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Review

Ontologies application in organizational learning: A literature review

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ABSTRACT

Although ontologies and organizational learning are issues that have been discussed for many years, there is not an approach on literature that gives an overview about how both issues have been applied together. This literature review has the objective of exploring how ontologies are being applied in the organizational learning process recently; as a consequence, only studies from the year of 2005 onwards have been searched. The identification process produced 353 papers from 11 different databases. After applying the exclusion criteria, the set was reduced to 11 papers, which clearly fitted to the criteria defined for accomplishment of the systematic review, which were then analyzed and classified. The papers have been classified according to the structure and level of the ontologies. Furthermore, the Information Technology (IT) used in conjunction with ontology was identified, as well as the way ontologies and IT can act as a means of facilitating the organizational learning process. It was observed that although ontologies are rather important, a very few number of researches have applied ontologies in the organizational learning processes. In a general way, ontologies and IT encourage the sharing of knowledge and formalization.

1. Introduction

Learning has become a crucial factor for the organizations to obtain competitive and sustainable advantages in the last decades (Schein, 1996; Senge, 2000; Stata, 1989). It is through it that the organizations reach an environment that stimulates innovation and improvement and they are also capable of responding to the changes demanded by the world of competition (Murray & Donegan, 2003). In this context, two concepts have been discussed in literature, and these two refer to organizational learning (OL) and learning organization (LO). Both concepts are considered complementary because there is not a clear distinction between the two (Finger & Buergin, 1998; Lahteenmaki, Toivonen, & Mattila, 2001).

OL is a process where organizations retain the knowledge that is located in the minds of its members and/or in the epistemological artifacts (maps, memories, policies, strategies and programs) and integrates it to the organizational environment (Argyris & Schon, 1996; Stata, 1989). In this approach, knowledge is considered as part of the organization and it is represented as procedures and rules (Sicilia & Lytras, 2005). LO is the ideal situation, to which the organizations must evolve in order to reach continuous learning (Finger & Buergin, 1998) and it is characterized by behavior changes in the organization as a result of learning (Reynolds & Ablett, 1998). LO presents a more modern approach, however, the concept of OL is still the most used to describe learning in organizations.

Nevertheless, there are still barriers impeding learning from happening and thus obstructing companies from getting sustainable competitive advantages. Among these barriers, one can point out communication deficiency, difficulty in the conversion from tacit to explicit knowledge and the lack of knowledge management (Riege, 2005; Schilling & Kluge, 2009; Von Zedtwitz, 2002).

As a tentative to reduce or eliminate these barriers, the Information Technology (IT) can be an allied. IT solutions such as e-mails, chats, blogs, collaborative systems, among others, can be implemented in order to obtain good results in this context, since they contribute for an improvement in communication among the people and help elucidating knowledge. However, for some issues, such as, adequate knowledge structure and mechanisms that makes its retrieval easier, certain types of IT should be applied in conjunction, so that a higher level of "intelligence" is offered in order to achieve more satisfactory results. In this sense, the area of Artificial Intelligence (AI) has conducted research in developing computational systems that incorporate knowledge on a given domain, allowing inferences, reasoning and decision making. These systems keep an explicit and symbolic representation of knowledge. Such representation has an advantage of being separated from the procedure aspects related to application, and it can be reused by other systems. In order to fulfill this task, it is necessary to organize knowledge in a formal way and make it available in a standard language, so that it can be shared, because computers are essentially machines processing symbols and need clear instructions on how to manipulate these symbols in a meaningful way (Cimiano, 2006).

In this context, ontology has a main role: it allows formal vocabularies that describe basic premises of a given domain; it

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gives a shared conceptualization expressed in a formal logic; it makes communication among people and computational agents easier; it promotes interoperability among organizational systems; and it can also be used by computational agents in order to act replacing human beings in processes or distributing tasks.

The most widespread definition of ontology is "an explicit specification of a conceptualization" (Gruber, 1995). This definition has been complemented by Studer, Benjamins, and Fensel (1998) as "ontology is a formal, explicit specification of a shared conceptualization". According to Studer et al.'s definition (1998), "shared" means that an ontology should capture the consensual knowledge, and "formal" refers to the fact that ontology should be declaratively defined, read and interpreted by machines.

Processing information using ontologies, that provide an excellent context for understanding the information for both human users and for software agents, is becoming a trend in several areas and types of application (Musen, 2002). The motivation for the development of ontologies can be found in many applications and through the benefits obtained by its use.

