Knowledge Management in Support of Education

Murray E. Jennex [1]

Abstract

This paper is about the application of knowledge management to supporting education. Knowledge management is about leveraging what an organization knows and improving connectivity between knowledge sources and/or knowledge users. New knowledge management methods and technologies greatly improve the ability of faculty and students to improve their connectivity, find knowledge, and to visualize knowledge. It is expected that this will lead to improved learning. However, issues such as cost, organizational politics, and learning culture may prevent this from happening.

Keywords : Knowledge Management, Education, Wiki, Knowledge Transfer, Community of Practice

Introduction

Knowledge management (KM) is about capturing knowledge created in an organization and making it available to those who need it to make decisions. Knowledge management achieves this by helping organizations leverage what they know and by improving connectivity between knowledge sources and/or knowledge users. Education is about learning and transferring knowledge from those that have it to those seeking to learn it. While it would seem natural for knowledge management to be used to support education; a review of the literature pertaining to implementation of knowledge management and knowledge management systems finds that the emphasis in knowledge management research is focused on knowledge management impacts on organizational performance and competitive enhancement (Von Krogh 1998; Hackbarth 1998; Davenport and Prusak 1998; Alavi and Leidner 2001, Jennex and Olfman 2005 and 2006). This paper attempts to address this shortcoming by providing an overview of how KM can support education. To accomplish this the paper will overview KM fundamentals and technologies, then discuss how they can be applied in an educational context.

[1] *Associate Professor, Dr.,San Diego State University, USA. Email address: mjennex@mail.sdsu.edu*

Knowledge

Davenport and Prusak (1998) view knowledge as an evolving mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. They found that in organizations, knowledge often becomes embedded in artifacts such as documents, video, audio or repositories and in organizational routines, processes, practices, and norms. They also say that for knowledge to have value it must include the human additions of context, culture, experience, and interpretation. Nonaka (1994) expands this view by stating that knowledge is about meaning in the sense that it is context-specific. This implies that users of knowledge must understand and have experience with the context, or surrounding conditions and influences, in which the knowledge is generated and used for it to have meaning to them. This also implies that for a knowledge repository to be useful it must also store the context in which the knowledge was generated. That knowledge is context specific argues against the idea that knowledge can be applied universally, however it does not argue against the concept of organizational knowledge. Organizational knowledge is considered to be an integral component of what organizational members remember and use meaning that knowledge is actionable.

Polanyi (1967) and Nonaka and Takeuchi (1995) describe two types of knowledge, tacit and explicit. Tacit knowledge is that which is understood within a knower's mind and which cannot be directly expressed by data or knowledge representations and is commonly understood as unstructured knowledge. Explicit knowledge on the other hand is that knowledge which can be directly expressed by knowledge representations and is commonly known as structured knowledge. Current thought has knowledge existing as neither purely tacit nor purely explicit. Rather, knowledge is a mix of tacit and explicit with the amount of explicitness (only one dimension needs to be measured) varying with each user. This is the knowledge continuum where purely tacit and purely explicit form the end points with knowledge existing somewhere on the continuum between the two end points. Smolnik, et al. (2005) have an individual position knowledge on the continuum through context explication where context explication reflects the experience and background of the individual. Nissen and Jennex (2005) expand knowledge into a multidimensional view by adding the dimensions of reach (social aggregation), life cycle (stage of the knowledge life cycle), and flow time (timeliness) to explicitness. Research is continuing to refine the concept of knowledge and its dimensions.

Knowledge transfer in an organization occurs when members of an organization pass tacit and explicit knowledge to each other. Nonaka and Takeuchi (1995) propose four modes of knowledge creation and transfer.

- Socialization is the process of sharing experiences and thereby creating tacit knowledge such as mental models and technical

skills. Tacit knowledge can be obtained without using language through observation, imitation, and practice.

