StoryMapper: a Multimedia Tool to Externalize Knowledge

Carlos E. Acosta, César A. Collazos[§], Luis A. Guerrero,
José A. Pino, H. Andrés Neyem, Olivier Motelet

Department of Computer Science, Universidad de Chile
Av. Blanco Encalada 2120, Santiago, Chile
{caacosta, luguerre, jpino, aneyem, omotelet}@dcc.uchile.cl

[§] *Department of Systems, Universidad del Cauca*
Sector Tulcan, Popayán, Colombia
ccollazo@unicauca.edu.co

Abstract

People with different skills and knowledge can contribute in future decisions and best-practices. In order to help us, there are different mechanisms to represent and organize knowledge. In this paper, we present and discuss a computer tool that it has been developed to support the externalization of tacit knowledge through a Storytelling activity. The tool uses conceptual maps to represent knowledge. The group members may synchronous or asynchronously contribute to the development of a story.

1. Introduction

Knowledge representation is an interesting vehicle to allow learning [11]. On the other hand, if knowledge is represented, then it may be easy to design mechanisms to capture, organize and communicate that knowledge.

As a mechanism to represent knowledge, conceptual mapping has been one of the most referenced in the literature [20]. A concept map is a schematic device used to enable the user to explicitly represent a number of concepts and their relationships. A concept map in its simplest form consists of just two concepts connected by a linking word to form a proposition [14]. The concept mapping activity is a process of organizing concepts and relationships between concepts in a hierarchical manner, from highly inclusive concepts to increasingly specific concepts.

Since a conceptual map represents in a graphical form a person's knowledge structure, the map may serve to make clear the person's concepts. Furthermore, conceptual maps tend to be easier remembered than text because of the visual image.

The objective of this work is to externalize certain kind of implicit knowledge. Our approach is based on Group Storytelling, a collaborative technique externalizing tacit knowledge into explicit knowledge [19]. This activity permits us to create a knowledge flow, which can be represented using conceptual maps. Group Storytelling is a process to create a story. It may be done synchronously or asynchronously, co-located or distributed, at various points in the decision process, and using various media. We base our work on the model presented by Valle et al. [19].

The goal of this paper is to discuss how a groupware, specifically a group storytelling tool, can support the externalization of the group tacit knowledge within a project. We claim that this approach is preferable when informal knowledge is to be recovered from past projects. While stories can be considered a nice way to report past experiences, it can also be an essential part of the organization knowledge.

One of the most important practices related with Knowledge Management is the Organizational Memory (OM) that, intuitively, can be classified as the registration of useful data, information and knowledge. OM can be retained in the culture, transformations, ecology, external files, corporate manuals, databases, stories and the individuals within an organization [1].

In fact, we cannot assert that the entire knowledge is registered in documents. The experience of the organization members, their ideas and decisions cannot be left out of the OM. Nonaka and Konno define these elements as tacit knowledge [12]. It consists of technical abilities: the type of informal dexterity, which is difficult to specify, incorporated to the term know-how, also embracing mental models, faiths and ingrained perspectives not subjected to the easy manifestation. It is opposite to the explicit knowledge, which is simple to share and easy to articulate in clear terms. The explicit knowledge can be represented through documents, computer programs etc.

Proceedings of the XXIV International Conference of the Chilean Computer Science Society (SCCC'04)
0-7695-2200-9/04 $ 20.00 IEEE

One of the main challenges of KM and OM is exactly to capture the tacit knowledge. Because it is not logical and strictly documented, it is difficult to maintain. Nevertheless, it should be disseminated among the members of the organization because it represents ideas that were drifted, decisions which were made, causes leading to the rejection of another decisions, options and choices before doubts in certain projects and other essential information. One possible solution to this problem is to transform the tacit into explicit knowledge, so that it can be registered and documented easily.

We also propose to implement organizational memory model and awareness mechanisms. The organizational model, besides the Group Storytelling and the conceptual maps, will allow us to capture, store, access and use knowledge. Awareness mechanisms will allow participants to build a shared knowledge on the collaboration objects and task goals [8].

