Enhancing Acquisition and Distribution of Knowledge in Professional Environments using 3D Virtual Worlds

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Abstract: In this paper we explore how the use of 3D Virtual Worlds can help to teach specific competencies useful in a professional environment. Concretely, we present a pattern for practicing and learning the competency of acquisition and distribution of knowledge. A number of features available on 3D Virtual Worlds make this approach particularly interesting, as an alternative to face-to-face collaboration.

Keywords: Professional learning, 3D virtual worlds, Communication competencies, Collaborative learning environments
Categories: L.3.6, L.6.1, L.6.2, M.0

1 Introduction

Skills and competencies related to information gathering and distribution of knowledge have revealed critical for the professional performance, as concluded from different models of competency management [Boam, Sparrow 1992], [Feltham 1992] [Sparrow, Bognanno 1993] and knowledge management [Collins 1993], [Daft, Lewin 1993], [Davenport, Prusak 1998], [Gallupe 2001].

Intellectual capital is considered the principal source of competitive advantage of the organizations [Drucker 1993]. But this organizational exploitation of knowledge is dependent on the competencies of the employees and of the behaviours that they develop [Brooking 1997], [Hodgkinston, Sparrow 2002]. Thus, information searching processes developed by the employees aimed at job tasks fulfilment are fundamental for the organization learning and adaptation to a highly changing environment. Employees are thus required to be able to boost information flows through interdepartmental links [Galbraith 1973], [Tushman 1977], to facilitate searches of knowledge that is not immediately available [Hansen 1999] and to transfer complex knowledge without message distortion [Zander, Kogut 1995]. In summary, competencies related to employees' ability for acquiring and distributing knowledge allows the knowledge-creating companies [Nonaka 1991] to efficiently adapt to an unsettled environment and remain competitive.

Based on the analysis of a wide range of models proposed both from the academia and from the practice of the organizations, [Bartram et al. 2002] and [Kurz, Bartram 2002] establish The Great Eight Competency Model (extended even hierarchically up to 112 specific competencies). The model, which obtained satisfactory results in different research tests [Kurz et al. 2004], [Kurz 1999], includes the competency of searching and distributing information, integrated in the set of

competencies related to information analysis and team work. The importance of such competency (searching and distributing information) for team work is also stated in [Stevens, Campion 1994].

The professional context demands flexible and personalized solutions that provide tailored training for employees in order to achieve the skills and competencies required by their jobs. Traditional e-learning solutions overcome time and spatial barriers posed by classical face-to-face learning. But though they provide a suitable solution for cognitive abilities, they have been failing to support the development and assessment of abilities involving psychomotor, social, or affective factors.

3D Virtual Worlds (3DVWs) are emerging as an alternative to traditional environments where the cognitive, psychomotor and affective learning domains stated at Bloom's taxonomy [Bloom, Krathwohl 1956] can be successfully developed [Clark 2008], [Yankelovich, Slott 2009] [Vassileva 2008]. However, there are few attempts to use these environments for the development of professional skills. Those few are aimed at the replication of real working environments in 3DVWs [MPK20 2010], [Qwat 2010]. In this work, 3DVWs are proposed for training the employees' competency on collaborative abilities, in particular, in searching and distributing information.

3DVWs do not however guarantee the achievement of any learning outcome by themselves. This is especially true when we try to exploit the collaboration capabilities [Dillenbourg 2002]. Educational patterns [Alexander et al. 1977], [Hernández-Leo et al. 2005] that reflect best practices in learning should be used for deploying a successful instructional strategy. In this paper, a collaborative pattern for the acquisition and distribution of knowledge is introduced in order to successfully exploit such a potential.

The organization of this paper is as follows. A pattern for developing two key professional competencies is introduced in [Section 2]. The characteristics of 3DVWs for the development of skills related to communication are then highlighted in [Section 3. [Section 4] shows how to use 3DVWs for the deployment of the pattern. Conclusions are finally discussed in [Section 5].

2 Pattern for Acquisition and Distribution of Knowledge

Knowledge acquisition within a community requires its members not only to transmit information effectively, but also to be able to acquire it in an organized manner. The information might be either received passively or acquired actively by inquiry to other community members. In the latter case, effective communication is necessary to eliminate communication noise by feedback. Communication skills are not easy to promote in classical courses because of the difficulty of isolating and organizing pieces of information and the problems associated with the transmission of messages. Besides, in a collaborative environment, the interactions that take place between the students do not necessarily happen spontaneously [Dillenbourg 2002]. It is thus necessary to direct the activities of the group in a specific direction.

