td>Document Type</td>
<td>General Journal Template</td>
</tr>
<tr>
<td>Economic Document</td>
<td>Journal Entry</td>
<td>General Ledger Posting</td>
</tr>
</tbody>
</table>

Table 1

Ontology-defined concepts and scenario-defined instances.

3.1. Ontology defined relations

A relation can be considered as an attribute used to describe the relationships between two concepts of an ontology. Hence, a relation is an attribute defined for an ontology concept whose value is another concept. As relations are used to define how a concept relates to another concept, relations are usually bi-directional. Therefore the relation 'structures' is used in order to define how a Chart of Accounts is used to define Accounts hierarchies in a direction from the Chart of Accounts to the Account concept. The inverse relation 'is structured by' appears in the inverse direction of the relation 'structures'. Relations can be defined at various levels of the concepts' hierarchy. In some cases relations are defined to link lower-level concepts, in some other cases they are defined to link higher-level concepts and be available to all lower-level concepts and concept instances. Therefore the relation 'structures' can be defined to relate lower-level concepts (like Chart of Accounts and Account) or higher-level concepts (like Accounting Structure and Accounting Entity). When the relation is defined between higher-level concepts, then the relation also applies to all lower-level concepts and concept instances (though object inheritance, one of the main features of ontologies).

Table 2 shows the relations defined for the needs of the training scenarios and how they are used in each scenario.

4. The knowledge network

A knowledge network is a collection of training scenarios serving a specific training need and is recorded into the knowledge repository. The knowledge network under consideration consists of two scenarios and aims to help trainees understand: (1) all the setup (parameterization) steps necessary before being able to post one journal entry into Microsoft Dynamics NAV General Ledger subsystem (Tutorial scenario) and (2) what is the meaning and use of each general ledger construct and how they relate to each
other (GL Transactions scenario). Scenarios use concept instances, relations between instances and supportive multimedia. Each concept instance must refer to an existing concept and each relation to an existing relation from the ontology repository. Supportive multimedia used to enhance understanding of ontology constructs are found in the content repository.

In the diagrams that follow, concept instances are represented as dark rectangle nodes and relations as directed arrows connecting concepts (with the description of the relation appearing on each arrow). In the text that follows, a description of each scenario is provided using concept instances followed by the ontology-defined concept per instance (in parenthesis immediately after each concept instance). Both concepts and concept instances are shown in italics and relations are shown in single quote enclosures.

4.1. The Tutorial scenario

The content repository for the knowledge network used in these examples contains material collected to show trainees all the setup (parameterization) steps necessary before being able to post one journal entry into Microsoft Dynamics NAV General Ledger subsystem. Fig. 2 shows the Tutorial scenario broken down into four subsections: (1) VAT (Value Added Tax) setup, (2) GL Accounts Setup, (3) Journal Templates and (4) Post GL Transactions. The relation connecting all concept instances is the ‘Next Step’ relation defined in the ontology. VAT setup consists of the steps VAT Business Posting Groups (Data Entry Screen), VAT Product Posting Groups (Data Entry Screen), General Business Posting Group (Data Entry Screen), General Product Posting Group (Data Entry Screen) and General Posting Setup (Data Entry Screen). GL

Table 2

<table>
<thead>
<tr>
<th>Relation</th>
<th>Use in the training scenarios</th>
<th>Scenario</th>
<th>Transactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>To define menu hierarchies</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Next Step</td>
<td>To define flows in trainee tutorials</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Refers to</td>
<td>To show that an Informational Entity refers to an Economic Document</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Refers to</td>
<td>To show that each Transaction must be made against an existing Account</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Updates Jnl Entry</td>
<td>To show that a specific Informational Entity (Data Entry Screen) updates a Journal Entry</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Uses for autonumbering</td>
<td>To show that various constructs receive automatically record number</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Updates Transactions</td>
<td>To show that, when posted, Journal Entries update Transactions</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Updates Balance</td>
<td>To show that a posted Transaction updates Account Balance</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Balance is analyzed to</td>
<td>To show that Account Balance is calculated from Account Transactions</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Use for VAT</td>
<td>To show which system parameters affect VAT calculations</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Imprints</td>
<td>To show that Economic Reports present information found in Accounting Entities</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td>To show that the Chart of Accounts defines the Accounts’ hierarchies</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2. The Tutorial scenario.
Accounts Setup consists of the step GL Chart of Accounts (Chart of Accounts). Journal Templates consists of the steps Number of Series (Record ID) and General Journal Template (Document Type). Post GL Transactions consists of the step General Journals (Data Entry Screen).