The rest of the paper is organized as follows. Section 2 presents previous work on conceptual maps and Storytelling. Section 3 includes our collaboration procedure. The StoryMapper tool supports such procedure and it is presented in Section 4. Section 5 discusses the procedure and its application areas. Finally, the conclusions and proposed future work are presented in Section 6.

2. Related Work

Some studies propose conceptual mapping as a vehicle for externalizing "internal" expert knowledge, to allow knowledge to be examined, refined, and reused [7]. There are studies as well proposing storytelling as a collaborative activity because the stories are not monologues; multiple people jump in with additions, questions, corrections, comments, protests [5]. Studies also ask for technologies to increase the exchange of knowledge in a business context through Storytelling [6].

2.1. Concept Maps

Concept maps were originally proposed by Novak [13]. They may be used as a language for concept description and communication within Ausubel's assimilation theory [2]. This theory is based on a constructivist model of human cognitive processes. In particular, it describes how a student apprehends concepts and how these concepts are organized. Several group tools are based on conceptual maps. A few of them are listed below.

CmapTools [7]. This tool supports asynchronous collaboration by providing features to (a) enable a group of people to collaborate on the construction of a set of concept maps, (b) allow users to share ideas, make comments and criticize each other's maps.

Kmap [10]. It is a groupware tool supporting knowledge processes in geographically dispersed learning communities. It provides a graph in which nodes and arcs can be programmed by the user to represent various concept maps.

Pascom-KB [16]: It is a collaborative learning support system to build knowledge using a conceptual map for communication between teacher and learners or among learners.

2.2. Group Storytelling

According to the dictionary, a story is "a narration of a chain of events told or written in prose or verse". Furthermore, "narration" comes from the Latin "narrere", meaning "to pass on knowledge". Therefore, a story is a way to transmit knowledge [19]. Stories can be told in many contexts. They are partial, structured memories of observed and articulated reality [9]. When a group of people contributes to build a story, we refer to a Group Storytelling activity [19].

The notion behind group storytelling can support tacit knowledge externalization is based on two assumptions. The first one is knowledge management practices should not mean additional work for teams or individuals [19]. These practices use, as a starting point, the elements generated during the project lifecycle of group interaction, such as documents, discussions, email messages, etc. The second assumption is storytelling is a natural way to communicate tacit knowledge among individuals, groups and organizations. A few tools for Group storytelling are reviewed below.

Sam [17]. Riokai et al. have developed an embodied conversational storyteller to be used with children. Sam was designed to appear as a peer to pre-school children; it tells stories in a developmentally advanced way in order to model narrative skills important for literacy. Literacy learning - learning how to read and write- begins long before children enter school. In particular, storytelling in a context of peer collaboration provides a perfect place where children not only learn language skills important for literacy, but also learn to be critical listeners of others' stories.

Story-Bases [6]. Story-bases can provide a facility for users to request stories on specific topics; requests can be obtained off-line; story-bases can also allow prospective storytellers to putout an 'offer' for a story on a particular

topic and obtain an indication of audience interest before contributing the story.

3. The Procedure

The provision of shared visual representations is considered to be an important facilitator for creative processes in group working and learning scenarios. Hoppe & GaBner consider that reusability and thus sustainability of the results of co-constructive group work can be much enhanced by integrating visual environments with functions for indexing, archiving and retrieval to support the construction of group memories [11]. The basic function supported by shared visual representations is externalization, i.e., transforming mental contributions from group members into manageable objects in a shared environment.

Our proposal is to externalize tacit or implicit knowledge from the members of a group using Group Storytelling supported by conceptual maps for visual representation. Creating a story from group contributions not only brings out the richness from various perspectives and the strengths of collaborative knowledge management, but it also shows the difficulties, such as a lack of common opinions, or misunderstandings on expressing ideas. Trying to avoid these disadvantages, Valle et al. proposed the use of the following group storytelling roles: Storyteller, Associator/Indexer, Organizer, and Story listener [19].