There is a high interest in the construction of ontologies, however, there is not a lot of work developed in this area and it has not been used widely yet. In the organizational learning context, where their development and application are notably relevant, ontologies have not been used so much. Some reasons for this may be: time, cost and the resources used for their development.

In this context, the objective of this paper is to explore how ontologies are being applied in this process. There are some questions that are still unanswered:

1. What types of ontologies are being applied in the organizational learning process?
2. What are the types of IT applied in conjunction with ontology in the context of organizational learning?
3. What are the ways ontologies and IT can facilitate the organizational learning?

The remaining sections of this paper are organized as follows: Section 2 presents the theoretical basis for organizational learning, learning organization, Information Technology and ontologies. Section 3 describes the research method. The results are presented in Section 4 and the discussion in Section 5. Section 6 concludes this paper.

2. Literature review

This section presents a theoretical background of the main concepts that are objects of this study. The first subsection describes the main concepts related to organizational learning and learning organization. While these concepts have some differences, both have been treated in literature as being complementary with regards to learning in organizations. Thus, the two concepts were considered in the search of this material. The second subsection describes concepts related to IT and more specifically, ontologies, their characteristics and how they can support the process of organizational learning.

2.1. Organizational learning and learning organization

Individuals are not distinct only by the group of knowledge and skills they have, but also by the ability to adapt and manage the changes demanded by their jobs and carriers. The same issue occurs with the organizations. In order to obtain continuous success in an ever changing world, it is required ability to explore new opportunities and learn from goals and mistakes from the past (Kolb, 1973). This ability is acquired through a learning process where individuals gain new knowledge and insights and it changes their behaviors and actions (Stata, 1989).

What differs organizational learning from individual, is that in organizational learning, learning occurs through shared insights and mental models; and the individual learning is acquired through past experiences by the organization (Stata, 1989). Fiol and Lyles (1985) reinforce this difference by stating that the organizational learning process influences not only its direct members as in individual learning, but it is subsequently transmitted to other members through the organization's rules and history.

Nowadays, learning is seen as an essential survival pre-requisite within the corporate world. There is a need to know the favorable conditions to apply it and understand its process with the objective of improving its effects (Lahteenmaki et al., 2001). Organizations need to learn to learn (Schein, 1996). In this context, there are two approaches that may be applied as a means of obtaining better results in the learning process: organizational learning (OL) and learning organization (LO).

As far as OL, there is not an holistic vision about its characterization (Lahteenmaki et al., 2001), however, there is a general consensus that the OL is an adaptative changing process influenced by an experience from the past, focused on the development or on the procedure modification and supported by the organizational memory (Nonaka & Takeuchi, 1995). Argyris and Schon (1996) define OL as a process performed by the members of an organization, working on their own or interacting with others, within an organizational community where individuals inquire on behalf of the organization. The members of a team create new perspectives through dialogues and debates. These dialogues may involve considerable conflicts and divergences, but it is this conflict that prompts the people to question the existing premises and to understand their experiences through a new manner. This type of dynamic interaction facilitates the transformation of personal knowledge into organizational knowledge (Nonaka & Takeuchi, 1995).

The LO presents a more modern view, and this concept was created to characterize organizations that facilitate learning, allowing their members to continually expand their capacity to create the results they really want, new and broad thinking patterns are stimulated, the collective aspiration is set free, and people learn to continually learn together (Pedler, Burgoyne, & Boydell, 1991; Senge, 2000; Sicilia & Lytras, 2005).

However, there is much confusion regarding these approaches (Finger & Buergin, 1998; Lahteenmaki et al., 2001). The LO is an ideal, which the organizations should evolve to, so that they are capable of learning continually. On the other hand, the OL is the activity and process through which the organizations finally achieve the ideal of a LO. The OL may occur without necessarily resulting in a learning organization and the contrary as well (Finger & Buergin, 1998).

In spite of the differences between these two concepts, both deal with learning in organizations, where it is expected to develop people's skills through their experiences. In this process, organizations obtain the knowledge that is located in the minds of their members and/or in the epistemological artifacts (maps, memories, policies, strategies and programs) and integrates it with the organizational environment (Argyris & Schon, 1996; Stata, 1989).

In the statements of Argyris, Schon and Stata is clear that one goal of the OL is the acquisition of knowledge as a means to realize the innovations and improvements. Garvin's definition reinforces this point when he says that LO is an organization capable of creating, acquiring, transforming knowledge and modifying its behavior in order to reflect new knowledge and insights (Garvin, 1993).

Due to the importance of knowledge for learning in organizations, it is coherent to identify the solutions that may be applied as conductors or facilitators in this process of knowledge acquisition,