REAL-LIFE LEARNING IN VIRTUAL COMMUNITIES OF TECHNOLOGY

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Abstract: This paper introduces an approach to building virtual communities for Real-life technology learning. The aim is to keep technicians and technologists updated with new advances in their specific technology area. The learning strategy is based on a 'skills and competences' pedagogy and the community is built in an adaptive and collaborative information system environment which provides tools for collective knowledge management with adaptive distribution. A methodology for building Virtual Communities for Technology Learning is presented, and the ongoing experience of implementing such a community in a countrywide institution of technology learning in Brazil is also reported.

Key words: Virtual learning communities; knowledge management, real-life learning.

1 INTRODUCTION

Technology learning is nowadays a central issue, especially in developing countries, where it is often the target of strategic policies in education and professional fields. Three major problems can be found related to technology learning: (1) The volatile nature of most technologies, which can become obsolete in a very short time, (2) The growing complexity

of technologic concepts, which can make it very difficult or even prevent further learning in certain cases, and (3) The lack of effective communication and collaborative behavior among technologists or teams aware of the novel concepts being introduced in labor activities, even when the WWW and full networking support is available.

To deal with these problems, Virtual Communities for Technology Learning (VCTL) seems to be an attractive idea, as they could provide students and professionals (technologists) with the necessary resources to keep their knowledge up-to-date and share it in a very flexible way. In a VCTL, the learning goal is to share not only information but also the technologic *knowledge* and *practice (know-how)*. Sharing of practice is essential for the correct understanding and use of tools and technologic processes of any kind. The usual pedagogy for technology learning, based on skills and competences, is well suited to organize the information flow in a VCTL, according to the evolution of the user model of each member of the VCTL, in relation to a desired profile. In addition, the pedagogic approach based on skills and competences suits the goal of supporting VCTL interactions directed to update the knowledge and skills of active professionals in areas suffering major technological innovations.

The research presented here aims to develop VCTL software environments endowed with three main features: (1) *adaptive interface*, so that each VCTL member can access specific contents to improve his/her learning process, according to his/her own user *model*, (2) *ontology-oriented tools* for supporting the VCTL goals, shared by all members, that will be building and keeping updated an ontology for representing and sharing knowledge related to the technologies focused by the VCTL, and (3) *collaborative tools* enhancing synchronous and asynchronous communication among VCTL members, so that goals can be assigned to groups and collaboratively solved (Palazzo et al, 2001).

VCTLs are intended to engage for life, not only for a short or medium-sized period of online technology courses. While collaboratively building the technology ontologies and keeping them updated, the technologists gather and share knowledge using their adaptive interfaces. These interfaces are dynamically framed in login time, with content matching the technologists' user models. The system tries to make available, for each one, adequate content and pointers that will help him/her to acquire the skills and competences of a desired referential professional profile, as well as to interact with fellows interested in the same subjects. We have designed a methodology and architecture for VCTL development. A prototype is being tested by SENAI (National Service for Industrial Learning), a countrywide traditional institution for technology learning in Brazil. The prototype

implements the three features commented above and new studies are being developed to introduce additional functionalities to the system.

Created in 1942, SENAI (National Service for Industrial Learning) is one of the most important Brazilian poles of professional grade, as well a generator and diffuser of applied knowledge to industrial development. Rendering services in all country, SENAI has a more detached area of development in Southern Brazil, comprising the Paraná, Santa Catarina and Rio Grande do Sul states, where it includes 111 units.

2 AN APPROACH TO VIRTUAL LEARNING COMMUNITIES

Virtual Communities (VC) are associations of individuals (members of the community, participants or users) sharing information, knowledge and objectives in some domain through the Internet. Examples of Virtual Communities include the groups constituted of the members of any organization in corporative, surrounding on-line spaces, intranets for collaborative action, distance Real-life educational systems, and so on (Rheingold, 1993; Kollock, 1997).