- Storyteller: People with this role should be able to use a wide range of expressions and story organization schema so that the tacit and explicit knowledge can be well represented.
- Organizer: After a completed story is recorded, it is necessary to go back and check the quality of the whole script. It is necessary to observe if all parts relate to each other, and if the whole script makes sense. This person can organize, edit and give a final format to the story after all storytellers have participated.
- Associator/Indexer: This person is responsible for linking items that are related to the recorded story. These items may be stored in any media (text documents, images, video, etc.).
- Story listener: This person should be able to discern the various perspectives of a story, considering what is implicit and explicit, as well as what is emotional and what is a factual narration of the events.

Although there are various roles, these may not be played by different people. One individual can play two or more roles in a group storytelling activity, increasing the possibilities of establishing common perspectives among group members. Another point to consider is the possibility of changing roles. That justifies the possibility the Storyteller and Associator roles be played by just one person, since their tasks have some similarity. There may be a role interchange between Storyteller and Story listener as well. Besides these roles, there should be a Coordinator role, with some specific responsibilities in the organization and coordination of the activity.

In our tool, one of the Coordinator's responsibilities is to assign colors to conceptual map links. These colors are intended to provide enhanced awareness on a group member navigating the story (see [18]). The related Coordinator's tasks are as follows.

- Define the group members.
- Make an initial role assignment to each member. Assign colors to each person.
- Establish semantic links and associate them to a certain color.
- State the main subject of the story to be told.
- Define the time frame for the activity (dates and times).
- Define the time frame for the story to be told.

We have excluded the Organizer role from our story, since we want to avoid an "official story". We prefer to keep the story or stories as told by the participants. The final result will then resemble more a digraph than a conventional story.

Once an activity is started, the Storyteller makes contributions to the story with a pre-defined worksheet. This worksheet contains a classification of important aspects related to the story to be told, such as date, time, place and event. An instance of the worksheet being filled has a border color identifying the author.

Contributed story worksheets represent nodes in the conceptual map. Each node must have at least one link to another node with its corresponding semantics. The activity ends with a graph representing each of the story events. The time sequence of events is included in the graph.

A prototype software to provide the above functionality was developed. It is an extension of Freestyler [4]. Freestyler was developed to be used within a CiC environment (Computer Integrated Classroom) [3], which is intended to provide facilities for generating, representing and managing learning material. This system has features to enable users to import, store, interchange, asynchronously distribute and synchronously share documents of any type. The Freestyler is organized into

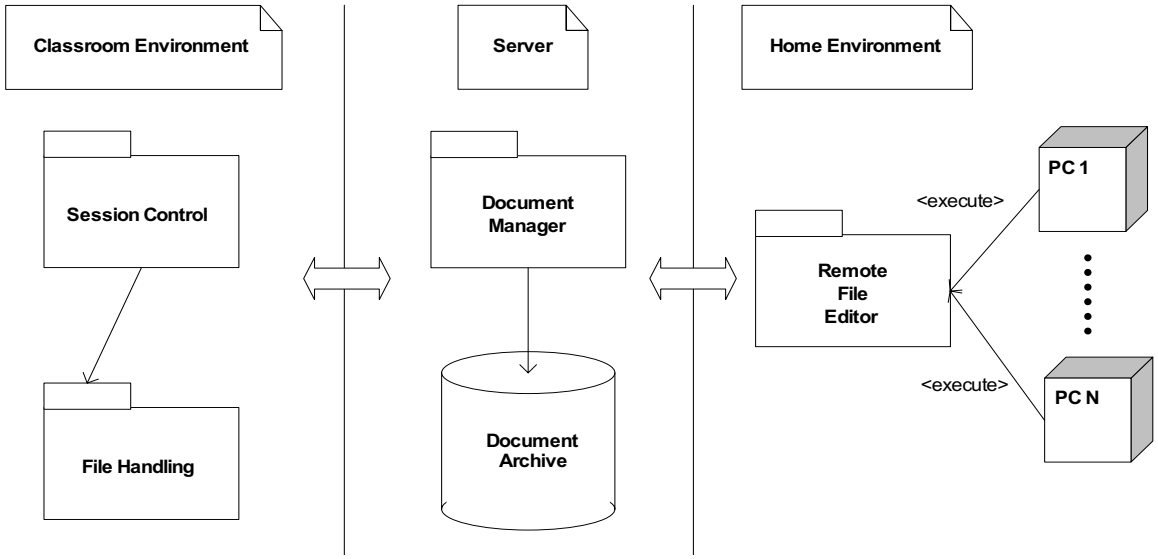

Fig. 1. Freestyler structure and environments.

different components, placed into three environments: classroom environment, server and home environment. Figure 1 depicts the functionalities of the components and their interaction with each other.