- Externalization is the process of articulating tacit knowledge in the form of explicit concepts, taking the shapes of metaphors, analogies, concepts, hypotheses, or models.
- Combination is the process of systemizing concepts into a knowledge system by combining different bodies of explicit knowledge. Explicit knowledge is transferred through media such as documents, meetings, email, and/or phone conversations. Categorization of this knowledge can lead to the generation of new knowledge.
- Internalization is the process of converting explicit knowledge to tacit knowledge and is closely related to learning by doing.

These four modes or processes show that the transfer of knowledge is dependent upon the transfer of a common understanding from the knower to the user of the knowledge. Common understanding consists of the context (the story behind the knowledge, the conditions and situations which make the knowledge understandable) and the experience (those activities which produce mental models of how the knowledge should be used) expressed in a culturally understood framework.

What is culture and context? The United Nations Educational, Scientific and Cultural Organization, UNESCO, states that culture is the "set of distinctive spiritual, material, intellectual and emotional features of society or a social group and that it encompasses, in addition to art and literature, lifestyles, ways of living together, value systems, traditions and beliefs" (UNESCO, 2002). The American Heritage Dictionary (2000) defines context as the part of a text or statement that surrounds a particular word or passage and determines its meaning and/or the circumstances in which an event occurs. Culture forms the basis for how we process and use knowledge by providing belief frameworks for understanding and using the knowledge, context provides the framing for the knowledge explaining how it is created and meant to be used. Both are critical to the transfer and reuse of knowledge. We normally expect explicit knowledge to be easily transferred while we expect issues with transferring tacit knowledge. However, we are finding that transfer of either dimension of knowledge in a multicultural environment is not easy.

Jennex and Zakharova (2006) discuss why we need to consider culture and issued a call for further research into the impact of culture on KM. This discussion is based on Hofstede (1980, p. 25) who refines the definition of culture as: "Culture consists in patterned ways of thinking, feeling and reacting, acquired and transmitted mainly by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditions (i.e. historically derived and selected) ideas and especially their attached values." His work focuses on identifying cultural differences between nations and illustrates that value sys-

tems are not the same the world over. The key to the impact of culture on knowledge transfer is how values impact how different social groups will externalize metaphors, analogies, hypotheses, and models; how groups will systemize concepts; how groups internalize concepts; and how groups understand experiences. Differences in culture, and Hofstede (1980, 2001) show that there are significant differences between national cultures, can lead to differences between national groups within the same organization, which can cause those groups to either understand knowledge differently, or have significant barriers to participating in the sharing of knowledge. We must understand that culture is a unique component that is so deeply imbedded into peoples' lives that our ignorance of it usually leads to failures. Knowledge Management Systems, KMS, as well as other systems created to improve organization's performance should use all possible information about culture to escape system's mistakes due to lack of cultural awareness and understanding. Probably no theory ever will be capable to capture all or even full knowledge about a specific culture but there are enough theories (as discussed above) to establish a process and methodology for including cultural parameters in the design of KM initiatives and the system analysis and design activities.

Along with concerns about how national cultures affect the use and understanding of knowledge is the impact of organizational culture on knowledge use. Organizational culture impacts the flow of knowledge through the organization as well as the willingness of its members to share and reuse knowledge. Jennex and Olfman (2005) synthesized literature and research into a set of twelve critical success factors. Organizational culture was found to be a key critical success factor by several researchers (Alavi and Leidner, 1999, Bock and Kim, 2002, Chan and Chau, 2005, Davenport, et al., 1998, Forcadell and Guadamillas, 2002, Jennex and Olfman, 2000, Sage and Rouse, 1999, and Yu, et al., 2004). Issues related to organizational culture include organizational reward, incentive, and personnel evaluation systems and management and leadership styles and support for KM.

Why consider context? Davenport and Prusak (1998, p.5) found that for knowledge to have value it must include the elements of human context, experience, and interpretation. Nonaka (1994) expands this view by stating that knowledge is about meaning in the sense that it is context-specific. This implies that users of knowledge must understand and have experience with the context (surrounding conditions and influences) in which the knowledge is generated and used for it to be meaningful. This suggests that for a knowledge repository to be useful it must also store the context in which the knowledge was generated. The suggestion that knowledge is context specific argues against the idea that knowledge can be applied universally.