Virtual *Learning* Communities (VLC) are VCs where the main goal is to *learn*. All members of a VLC are *learners*, but this does not mean that the learning process must be the same for everyone. Instead, each learner can be *modeled* by the system and learning is made to fit the needs of each one. VLC interfaces can also be constructed to be *adaptive* (Brusilovski 1997, 2001), as structures based on personalized interfaces, dynamically constructed from the user models.

In our approach to VCL, data about users are automatically collected and stored in databases which are kept updated, reflecting the evolution of user skills and competences in a specific domain. A large amount of information about the user, such as cognitive profile, previous formation, objectives and main interests, are also made available to the system through the *user model*. With this information the system will then construct personalized interfaces, with adaptively selected contents to fit the needs of each user.

New knowledge can be automatically produced, stored and distributed for the community through a set of knowledge management tools. These includes a search engine, tools for validating and describing resources, support for groups to participate in collaborative problem solving activities and collaborative project execution tasks, etc.

The main features designed to support VLC, briefly described below, are:

- Adaptive Hypermedia Interface

- Ontology-oriented Tools
- Collaborative Tools

2.1 Adaptive Hypermedia Interface

Currently, one of the main branches in Adaptive Systems research is Adaptive Hypermedia Interfaces (AHI) and its related technologies, as User Modelling (UM) and Intelligent Interfaces (II). One of the most critical features in an AHI is the *user model*, a representation of the goals, knowledge, preferences, needs and desires of its users. The underlying idea is that users with different profiles will be interested in different pieces of information presented on a hypermedia page and may also want to use different links for navigation.

AHI attempts to use the knowledge about a particular user, represented in the user model, to adapt the information and links being presented to that. User models can also be viewed as constraint sets imposed on the available hypermedia. The adaptation task performed by an AHI is oriented to assist users with personal-tailored hypermedia information and navigational help.

A major difficulty in producing AHI or indeed user-adaptive systems in general, lies in structuring information in such a way that it will be possible to do adaptations. The representation must include user profilers that allow for useful adaptations, and the interface must be designed to allow the underlying system to infer the required patterns from user actions at the hypermedia interface (Palazzo and Costa, 2001). This problem is most apparent in domains where the information is rapidly changing or highly unstructured. How could one, for example, analyze and represent the widespread needs of users of the Web in such a way that it would be possible to filter information or adapt navigation to an individual user? And even if it is possible how one could infer those needs from just observing the user's navigation through the Web?

2.2 Knowledge Management with Ontology-oriented Tools

Interaction in VLC informally produces a Shared Knowledge Web (SKW) that is indexed by the community learning domain *ontology*. This ontology is a conceptual network with *annotations* that can be of any format (text, video, audio, links, etc.), but are always about the learning domain. Community SKW can then be viewed as being its own ontology which is dynamically built by its members in a learning process.

VLC dynamics produces intensive communication among learners that share the knowledge individually gathered through SKW. New *discoveries* about any domain topic can be made available to all by anyone, stimulating knowledge interchanging and sharing. The SKW is then a dynamic collective knowledge body, a concrete product of a VLC and should be portable and reusable in other contexts. To make this possible, a document standard is needed as RDF (*Resource Description Framework,* W3C/RDF 2002) or XML Schema (W3C/XML 2002).

2.3 Collaborative Tools

Collaborative action is very important in modern learning environments and can enhance the interaction among the members of a community. Problems and challenges can be set to adaptively selected groups and collaborative action is supported by tools that, for instance, allow two or more participants to navigate together or present to the group a common blackboard or agenda, where they can share ideas, annotations, assignments, etc. In Figure 1 these three features are shown in its relation with the VLC learning domain

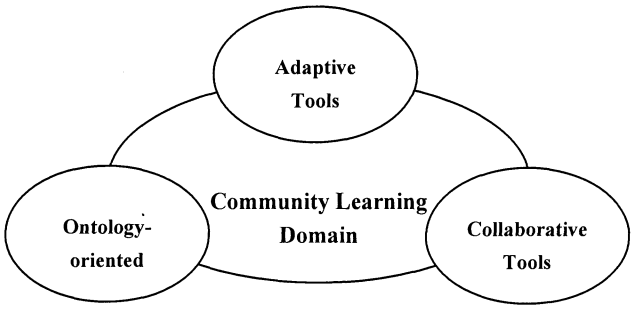

Figure 1: Key features in a VLC conception.

