A VISUALIZED AUGMENTED TOOL FOR KNOWLEDGE-ASSOCIATION IN IDEA GENERATION [1]

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Abstract

Recently, creativity has become one of the most important keywords in the wide area of academic and industrial research. Idea generation can be viewed as a knowledge creation activity. In this paper, we present a computerized tool, Brainstorming Argumentation Room (BAR), which use a two-dimensional space connected to knowledge association process to stimulate the creativity of experts. The input utterances and keywords are used for knowledge creation as keypoints. Applying dual scaling method processes this association procedure.

Keywords: idea generation, knowledge creation, knowledge association, dual scaling method

1. Introduction

Interests exploration, idea generation and knowledge creation can be viewed as divergent thinking activities——which is one of two significant stages in the human creative process (Tang & Liu 2002). Those activities are critical during problem solving, new product development, business process improvement and other applications.

One of aims of divergent thinking is for creative ideas toward unknown issues, hence demand for computerized environment tools to provide more help during such a thinking process. So, we develop a visualized augmented knowledge-association tool, brainstorming argumentation room (BAR), which is a human-machine interactive system to support group's activities. BAR system connects to the knowledge-association process to stimulate the creativity of experts during the idea generation stage.

The reminder of this paper is organized as follows: in section 2, we discuss the idea generation is a knowledge creation activity at length. The progressed knowledge association model will be explained in section 3. Section 4 presents the knowledge-association-based visualized computerized tool. Section5 describes concluding remarks and plans for future research.

2. Idea Generation——a Knowledge Creation Activity

Recently, creativity has become one of the most important keywords in the wide area of academic and industrial research (Hori 1997). Idea generation starts with the problem list from the planning phase. This is the anchor for creative thinking

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because it provides clear targets for designers and engineers to shoot for. The well-known idea generation methods have evolved from 'brainstorming', developed by Osborn in the 1950's.

Idea generation can be viewed as a knowledge creation activity. In Nonaka's opinion, the essence of creativity is the development and exchange of new knowledge that ultimately help solve the complex problems (Nonaka & Nishiguchi 2001) . Knowledge is recognized as the core component of creation, which is undoubtedly an indispensable resource to create value for the next generation of society, industries and companies.

Nonaka also presented five knowledge-creation steps: (1) sharing tacit knowledge, (2) creating concepts, (3) justifying concepts, (4) building a prototype, and (5) cross-leveling knowledge. Accordingly, five knowledge enablers have been proposed to support the knowledge-creation steps: (1) instill a knowledge vision, (2) manage conversations, (3) mobilize knowledge activists, (4) create the right context, and (5) globalize local knowledge (Krogh , Chijo & Nonaka 2000).

The relationship between knowledge-creation steps and knowledge enablers is revealed by the table1.

From the table1, we can see the enabler——manage conversations, strongly affects all five knowledge-creation steps. Conversation environment can be viewed as a knowledge creation platform, in Japanese, called 'Ba'. For exploiting and creating knowledge effectively and efficiently, it is necessary to concentrate on how to build a good 'Ba' (Nonaka & Nishiguchi 2001).

Table1 the relationship between knowledge-creation steps and knowledge enablers

Knowledge-creation steps / *Knowledge enablers*	*Sharing Tacit Knowledge*	*Creating a Concept*	*Justifying a Concept*	*Building a Prototype*	*Cross-levering Knowledge*
Instill a vision		√	√ √	√	√ √
Manage Conversations	√ √	√ √	√ √	√ √	√ √
Mobilize Activists		√	√	√	√ √
Create the Right Context	√	√	√ √	√	√ √
Globalize Local Knowledge					√ √

3. The Processed Knowledge Association Model

In Niwa's opinion (Niwa 1986), knowledge association can be viewed as a process whereby the absorption of a piece of knowledge stimulates the mind and causes it to recall another piece of knowledge. That is, the aim of associating knowledge is for creativity. He also proposed a knowledge association model is shown in Figure1.

Keywords are inserted between Situation1 and 2 as a keypoint of knowledge association. In our system, we improve this model. Then not only keywords but also utterances are used for knowledge creation as keypoints. We view the keywords and utterances as two objects. During the early stage of idea generation, expert's institution can be represented as meta-knowledge, which is knowledge concerning expert's some domain knowledge.