Context is the collection of relevant conditions and surrounding influences that make a situation unique and comprehensible to the users of the knowledge, Degler and Battle

(2000). Context can be stored with knowledge and/or can be possessed by knowledge users. When a system's knowledge users are known, the knowledge that is captured is used to support specific activities. KMS users are readily known when the KMS is built to support a specific team, project, or process and the users are those involved with that team, project, and/or process. These users tend to possess a high degree of shared understanding where understanding incorporates context and experience. Experience is what knowledge users use to generate mental models of how to use or apply the knowledge, Degler and Battle (2000). Experience comes from the individual's own experience with the knowledge domain, other's shared experience with the knowledge domain, and/or a collective experience with the knowledge domain, Degler and Battle (2000). Combined, this means that knowledge users in teams, projects, or even processes understand the organizational culture, the structure of organizational documents, organizational terminology and jargon, and how the organization works and are able to use posted knowledge, even if it does not include context, as they implicitly understand the context in which the knowledge was created and have experience in using this knowledge. On the other hand, when KMS users are not known it is not possible to assume these users possess a common understanding or experience associated with the generation of the knowledge. This means the KMS will have to capture this context and experience for users to be able to utilize the captured knowledge effectively.

This section has presented current thought on what knowledge is, but the definition of knowledge is far from agreed upon. Knowledge is a difficult construct to define as most knowledge is context, culture, and time specific and is rarely viewed as universal, leading individuals to define knowledge uniquely. It is expected that the definition of knowledge will be debated for quite a while, perhaps as long as KM is researched. Ultimately I agree with Keen and Tan (2007) who believe that while it is important to understand what knowledge is, it is unproductive for researchers to get focused on trying to precisely define knowledge at the expense of furthering KM research.

Knowledge Management

Jennex (2005a) utilized an expert panel, the editorial review board of the International Journal of Knowledge Management, IJKM, to generate a definition of KM as the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization's effectiveness. Another key definition of KM includes Holsapple and Joshi (2004) who consider KM as an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity, in the sense of positive results in accomplishing its objectives or fulfilling its purpose. Finally, Alavi and Leidner (2001) con-

cluded that KM involves distinct but interdependent processes of knowledge creation, knowledge storage and retrieval, knowledge transfer, and knowledge application. Taken in context, these definitions of KM focus on the key elements of KM: a focus on using knowledge for decision making and selective knowledge capture. This is important as the selective focus on knowledge capture separates KM from library science which attempts to organize all knowledge and information and the decision making focus emphasizes that KM is an action discipline focused on moving knowledge to where it can be applied. Ultimately, KM may best be described by the phrase "getting the right knowledge to the right people at the right time" and can be viewed as a knowledge cycle of acquisition, storing, evaluating, dissemination, and application.

Knowledge Management System

Jennex (2005) views a KM system, KMS, as that system created to facilitate the capture, storage, retrieval, transfer, and reuse of knowledge. The perception of KM and KMS is that they holistically combine organizational and technical solutions to achieve the goals of knowledge retention and reuse to ultimately improve organizational and individual decision making. This is a Churchman (1979) view of KM that allows KMS to take whatever form necessary to accomplish these goals. Alavi and Leidner (2001, p. 114) defined a KMS as "IT (Information Technology)-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application." They observed that not all KM initiatives will implement an IT solution, but they support IT as an enabler of KM. Maier (2002) expanded on the IT concept for the KMS by calling it an ICT (Information and Communication Technology) system that supported the functions of knowledge creation, construction, identification, capturing, acquisition, selection, valuation, organization, linking, structuring, formalization, visualization, distribution, retention, maintenance, refinement, evolution, accessing, search, and application. Stein and Zwass (1995) define an Organizational Memory Information System (OMS) as the processes and IT components necessary to capture, store, and apply knowledge created in the past on decisions currently being made. Jennex and Olfman (2006) expanded this definition by incorporating the OMS into the KMS and adding strategy and service components to the KMS.