3 VIRTUAL COMMUNITIES FOR TECHNOLOGY LEARNING (VCTL)

3.1 Pedagogical Framework

Technologic learning has a special trait related to what is technology and how someone can learn about it. Virtual Communities for Technology

Learning (VCTL) are a specialization of VCL that incorporate information about *professional profiles*, so that the learning can be directed to such profiles.

Skills and Competences have been considered the two main concepts around which to organize technology learning. At SENAI, professional profiles are defined, based on an analysis of the competences and skills needed for the corresponding professionals, in their daily work in industry. Figure 2 shows the *profile ontology* around which SENAI's professional profiles are defined. Such profile ontology, when integrated to a VCTL, can usefully index documents and activities in the community, helping the users to find information relevant for their corresponding professional profiles.

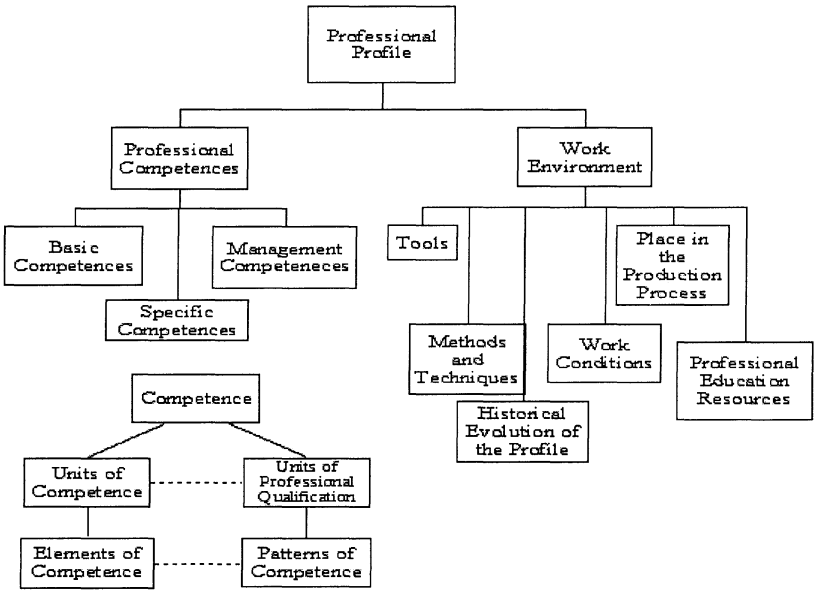

Figure 2: SENAI's Professional Profile Ontology

4 A METHODOLOGY FOR BUILDING VCTL

The construction of a VCTL is a gradual process, introducing one by one the competences associated with the desired technologic profile. A natural sequence for the VCTL evolution until its consolidation is shown in Table 1.

In the first stage the participants will learn the use of New Technologies of Information and Communication (NTIC). At the same time they *live* in VCTL, they learn about it and help in its construction. This is an adaptive

stage where basic competences for belonging to and acting in a VCTL are introduced to all. At the end of this stage, all participants must be able to produce new content, express themselves, communicate in several vehicles, search for and locate information and act collaboratively sharing common challenges.

In the second stage, the participants are introduced to the concepts of *skills and competences pedagogy*, working in groups for analyzing and designing reference profiles for their corresponding learning objectives. Activities here aim to stimulate work with the NTIC instruments from Stage 1 for modelling contents, relationships and tasks related to the skills and competences of any desired reference profile. At the end of this stage, all community members must have clearly understood the proposition of technology learning by means of the skills and competences pedagogic framework and how such framework is modelled in VCTLs.