Concept instances defined in the existing scenario are enriched with multimedia objects from the content repository and are readily available for use in all subsequent scenarios.

4.2. The GL (General Ledger) Transactions scenario

The GL Transactions scenario shows what is the meaning and use of each general ledger construct and how constructs relate to each other.

Fig. 3 shows the GL Transactions scenario. New transactions are entered through General Journals (Data Entry Screen). When the user first enters the screen a ‘choice’ appears in General Journal Template List (List of Values) that ‘refers to’ General Journal Template (Document Type) and the user must choose the type of document he/she wishes to enter (payments, receipts, clearing transactions, etc.). Each General Journal Template (Document Type) ‘uses for autonumbering’ Number of Series (Record ID) as each new document takes automatically by the system a new ID. Each General Ledger Posting (Journal Entry) that ‘uses for autonumbering’ Number of Series (Record ID) as each new journal entry must have a unique ID. When General Ledger Posting (Journal Entry) is posted it ‘updates journal entry’ General Ledger Posting (Journal Entry) ‘refers to’ an existing GL Account (Account) and ‘updates balance’ of GL Account (Account). On the other hand GL Account (Account) ‘balance is analyzed to’ GL Transaction (Transaction). For VAT calculations, each GL Account (Account) ‘use for VAT’ General Business Posting Group (Data Entry Screen) and General Product Posting Group (Data Entry Screen). Each GL Transaction (Transaction) ‘refers to’ a GL Account (Account) and receives in order to ‘use for VAT’ General Business Posting Group (Data Entry Screen) and General Product Posting Group (Data Entry Screen) whose values can be modified per GL Transaction (Transaction), if needed. The GL Chart of Accounts (Chart of Accounts) ‘structures’ GL Account (Account) and GL Trial Balance (Balance of Accounts Report) ‘imprints’ GL Account balances.

This scenario aims to show to the trainee (1) the steps that a user must go through in order to post a transaction into the GL subsystem (select template, enter journal entry and post transactions), (2) how setup is involved with the process (number of series, templates, GL accounts, VAT parameterization) and (3) how posted transactions relate to accounts and how accounts’ balance is calculated from the transactions. Although the scenario introduces some new instances, many instances used were defined in the previous scenario and their use into the current scenario is just a drag and drop exercise.

One of the advantages of the proposed approach is when renaming or changing (change attributes, introduce new supportive multimedia, etc.) a concept instance or a concept, the action affects all occurrences of the concept instance (in the case of instances) and all concepts and concepts instances of the specific concept (in the case of concepts).

4.3. The user interface

Fig. 4 shows the users’ interface of the scenarios. The user has two options: (1) chose one of the scenarios and navigate through concept instances and relations or (2) search for a concept instance, in which case the system displays all occurrences of the concept instance in all scenarios and then select a specific scenario to navigate. When selecting an instance (for example GL Chart of Accounts) the system...
displays its properties and all supportive multimedia associated with the specific instance. So the user can discover in the properties window (on the left): (1) all the scenarios (pages) where the specific instance appears, (2) comments explaining its use in the ERP application, (3) the ontology-defined concept that relates the term used by the ERP vendor (concept instance) to the generally accepted term used in the literature (concept) and (4) all the relations defined for the specific instance in relation to other instances. The user can also navigate into the supportive multimedia (in the specific example an adobe acrobat document) and find additional information about the instance under consideration. Finally the user can navigate into the specific scenario or other scenarios of the knowledge network and understand (1) when, in the sequence of actions necessary to perform before posting GL Transactions, is the specific instance needed (Tutorial scenario) and (2) how the specific instance relates to other instances involved in the case under consideration (GL Transactions scenario).