- Session Control: This component of FreeStyler is a supervision tool for the teacher: the Session Control. It is to be run by the teacher only, either on the electronic blackboard or on a separate computer. It includes mechanisms for synchronizing the instances of client interfaces in the classroom environment, for giving and taking rights to or from the users, and for logging session information. As the central component for the teacher it also includes file handling functionalities. This enables the teacher to use the Session Control as a stand-alone interface on the blackboard or in combination with the File Handler (run on the blackboard). Not only can any document from the Document Archive or inside the classroom environment be sent to a selection of students, any document that is currently being worked on by any user can also be displayed on a selection of students' File Handlers.
- File Handling: It is used in the classroom environment by the students and the teacher to open, edit, create, transfer and display the user's files or course files. Adding to this allows direct communication with the Session Control Interface via a questions and answers dialogue.
- Remote File Editor: The home environment consists only of the Remote File Editor, which enables the users to view, create, edit and transfer their files located on the Document Archive from a remote location. This is implemented by an internet connection and the document editor FreeStyler. It does not include synchronous collaboration with other users.
- Document Manager: The Document Manager is part of the server environment and provides authentication to all users in either the classroom or home environment, including the individual's rights inside the whole CiC system. Adding to this it controls all file transfers from and to the Document Archive and keeps track of new and existing sessions and courses.

A special Freestyler feature is its ability to use ad-hoc pluggable modules called palettes, in order to define new functionalities. The palettes provide visual elements for nodes in the case of conceptual maps. They also allow multimedia indexing and hypertext in story contributions. Implicit knowledge may be in various media and thus, the system allows contributions in audio, video, animations, etc. The Coordinator can, of course, establish semantic relations and represent them as arcs with various colors. The prototype allows temporary storage and later retrieval of concept maps created by a group.

One of the main goals of the tool is to avoid group members' groupthink. Groupthink is a situation in which group members quickly agree on a consensus without exploring alternative views [15]. Frequently, this situation occurs because there is pressure to suppress conflicting options, doubts or arguments validity.