In the third, participants are grouped by interest area for building specific VCTLs. These VCTLs should be designed to support a specific professional profile. In this stage the participants should acquire the necessary competence to conceive, model, design and implement VCTLs in practice. Different interest groups establish an initial state for the area underlying professional profile ontology. This ontology is collaboratively built as the SKW of the group. The challenge is to establish an ontological ground able to support the autonomy and evolution of the VCTL.

Finally, in the fourth stage, the several groups implement their own VCTLs. The four stages are shown in Table 1.

Table 1: Stages in Building a VCTL

Stage	**Key Activity**	**Description**
1	Instrumental: NTIC	Participants learn to use NTIC and how to apply it in VCTL.
2	Instrumental: Skills and Competences	Participants learn about skills and competences for technology learning in VCTL.
3	Content Design and Community Evolution Plans	Participants are grouped by specialty to learn how and to design contents for specific topics in the SKW. They will also define and develop reference profiles for matching desired skills and competences for each considered domain subset.
4	Open Community	The CVTL is open for new participants that will learn from the contents already provided by older members that will also keep related SKW updating.

4.1 Implementation

The subsystems that support VCTLs are:

(i) *Dynamic Interface*: changes at any new access in response to the evolution of the users profile.
(ii) *User Model Base*: stores and updates each user profile.
(iii) *Resources Description Base*: describes in *RDF/XML* each resource existing in the web that may be of community interest.
(iv) *Shared Knowledge Web*: it is organized as an ontology, covering the focus of the community where concepts and their relations can be noted and enriched with text, media, links added by any participant.
(v) *Adaptation Mechanism*: comprehend a base of rules and an algorithm for the appliances in entries of the items (ii), (iii) and (iv).

As users interact with the community their profiles become more precise, allowing the system to create more effective feed-back in selection and resources. Besides, the *RCC* of the community develops in relation to notes about their concepts and their relations.

As a result, the interaction with the community presents more fluidity and objectivity in the prosecution of the themes that compose its focus. This strategy allows that the participant receives contents and resources in a customized way making the interaction process more effective and productive.

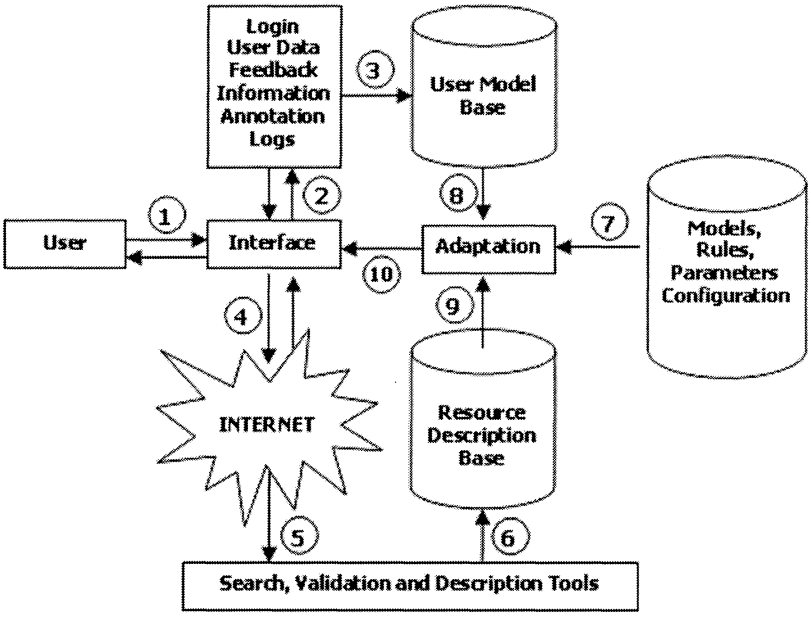

Figure 3: Functional Diagram of a VCTL

Figure 3 shows a simplified functional diagram of the VCTL/SENAI representing in the blocks the main components of the system. The numbers in the black circles represent the relations between the components, through which is described the general function of the system.