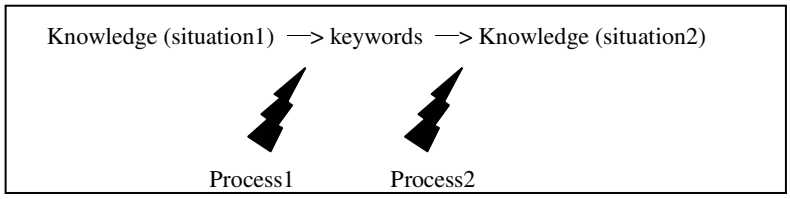


Figure1 Niwa's knowledge-association model

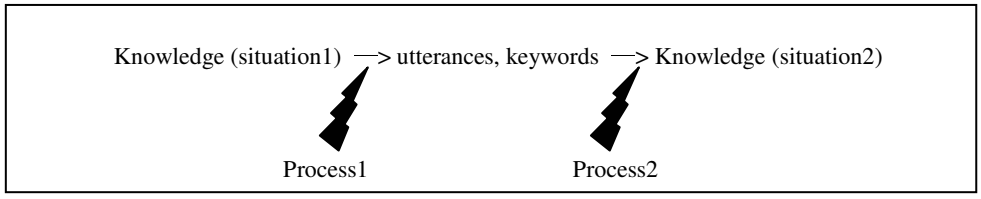


Figure2 the progressed knowledge-association model

Figure2 showed, as many pieces of knowledge as possible are gathered from domain experts in the phase of Process 1 (situation1 -> utterances, keywords). Process 2 (utterances, keywords -> situation2) can be done by computers with method between utterances and keywords stored in the knowledge base.

4. Brainstorming Argumentation Room

Nowadays, a variety of web applications provide versatile platforms for information exchange via the Internet. Most web-enabled forums can be regarded as simple electronic brainstorming sessions. However, if knowledge exists as textual information, it can only increase the complexity of the problem. Visualization is an effective method to permit experts to use their visual thinking abilities to solve problems (Pracht 1986). So, we design a visualized knowledge-association computerized tool, brainstorming argumentation room (BAR).

BAR is an online conversation system seamlessly integrated with techniques for visualizing experts' argumentation contents. The conversation window of BAR system is shown on the left of Figure 3. The bottom of window is a place where the user can submit his or her utterances and keywords, while the window's top lists all collected utterances.

BAR system has three mainly discussion viewer on the right of the window:

- Common viewer: This discussion space can be regarded as a joint thought space for the participants. All users can participant in argumentation and understand the global structure and relationships by viewing the shared discussion space.

- Personal viewer: It is an anonymous idea-gathering space in which the relationships between utterances and their keywords can be visualized. Participants can be stimulated personal creativity through observing this personalizing space.

- Search viewer: Through this viewer we can access Web information, the search engine (www.google.com) will help us quickly find what we're looking for by using keywords or indexed topics.

When the user inputs utterances and keywords to be recognized by the server, new associations are generated in accordance with the user input and the result may be displayed in a two-dimensional space, which visualized the relationships between utterances and their keywords. The association process employs the dual-scaling method.

Dual scaling is an exploratory, descriptive multi-variant statistical method that has some of the characteristics of correspondence analysis and exploratory factor analysis (Nishisato 1980). The core of the dual scaling method provides the principal components for given relations between keywords and utterances containing them, which compute an n*m array of n utterance-objects and m keywords (see the Table 2). The math underlying dual scaling is based on calculations of eigenvectors and eigenvalues of a frequency matrix. We can view utterances and keywords as an object respectively. Those two object sets are constructed a two dimensional matrix which automatically transformation with