5. Discussion

The proposed model does not disregard existing methodologies for structuring training material, but enhances and empowers them by allowing the semantic representation of knowledge so that to enable users navigate into a knowledge network based on the characteristics of the application domain under consideration. Thus, the model can combine the existing multimedia material with concept instances, in order to build user training scenarios and satisfy specific training needs. Hence, in addition to the existing multimedia objects, the knowledge built into both the ontology and the training scenarios is fully reusable. This reusability enhances the quality of learning materials both from a creator and a user perspective.

With regard to the creator of the training material, the main advantages of the proposed model can be grouped around its three main components (repositories):

(a) Ontology repository – There are many benefits when using ontologies, in order to make explicit the underlying business process logic in an application domain so that it can be made reusable, that have already been recognized in the learning technology community (Lytras, Tsilira, & Themistocleous, 2003; Sampson, Lytras, Wagner, & Diaz, 2004), such as: (1) Semantic consistency. All ontology concepts, concept instances and relations are defined once in the appropriate hierarchy and wherever used in training scenarios they are found with the same name and meaning. (2) Explicit definition of each construct used and of the relations between constructs (through construct hierarchies). (3) Knowledge reusability. Each ontology construct is reusable as it is defined only once, associated with other relating constructs and enriched with appropriate attributes and supportive
multimedia. (4) Object-oriented design. The object-oriented approach used in creating ontologies and the hierarchical structure of the ontology, allows to lower-level sub-concepts to “inherit” all the characteristics of higher-level concepts (attributes, relations etc.), therefore improving considerably the productivity.

(b) Content repository – Content reusability of the educational material created, that is achieved with the proposed model and is related to the knowledge domain under consideration, is a key issue in the literature (Chebotko et al., 2005; Steinmetz & Seeberg, 2003).

(c) Knowledge repository – A knowledge network is a self-contained entity that serves a specific training need in a specific knowledge domain, in a specific business context and has a specific structure (Stojanovic et al., 2001). Reusability of knowledge recorded into training scenarios is also achieved as constructs instilled into older scenarios can be used into new scenarios in order to meet new training needs.

With regard to the trainee, the main advantages of the proposed model are the following:

(a) Semantic search – This allows to search ontology constructs semantically instead of textually (i.e. the search is based on language-agnostic semantic matching instead of keyword matching, that involves: (i) the knowledge domain under consideration, (ii) the business context and (iii) the structure of the educational scenario) putting emphasis on matching the content and the real meaning of each relevant construct searched (Stojanovic et al., 2001).

(b) Knowledge or conceptual navigation – This allows the use of browsing and navigation capabilities in order to identify the constructs as they are recorded into the knowledge repository and used in the training scenarios and involves: (i) navigation into the knowledge domain under consideration, (ii) navigation into the business context and (iii) navigation into the structure of the educational scenario (Stojanovic et al., 2001).

(c) Knowledge dissemination – This is an important function of any kind of training activity that can only be achieved if the trainee is provided with the ability to extract the knowledge implicit in the problem domain, as opposed to the mere presentation of facts and disconnected information which, in most cases, is not adequate. With the proposed model, knowledge is made explicit in order to assist the trainees' knowledge transformation processes (Naene, Yi-Luoma, Kravicik, & Lytras, 2008; Nonaka & Takeuchi, 1995). With regard to ERP systems training, there is a need for an in-depth understanding of each process, including the process task structures and dependencies. Considering an ERP process from the domain expert’s viewpoint leads trainees to deeper understanding of the processes under consideration and this understanding is essential when trying to develop critically thinking users. And the ability to think critically is a necessary criterion in order to say that knowledge has been disseminated. Obviously, this ability is much more important when studying complex ERP processes that consist of many interrelated tasks that combine various resources available.

Summarizing, the proposed approach helps trainees understand: (i) which are the building blocks of an ERP application, (ii) how they relate with each other and (iii) how they can be used in order to solve business specific problems.

Due to the encouraging results of the approach described, applicable both for classroom and other training needs, it is intended to evaluate it extensively using more elaborate implementation tools and more complex ERP processes in real-world situations.

References