1. *User - Interface*: the relation of the user with the system always occurs through the interface. This is an adaptive hyper document that can be visualized through a *navigator*. As there is the prospect of a large number of users in the future it may be interesting to invest in the development of a client module, installed to accomplish several tasks such as, for example, optimize the communication with the server, the temporary information stock, etc. It is required that the interface has the presentation and functions of good quality.
2. *Interface – User's Entries*: the user's information are continually captured to update their profile and to add descriptions, opinions, links, etc, in the *RCC* of the system.
3. *User's Entries – User Model Base*: an agent mechanism must transform the captured information in significant expressions of the profile of each user to subsequent application in adaptation processes.
4. *Interface - Internet*: Most resources described here and made available and distributed on the Internet. The system interface presence must be guaranteed during navigation. It can be achieved, for example, by opening every external site on a new browser window.
5. *Web Search - Internet*: An agent is permanently searching the Web for resources related to the community interests. To do so, it applies the specific ontology for the community knowledge domain and keywords associates with each concept. It is possible to use available indexes and web search engines. This process creates a file containing the initial information about each specified resource.
6. *Describe and Classify - Resource Description Base*: Information about resources found on the Web is refined and classified using a description pattern (i.e. RDF/XML) that provide portability and allow future reuse.
7. *Models, Tables and Configuration - Adaptation*: The system must be constructed in a way that allows that all parameters of all processes can be revised and updated collectively. This is extremely important to make maintenance easier and guarantee generality. "Parameters" are not only values, but also images, texts and other objects that will dynamically compose the user interface at every new login. Ideally, every object in the system is an item in a database.
8. *User Models Base - Adaptation*: To make Adaptations, the user model (UM) must be available to the system. The UM is, therefore, loaded at every login. Among the UM information there are interface

presentation parameters, resources to be presented in a certain order, research results, specific contents e-services etc.

9. *Resource Description Base - Adaptation*: The RBD completes the set of databases necessary to the system. All resource descriptions are stored in the RBD, classified by keywords and containing meta-information (RDF/XML). The database will be continuously verified to check URLs validity and modifications that may have occurred in the resources referred.
10. *Adaptation - Interface*: Interface is generated by an adaptive action the uses the information contained in the user model to aggregate the elements at the description base and the different models, tables and configurations of the system, producing an interface adapted to the user, that is renewed at every login. This is the nucleus of the system, to which all other components converge. At the end, all the system processes result on this interface, that must be unique to each user, providing easy access to all the resources that, in thesis, will contribute for his/her learning.

5 CONCLUDING REMARKS

This article presented a definition for the concept of *Virtual Communities for Technology Learning* (VCTL). It has also presented a possible pedagogical definition for this kind of virtual community, based on the idea of competence based teaching. This pedagogical approach is justified, in VCTL context, by its practical character and by a strong connection with the market that teaching must have on these communities. Furthermore, this article presented a methodology propose for creating and developing VCTL.

The ideas presented were elaborated for the creation of VCTL/SENAI, a virtual community for technological learning that is being built at SENAI. This is a partnership work between SENAI/RS and the School of Informatics at Catholic University of Pelotas, through its Artificial Intelligence (GPIA) and Web Programming (WPG) research groups.

These ideas are an adaptation of the concepts and the methodology adopted for the construction of the Virtual Learning Community at ESIN/UCPel that those groups are working on in the context of technological learning.

VCLT/SENAI will be fully operational by the end of 2004, with at least three thematic communities and a support community.

The planning experience of VCLT/SENAI itself has been productive from a conceptual point of view, because it has been confronted researchers

with concrete problems and practical demands, brought by the professionalizing teaching institution, which the construction of a VC in an academic environment cannot provide.

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