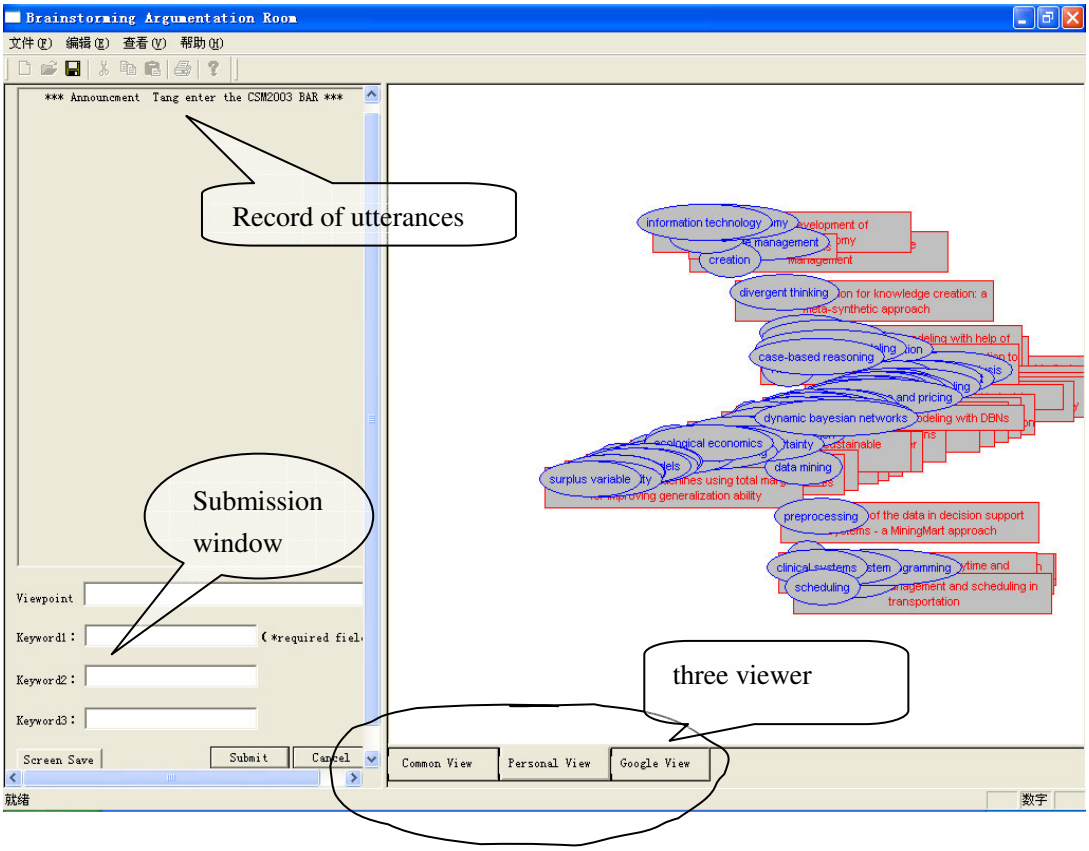


Figure3 the main window of BAR system

the expert' utterances input. The result is a pair of utterances with more common keywords locating closer together (Mase, Sumi & Nishimoto 1998, Murakami, Taki, Takashiro &Nishida 2000).

Figure 4 exhibits a glimpse of a two dimensional association space. The concerning topic is about the issues of CSM'2003 (Workshop on Methodologies and Tools for Complex System Modeling) meeting held by IIASA (The International Institute for Applied Systems Analysis). The rectangular icons are utterance-objects, which is the subject of expert's speech respectively. While the oval icons are keyword-objects, standing the experts who attend the meeting.