In our proposed professional learning experience [see Fig.1], each group ($g_1,\ldots,g_n$) of students receives a subset of the units of information ($u_1,\ldots u_m$) and should seek the missing information by talking to his/her colleagues. Problems

inherent to any communication process such as the lack of ability to communicate information or misunderstandings should be neutralized through redundancy of information. The pattern is organized in the following phases:

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- **Preparation**. The teacher chooses the information to be transmitted to the course.
- **Distribution**. Each group of students receives a subset of the information and references to the missing pieces.
- **Intra-communication**. Each students group compares, discusses and agrees over the shared information units, and plans how to find the missing ones.
- **Inter-communication**. Individuals interact with members of other groups by requesing for information or providing the requested message.
- **Final agreement**. Each group of students agrees upon the whole information.

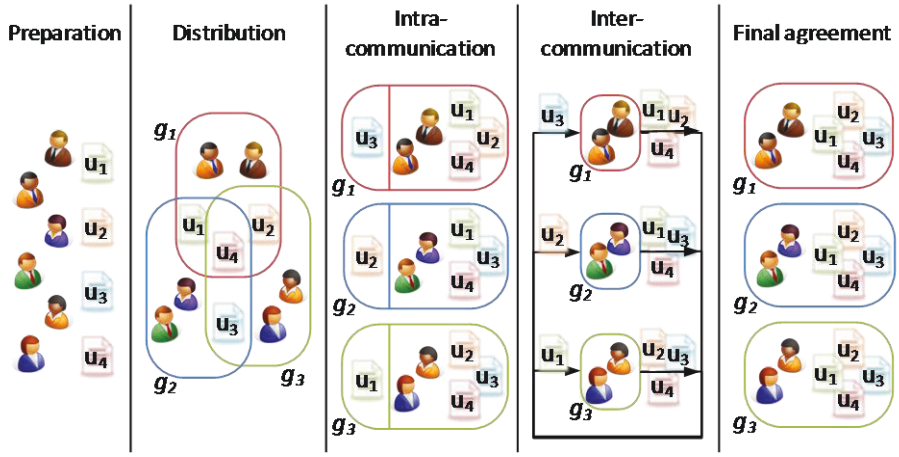

Figure 1: Pattern for acquisition and distribution of knowledge

This pattern promotes the development and improvement of three information- and communication-related competencies stated at [Bartram 2005]: Analyzing and interpreting, interacting and presenting, and organizing and executing. The competency known as *analyzing and interpreting* is present at the inter-communication phase where students must first capture information from their fellows, and then interpret it. The *interacting and presenting* competency is developed at the inter-communication phase where students must communicate information to those who request it. This competency is also promoted at the final agreement phase where students must achieve a consensus about the information gathered. The pattern also contributes to the development of the competency called *organizing and executing* at intra-communication phase because students in each group must develop a group strategy to gather information.

3 Using 3D Virtual Worlds for Enhancing the Professional Competencies of the Communication Pattern

As explained in [Section 1], the ability to acquire information from many sources and very especially from work colleagues is a key competency at the professional workplace. As with any other knowledge, skills or competencies can be learned and improved. The professional setting poses nevertheless specific challenges for the learning process, time and spatial constraints being the most remarkable ones.

In this context, 3DVWs constitute a suitable solution for facilitating the accessibility to the learning process. Physical constraints vanish in 3DVWs and they also remove time constraints by providing asynchronous interaction methods. But in addition to these generic advantages, 3DVWs provide interesting elements to enhance competencies related to collaboration as well as to information and knowledge sharing and distribution in particular:

- **Multi-user**: 3DVWs are multi-user environments that combined with their time-spatial flexibility allow communities to develop, overcoming time and physical barriers.
- **Immersiveness**: 3DVWs combine advantages from both face-to-face and virtual environments providing psychological, physical, and social immersion.
- **Configurable environment**: 3DVWs offer dynamically reconfigurable environments where it is feasible to organize users and necessary working tools in different workspaces.
- **Collaborative instruments**: One of the most cogent aspects of 3DVWs is their potential for integration of any kind of objects, including collaborative objects that can be shared and manipulated by a set of users, either synchronous or asynchronously.
- **Controlled learning environment**: A 3DVW can be seen as a controlled pedagogical laboratory -only the relevant information is there-, minimizing the amount of intellectual noise that might disturb and distract the learners.

Additionally to the above mentioned characteristics that boost learning processes in 3DVWs, these environments introduce functionality that can remarkably contribute to the assessment of collaboration: any possible interaction is susceptible to be logged. Collaboration tasks have been usually difficult to evaluate, as group members interact mostly outside the scope of the supervisor. Even though part of such interactions is forced to happen within his/her reach, to allow observation, such observation influences the group behavior and can distort the perceived results. Traditional attempts to alleviate this problem are based on involving the group members themselves (the only ones who have complete and accurate information on the collaboration process) in the assessment process, either as self- peer-assessors or a combination of both.