Knowledge Management Tools and Technologies

Although there is strong support for using the Internet as a Knowledge infrastructure, there are concerns. Chief among these concerns is the difficulty in organizing, searching, and retrieving unstructured knowledge artifacts. Ezingeard, et al. (2000) points out that Ernst & Young UK in the beginning of 2000 had in excess of one million documents in its KMS. Another concern is the tendency to not to use the system. Cross and Baird

(2000) discusses this tendency but comes to the conclusion that repositories are essential. Jennex (2007) found that use and importance for knowledge do not correlate suggesting that use is not a true measure of the value of a KMS. Jennex and Olfman (2002) found that voluntary use is enhanced if the system provides near and long term job benefits, is not too complex, and the organization's culture supports sharing and using knowledge and the system. Stenmark (2002) found that if the Internet is visualized as a system for increasing awareness of knowledge and the KMS, a system for retaining and sharing knowledge, and as a system for enhancing communication and collaboration between teams and knowledge experts and users; then it should be successful as a KMS. In all cases, researchers are experimenting with technologies that improve the handling of unstructured knowledge. These are discussed in the following paragraphs.

Newman and Conrad (2000) propose a framework for characterizing KM methods, practices, and technologies. This framework looks at how tools can impact the flow of knowledge within an organization, IT's role in manipulating knowledge artifacts, and the organizational behavior most likely to be affected. The framework also looks at the part of the KM process the tool works in. The Activity phase looks at the utilization, transfer, retention, and creation of Knowledge. This framework can be used to show that Internet and Browser based KMS tools are effective.

Gandon, et al. (2000) proposes using XML to encode memory and knowledge, and suggest using a multi-agent system that can exploit this technology. The proposed system would have improved search capabilities and would improve the disorganization and poor search capability normally associated with Internet systems. Chamberlin, et al. (2001) and Robie, et al. (1998) discuss using XML query language to search and retrieve XML encoded documents.

Dunlop (2000) proposes using clustering techniques to group people around critical knowledge links. As individual links go dead due to people leaving the organization, the clustered links will provide a linkage to people who are familiar with the knowledge of the departed employee. This technique would improve the reliability of the links to knowledge called for in Figure 2. Lindgren (2002) proposes the use of Competence Visualizer to track skills and competencies of teams and organizations.

Te'eni and Feldman (2001) propose using task-adapted websites to facilitate searches. This approach requires the site be used specifically for a KMS. Research has shown that some tailored sites, such as ones dedicated to products or communities have been highly effective. This approach is incorporated in the examples in this paper with the exception of the use of dynamic adaptation.

Abramowicz, et al. (2002), Eppler (2001), and Smolnik and Nastansky (2002) discusses the use of knowledge maps to graphically display knowledge architecture. This technique uses an Intranet hypertext clickable map to

visually display the architecture of a knowledge domain. Knowledge maps are also known as Topic Maps and Skill Maps. Knowledge maps are useful as they create an easy to use standard graphical interface for the Intranet users and an easily understandable directory to the knowledge.

The use of ontologies and taxonomies to classify and organize knowledge domains is growing. Zhou, et al. (2002) propose the use of ROD, Rapid Ontology Development, as a means of developing an ontology for an undeveloped knowledge domain.

Making sense of seemingly unrelated structured data, information, and knowledge can also be difficult. Data mining is being used as a method for identifying patterns in this data, information, and knowledge that can then be assessed for meaning. Zaima and Kashner (2003) describe data mining as an iterative process that uses algorithms to find statistically significant patterns in structured data, information, and knowledge. These patterns are then analyzed by business process experts to determine if they actually have meaning in the business process context. CRM tends to use this technology the most as illustrated by the example from Al-Shammari (2005).

Organizing and visualizing data and information into usable knowledge is a challenge that digital dashboard technologies are seeking to solve. Few (2005) describes dashboards as providing single screen summaries of critical data and information. Key to developing effective dashboards is the use of KM to identify critical knowledge for key decision making and then linking it to the appropriate context data and information that indicates the status of the key knowledge. Dashboards can be used with a Internet browser or any other KMS infrastructure.