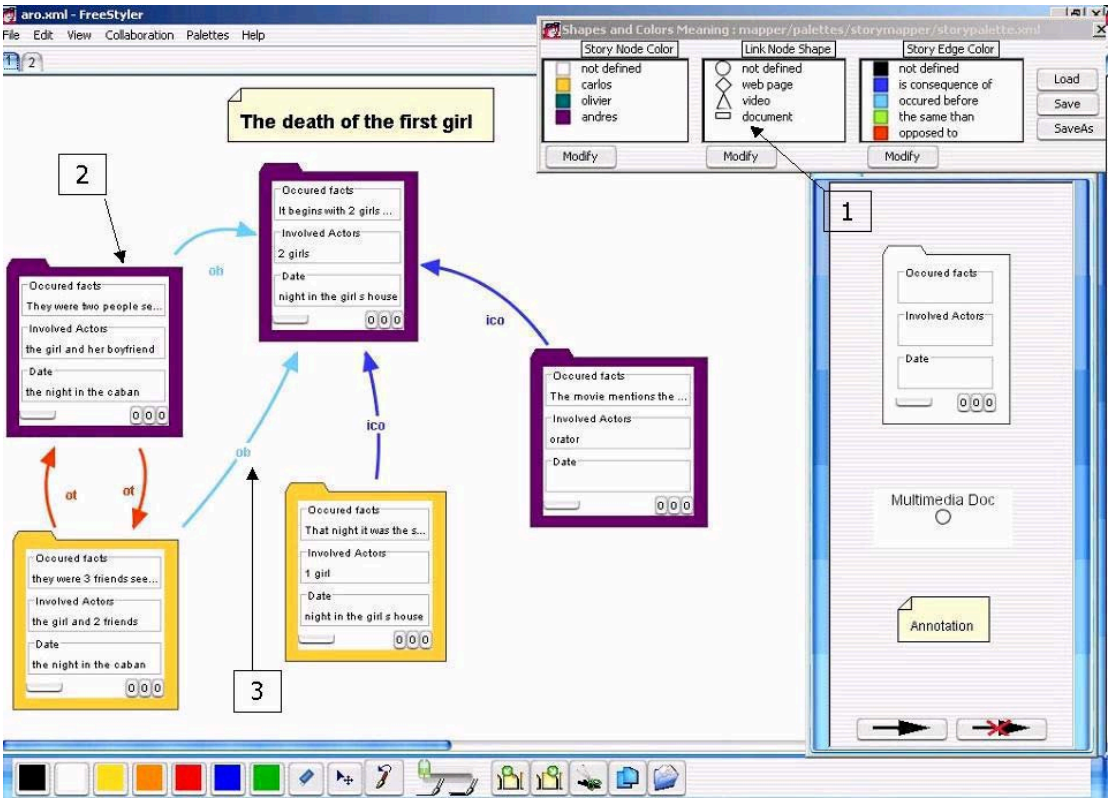

Fig. 2. StoryMapper user interface.

It is a negative situation because typically the best option is not chosen: it does not even have a chance to be stated. In our case, groupthink implies a story may have important missing pieces or a distorted narrative may be obtained.

The Figure 2 depicts the StoryMapper user interface. It provides users the following elements:

1. Semantics Palette: it provides means to state relations between nodes. It also associates colors to users and it allows description of multimedia types.
2. Node (worksheet instance): it is the place to contribute to a story.
3. Colored node links: semantic descriptions identifying a sequence of events described by the corresponding worksheets; each color corresponds to a semantics associated to the nodes relation.

4. A Sample Application

The following case exemplifies a Group Storytelling with StoryMapper help. Suppose a situation in which some people are required to see a movie and then, re-create the story from the various points of view. In our first experiment, the chosen movie was The Earring, telling the story of a single mother facing the mystery of a videotape, which provokes death to viewers within seven days.

Each group member has a view on the movie, which will be contrasted with others during the Storytelling session. Three people participated in our experiment. Before starting an activity, the worksheet must be defined in order to choose the main concepts to be told by each contribution. In this case, assume the members of the group agree the main concepts are: Events, Involved actors, and Date (see Figure 3). The Coordinator must define this worksheet.

Fig. 3. Worksheet defined by the Coordinator.

As mentioned above, another component of the activity is the definition of the semantic relations. In our

case, the Coordinator defines four relations. They are shown in Figure 4, including the associated colors. Color is a useful device to avoid information overload on users. In our case, a semantic relation associated to a color makes easy and fast to see the intended relationship in the conceptual map.

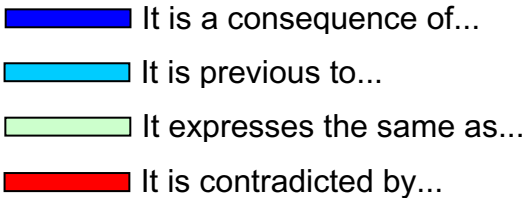

Fig. 4. Relations (colored) for the movie case.

Activity can start once the worksheet and the relations are defined. The Storyteller begins story construction by contributing through the worksheet and relating each instance of it via semantic links. The Story listener will explore concepts within the conceptual map. As we mentioned above, a typical role interchange between a Storyteller and a Story listener occurs after the Storyteller ends his writing.

Figure 1 shows how the first events occurred in the movie are represented by five nodes connected by semantic links. Three of the worksheet instances are authored by a user called Andres and the other two by the user called Carlos. Worksheet border colors identify users; arcs are also colored associating semantic descriptions described in the same palette. The experiment showed two participants of the group to be very active, while the third one concentrated mainly on organizing semantic links.