3DVWs make it possible to non-intrusively register any interaction between the avatar and other avatars, active objects or non-player characters (NPCs), even the time and place where such interactions happen. For communication abilities (the ones this work focuses on), interactions among avatars are the most relevant. Interactions with objects should however be considered too, for analyzing collaboration mediated by such objects. Conveniently analyzed, interaction log data can provide the instructor

and the learners themselves with invaluable information about the communication and collaboration abilities of the involved actors, as explained in the following section.

4 Deploying the Communication Pattern in 3D Virtual Worlds

The deployment of the pattern described in [Section 2] using 3DVWs as described in [Section 3], allows acquiring and developing professional competencies tied to communication. Apart from the preparation stage, where the teacher distributes the units of information among students, the rest of the pattern steps can benefit from the use of these environments.

Once the preparation step has finished, students should log in the 3D virtual learning environment. Virtual worlds should be implemented over a multi-user platform with 3D capabilities, where students can be represented by avatars, NPCs can play dialogues and smart objects can be created and manipulated. It is also necessary that avatars have the possibility to communicate among them through audio, chat, gesture, and also manipulate smart objects. Several open source platforms fulfil the requirements to deploy such a 3D virtual environment; among them it is worth mentioning Croquet [Croquet 2010], OpenSim [OpenSim 2010] and Open Wonderland [OpenWonderland 2010]. Besides, the pattern would benefit from the use of a Learning Management System associated to the 3DVW to orchestrate the learning sequence and provide students with the necessary scenario and learning objects.

At the inter-communication phase, students will explore freely the 3D learning environment and will listen to the dialogues played by NPCs with the information they are expected to acquire and also the clues for the missing information. The system will record the paths followed by the avatars, including the amount of times they repeat the dialogues in order to determine how difficult it is for each student to develop the competency tied to *information capture*. This information is available to the instructor in real time, thus (s)he can take any corrective action if necessary. A final assessment of this competency can be done with an automatic test at the end of the learning sequence.

The next step in the learning sequence is the intra-communication phase where avatars will group in private spaces specially designed in the virtual world. There, students will decide the best strategy to follow in order to find the missing information. The plasticity of the 3DVW provides the possibility to easily deploy a private 3D environment suitable for such a kind of interaction where group cohesion can be promoted without any extra cost. These areas may have security permissions to admit students belonging to only the corresponding group and deny the entrance to others. Any dialog can be recorded in order to evaluate the *organizing and executing competency*.

Once the strategy has been defined, students will practice the *interacting and presenting* competency. Students will have virtual money to pay for relevant information they receive from their peers. A commercial trade will be carried out where information is the merchandise. Virtual money is thus an objective indicator of the learners' competency for communicating information. At the end of the experience, the avatar that has more money is the one that was able to transmit better the information to their peers. In order to assess the way students capture and interpret

information, a final test must be taken. Before taking the test, students meet again to reach a final agreement in the last phase, where the activities conducted are similar to those carried out during the intra-communication step.

[Table 1] summarizes the ideas stated at this section, developed in the first implementation of the pattern that has been deployed using Wonderland [OpenWonderland 2010], an open source 3DVW.

	Competencies	**Activities**		**Assessment**
		Scenario	**Task**	
Distribution		Global	Exploration, Interact w/ NPCs	Path followed, time spent
Intra-communication	Organizing & executing	Private	Communicate w/ peer avatars	Interaction log
Inter-communication	Analyzing & interpreting; Interacting & presenting	Global	Communicate w/ peer avatars, trade information	Virtual money earned
Final	Interacting & presenting	Private	Communicate w/peer avatars	Interaction log final test

Table 1: Pattern deployment in 3D Virtual Worlds (phases involving student activity)

5 Conclusions

One of the assets of any enterprise is the collective knowledge accumulated with its employees. The company must make sure that this knowledge flows and is shared adequately. This is also true for distributed companies, where the interactions between employees occur mainly through on-line communication. How can the employees in such a context learn to acquire and distribute information appropriately?

Competencies related to collaboration have traditionally posed a tough challenge for learning and evaluation, as most interactions are developed outside the scope of the supporting instructor. We have shown how 3D Virtual Worlds can help in such an endeavour by taking advantage of its unique features. But appropriate instruction strategies need to be deployed in order to materialize such potential. We thus propose a pattern for acquisition and distribution of knowledge that promotes the development of employees' key competencies –like information analysis and interpretation, interacting and presenting, and organizing and executing– and discuss its deployment using 3D Virtual Worlds in order to successfully achieve the intended outcomes.

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