Table2 utterance sets and keyword sets

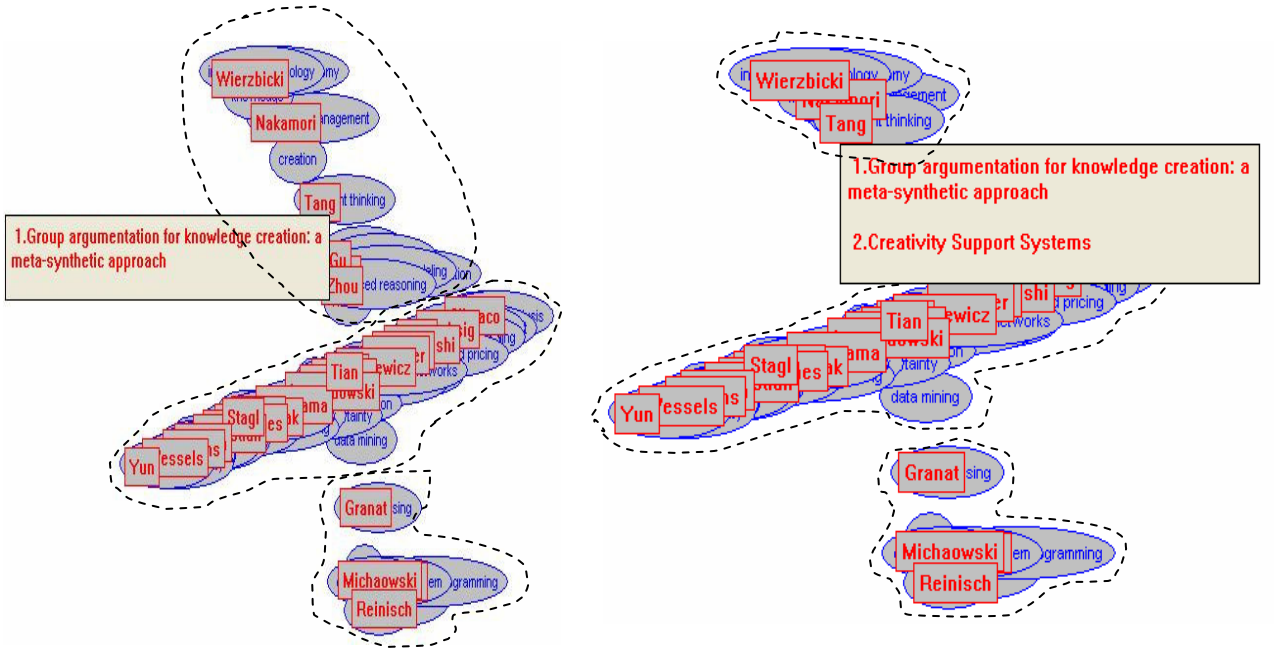
Y \ X		$keyword_1$ x_1	$keywords_2$ x_2	… …	$keyword_m$ x_m	
$utterance_1$	y_1	1	1	…	—	$y_1=x_1+x_2+\ldots$
$utterance_2$	y_2	—	1	…	1	$y_2=x_2+\ldots+x_m$
⋮		⋮	⋮	⋱	⋮	⋮
$utterance_n$	y_n	1	1	…	1	$y_n=x_1+x_2+\ldots+x_m$

By viewing the clusters of utterance icons and keyword icons scattered around them, we can intuitively understand their relationships. The most important difference between figure 4 (a) and (b) is that the utterances can be clustered more

clearly and crystallized in the latter one with only one more utterance from Prof. Tang. For explaining the difference better, the same parts will be simply ignored.

In figure 4(a), Prof. Nakamori (with utterance "Systems methodology for knowledge management") and Wierzbicki (with utterance "Modeling and the development of knowledge-based economy") can be grouped as the "knowledge" session because both of them focus mainly on the topic of "knowledge". In contrast, Prof. Gu (with utterance "Metasynthesis systems modeling with help of experts group"), Zhou (with utterance "Metasynthesis methodology and its application to economy system") and Dai (with utterance "A metasynthetic approach for decision support system") can be grouped as the "Metasynthesis" session because all of them focus mainly on the topic of "metasynthesis". The two sessions are connected by the utterance of Prof. Tang (with utterance "Group argumentation for knowledge creation: a metasynthetic approach") who focuses not only on "knowledge" but also "metasynthesis".

Figure 4(b) refreshes the structure of the space after Prof. Tang types a new utterance "Creativity support system". Because Prof. Tang focuses mainly on "knowledge" in this utterance, she can be clustered closely to the "knowledge" session. As a result, the group of "knowledge" and "metasynthesis" is divided into two respectively clusters.



(a) (b)

Figure 4 the snapshot of the viewer of BAR system

5. CONCLUSIONS AND FUTURE WORK

We have proposed a visualized conversation support environment, called BAR which associates the meta-knowledge to creative new knowledge in the stage of idea generation. It is one part of our on-going 4-year NSFC major project-the study on man-machine collaborative meta-synthetic systems support for macroeconomic decision making.

Actually our major concern of this tool has only concentrated on divergent thinking process, that is, which supported confident hypothesis formulation. In future, with the guidance

of ‘meta-synthesis system approach’ (Tang& Liu 2002, Qian, Yu & Dai 1993) we will explore knowledge creation united with knowledge synthesis. Also, from technology, the software can’t automatically extract keywords form the text along with their importance values. Lots of work is left fulfilled for a mature BAR.

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