5. Discussion

There are software tools to support conceptual maps as a way to structure knowledge and the reasoning construction processes. On the other hand, there are also computer tools supporting Storytelling as a mechanism to externalize a person's knowledge in a collaborative learning environment. Our approach integrates in a flexible way the cooperative aspects of a Group Storytelling activity to externalize members' tacit knowledge as shared conceptual maps.

An effective interaction among group members requires the Coordinator ask questions concerning contributions. His role is not to intervene at the task level, but to guarantee that all the group members participate, and to frequently ask questions such as: What happened? What does it mean? As the collaboration progresses, the state of interaction is evaluated and remedial actions may be proposed to reduce discrepancies between these states.

The coordinator sometimes played the devil's advocate role in our experiment. This helped to improve the final result besides increasing the number of contributions. This role may be played by a person in a face-to-face setting. An agent perhaps may do it for distributed and/or asynchronous works.

There are certain aspects needing further research, e.g., which is the maximum number of people for a successful Group Storytelling activity? Our example included three persons and we estimated from this experience that up to five people would be acceptable. It must be noted increasing the number of participants implies a larger conceptual map containing the story. This, in turn, means there is a larger cognitive load to understand the map.

A story may have more than one ending. This implies the existence of various paths within the corresponding story graph. Again, this may mean a large number of nodes. Therefore, a special navigational mechanism may be developed to support work with large conceptual maps. The result is akin to hypertext with many links.

Discussion concerning nodes could be done in several ways. One of them is to allow annotations to be associated to the nodes. Another simple support tool could be a chat.

Our experience with telling the movie presented valuable situations. The storytellers had independently seen the movie at various times. When one storyteller was re-creating the story, another participant remembered facts, which allowed making explicit events not included at the beginning. This kind of situations makes us to think the proposed tool can be applied to several fields. It could be used to support collaborative learning or as a tool for managing learning in an organization. There are important intervening variables: situations generate interaction patterns, interactions trigger cognitive mechanisms, and mechanisms generate cognitive effects. Given the diversity of opinions among participants, discussions may lead to particular kinds of interactions; these, in turn, will generate learning mechanisms.

Another context on which the application of our procedure constitutes a great contribution, is in capturing and analyzing requirements for system development. Here, there are many people or stakeholders having direct or indirect influence on the system requirements. This is a difficult process because:

- Stakeholders find difficult to express what they want of the system. They express the requirements in a natural way and with an implicit knowledge of their own work.
- Different stakeholders have different requirements and express them in different ways.

Considering these difficulties, our procedure could be a great support by means of the narration techniques to externalize and to model the tacit knowledge that stakeholders have on the requirements of the system in a development project.

One of the challenges of the KM is to capture the individuals' tacit knowledge that participated together on the accomplishment of tasks. We believe the stories, narratives with beginning, middle and end, are an appropriate way of telling what happened and, at the same time, can externalize the tacit knowledge of the group.

Finally, it is possible to find many contexts in which this technique and the tool may be useful. Examples may be: historical fact reconstruction, news coverage, accidents or crime scene reconstruction, and requirements specification in Software Engineering,

6. Conclusions and further work

StoryMapper is a tool including pluggable components, which allow to model knowledge through semantic and syntactic elements. It provides a single environment for all the elements generated during group interaction in a Group Storytelling session. The tool supports both cognitive processes: externalization and representation of knowledge in a shared environment. Thus, the user interface reduces the cognitive load on the interacting person. Besides representing knowledge, the maps allow easy visualization of the presence or absence of semantic links among knowledge pieces.

Conceptual maps allow to clearly visualizing the knowledge creation process. The various roles let participants express their ideas in relation to previous ideas. These externalized ideas can then be integrated to the context of the other ideas through the conceptual maps with natural coherence. The presented procedure can also be used in cases in which there is a chronological sequence of events.

Future work in this subject includes experimentation with users to get feedback on usability and suitable group size. Other work with the system is listed below.

- Development of a control mechanism to manage roles and their changes.
- Development of a structured discussion tool to hold comments on the stories.

Acknowledgements

This work was partially supported by grant No. UCH 0109 from MECESUP (Chile) and Fondecyt projects No. 1030959 and 1040952 (Chile).