'Wiki' is a Hawaiian word that means 'quick' and is used by the information systems community to refer to a open source, collaborative, content management system. Wikis were first implemented by the Portland Pattern Repository group to create a seamless database that enabled their members to create, edit, store, and structure content (text and graphics) in Web format (Wagner, 2004; Leuf and Cunningham, 2001). Wikis run over the World Wide Web and are browser independent. The hypertext transfer protocol (HTTP) governs the communication process between the client and server within a wiki. Wiki communities consist of registered members who can edit any page within the wiki website without any additional functional support from the web browser. Members establish topic associations by using hyper-linking capabilities inherent in any wiki. The value of wikis is greatest when members actively engage in collaborative editing, sharing of information, and creating new wiki pages within a given wiki (Leuf and Cunningham, 2001). The ability of wikis to handle collaborative creating, editing, storing, and disseminating information/knowledge has led to wikis being accepted as a collaborative, knowledge management technology (Wagner, 2004; Leuf and Cunningham, 2001).

Knowledge Management and Education

How can KM support education? A traditional approach would look at the knowledge repository, search, and retrieval functions of KM as a method of improving the ability of students and faculty to conduct research that finds and links knowledge for solving problems of interest. This is a good use of KM but not the best use in support of education. KM is also about improving connectivity and communicating and transferring knowledge through the SECI model. This is where KM can greatly enhance education. Collaboration between students, either as teams, work groups, classes, or between students and faculty can greatly enhance the learning process through improved knowledge sharing and transfer. Knowledge visualization can improve the ability of students to understand knowledge being transferred. Use of KM technologies can increase the reach between students and faculty. Examples of this support are:

- Use of wikis for collaborative team projects, this improves the ability of team members to collaboratively author project documents resulting in improved learning by all team members as instead of one member doing the bulk of the writing, all can share.
- Use of blogs or wikis to create virtual class spaces where discussions can continue outside of the classroom. This also allows students to ask questions that normally would not speak in class and allows faculty to post richer knowledge artifacts in support of knowledge transfer.
- Use of blogs, wikis, Linkedin, or Facebook to create student and/or faculty spaces, communities of practice, and social networks. This allows students to discover the experts among them and to learn from each other.
- Use of second life, data fusion, mapping technologies such as GIS, and knowledge portals to provide self directed visualization of knowledge.
- Use of blogs or wikis to connect faculty for discussions and repositories of best practices and other teaching artifacts.

Ultimately, KM supports education through the following:

- Improved knowledge mapping and repositories for class specific knowledge artifacts
- Improved knowledge transfer through creation of class and topic specific communities of practice and/or social networks
- Improved knowledge representation through visualization
- Improved knowledge sharing through common repositories, communities of practice, and/or social networks

Additionally, KM supports education during the following activities:

- During class preparation through improved knowledge sharing of best practices and increase standardization of lessons and class artifacts
- During class delivery through additional

channels of knowledge transfer and improved repositories and visualization of class specific knowledge artifacts

- After class completion through better post class analysis and continued knowledge transfer through communities of practice, repositories, and/or social networks.

Conclusions

This paper has summarized the state of the KM discipline and proposed methods and technologies for using KM to support education. Implementing KM in education will not be an easy task. Organizational politics and social norms among faculty will have to be changed to reward collaboration and shared excellence rather than individual achievement and traditional student-faculty relationships changed to be more collaborative. Additionally, faculty will have to be trained in KM methods and technologies and universities and schools will need to invest in more tools and Internet connectivity. All this is difficult and expensive and there is little research to indicate how much learning will improve, making cost benefit analysis and justification difficult.

This said, there are things that can be done to implement KM in the classroom that are relatively inexpensive and whose use should demonstrate the value of KM to education. These resources include:

- Open source wiki software
- Free access to Facebook and LinkedIn
- Implementation of knowledge sharing processes among faculty in the same subject
- Creation and implementation of class assignments that incorporate collaborative team work
- Knowledge repositories of artifacts, assignments, and/or best practices created and supported by external organizations such as Association for Information Systems (AIS) special interest groups (SIG) and the Terradata Student Network.

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