References

[1] Ackerman, M.S. “Augmenting the Organizational Memory: A Field Study of Answer Garden”. In: Proceedings of CSCW'94, The Association for Computing Machinery, New York, Nov. 1994, pp. 243-252.

[2] Ausubel, D., Novak, J.. & Hanesian, H., Educational Psychology: A Cognitive View (2nd ed.). New York: Holt, Rinehart & Winston, 1978.

[3] Baloian, N., Hoppe, U., & Kling, U., Structural Authoring and Cooperative use of Instructional Multimedia Material for the Computer integrated Classroom. Proc. of ED-Media, Graz, Austria (1995). 81-86.

[4] Baloian N., Berges A., Buschmann S., Gassner K., Hardings J. Hoppe U., & Luther W., Document Management in a Computer-Integrated Classroom. In Haake & Pino (Eds): Groupware: Design, Implementation and Use. Lecture Notes in Computer Science 2440, 2002, pp. 35-44.

[5] Blum-Kulka, S. You gotta know how to tell a story: Telling, tales, and tellers in American And Israeli narrative events at dinner. Language in Society, 22, 361-402, 1993.

[6] Boje, D. The storytelling organization: A study of story performance in an office-supply firm. Administrative Science Quarterly, 36, 106-121, 1991.

[7] Cañas, A., et.al. Managing, Mapping, and Manipulating Conceptual Knowledge.Exploring Synargetics of Knowledge Management & Case-Based Reasoning. AAAI Workshop. AAAI Press.

[8] Collazos, C., Guerrero, L., Pino, J., and Ochoa, S., Introducing Knowledge-Shared Awareness. Proc.of IASTED International Conference: Information and Knowledge Sharing (IKS 2002), St. Thomas, Virgin Islands, USA, ACTA Press, November, 2002, pp.13-18.

[9] Davenport, G., Bradley, B., Agamanolis, S., Barry, B., Brooks K., Synergistic storyscapes and constructionist cinematic sharing, IBM Systems Journal, vol. 39, issues 3-4, pg. 456 - 469. November 2000.

[10] Gaines, B., & Shaw, M., Collaboration through Concept Maps, Knowledge Science Institute, University of Calgary, 1995.

[11] Hoppe, U., & Gaßner, K. Integrating Collaborative Concept Mapping Tools with Group Memory and Retrieval Functions. In: Stahl, G. (eds.): Computer support for collaborative learning: Foundations for a CSCL Community. Lawrence Erlbaum, Hillsdale, New Jersey, USA, 716-725, 2002.

[12] Ikujiro Nonaka, Noboru Konno, The concept of "Ba': Building foundation for Knowledge Creation. California Management Review Vol 40, No.3 Spring 1998.

[13] Novak, J., A Theory of Education. Ithaca, NY: Cornell University Press, 1977.

[14] Novak, J., Gowin, D., Learning how to learn. New York: Cambridge U. Press, 1984.

[15] Pepper G., Group, Think! - Meeting Productively, Brainstorming Effectively, Avoiding Groupthink, BrownHerron Publishing, 2002.

[16] Saitoh, H., Tanaka, N., Ohno, T., Maeda, T.& Ohuchi, A., A Collaborative learning support system for knowledge building using conceptual maps, Conference on Educational Uses of Information and Communication Technologies, Beijing (China), 50-57, 2001.

[17] Ryokai, K., Vaucelle, C., & Cassell, J., Literacy Learning by Storytelling with a Virtual Peer. Journal of Computer Assisted Learning 19(2): 195-208, 2003.

[18] Thompson, E., Colour Vision: A Study in Cognitive Science and the Philosophy of Perception. London: Routledge Press, 1995.

[19] Valle C., Raybourn E., Prinz W., Borges, M., Group Storytelling to Support Tacit Knowledge Externalization, In Universal Access in HCI: Inclusive Design for the Information Society, C. Stephanidis (Ed.). Lawrence Erlbaum Associates, 1218-22, 2003.

[20] Wong, M., The concepts map: A tool for learning science concepts and understanding cognitive processes of pre-service teachers – A Case Study. Unpublished Masters thesis, University of Malaysia Sarawak, Malaysia, 1997.