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Group Argumentation and Its Analysis on a Highlighted Social Event — Practice of Qualitative Meta-synthesis

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Abstract: In social life, some highlighted issues are regarded as unstructured or wicked problems, the solving of which is actually a problem-structuring and problem-solving process including the detection and discovery of some problem structures and relevant solutions, which are finally synthesized into an integrative solution toward the whole issue. In this study, a group argumentation test about a social highlighted event is introduced based on our designed group argumentation environment (GAE). With versatile analyses of the test results, it is addressed how GAE support people to become aware of or to acquire some threads or structures, which lead to in-depth research or quantitative modeling during unstructured problem-solving process.

Key Words: group argumentation; qualitative meta-synthesis; social foci; GAE

1 Introduction

Some highlighted issues in social life may be regarded as unstructured or wicked problems. Different solutions may lead to different results. In such an advanced networked world, increasing information and even community opinions can spread very quickly through the network, which is becoming a magnifying information field. The resolution of the wicked problems, especially the issues with social concerns not only requires both serious and systemic thinking but also requires creative ideas to overcome traditional barriers. The meta-synthesis system approach (MSA) which is simplified as “confident hypothesizing, rigorous validating” in practice, i.e. qualitative knowledge arises from quantitative understanding, where dominant role of humans during human–machine interaction is emphasized, is an effective way.

One of the goals of qualitative meta-synthesis is to produce assumptions or hypotheses regarding the complex problems. Various group argumentation activities are usual technical solutions with high operability and can be regarded as a type of collaborative problem-solving method, especially happening among various experts with diverse technical disciplines confronting complex wicked problems. The whole process includes participants’ communication and information sharing, opinions collection, knowledge acquisition, interaction between participants for idea generation, etc. Studies on computerized support for group activities since 1990s have begun to emphasize on explorations of procedural rationality, especially on argumentation and sense-making during problem-structuring process. Typical methods and tools include Dialog Mapping (gIBIS-based QuestMap, CogNexus Institute, California, USA), Cognitive Mapping (Decision Explorer, Banxia, Kendal, Cumbria, UK; Group Explorer, Phrontis, Banbury, Oxon, UK), Augmented Informative Discussion Environment (AIDE, ATR, Kyoto, Japan), etc. These tools reflect a trend toward supporting thinking visualization and generation of ideas for complex and wicked issues, such as applying brainstorming, cognitive mapping or voting to acquire scenarios, from where to conduct in-depth analysis, and modeling for final solutions of problems[1]. How to support group interaction to generate ideas is one of the most difficult areas among group support research. Group argumentation environment (GAE) is a type of distributed computerized tool designed to facilitate idea generation or knowledge creation during group-divergent thinking.

This study introduces a specially designed GAE-supported group discussion experiment on “How to Oppose Japan’s Bid for a permanent seat in the UN Security Council” initiated in April of 2005. Feature functions of GAE and results of experiments address how GAE supports awareness and provides insights into potential hints or structures of problems from which quantitative modeling for alternatives during complex social problem-solving process is undertaken.

2 Brief introduction to group argumentation environment

Initiated at Fall of 2001, GAE is a computerized support tool, which has absorbed latest advances in many disciplines, such as system sciences, knowledge sciences (including knowledge management), meta-synthesis and complex system, complex network and social network and other relevant research, and which aims to support divergent group-thinking process for the cooperative complex
problem-solving process\textsuperscript{[2–3]}. By a series of tools, such as group argumentation environment-brainstorming argumentation room (GAE-BAR), augmented information support-group argumentation environment (AIS-GAE), and group argumentation environment-idea viewer (GAE-iView), GAE provides multiple functions, such as

- Visualizing correspondence between participants and their opinions toward specified topics to expand their thinking space;
- Various clustering concerning the group discussion to elicit concepts for effective summarization;
- Evaluating the contributions of participants, which aims to provide further help to organizers in selecting participants;
- Applying a virtual agent to facilitate discussion procedure and to bring out further output of the session. As the facilitation agent detects the stagnation during the discussion, it can issue cold words to stimulate human participants’ attentions and then can initiate hot discussion. Such an indirect intervention that is not conducted by human facilitator reflects a soft control to the discussion process. It also applies some type of autonomous computing for problem-solving process;
- AIS for discussion, especially push information to participants by Web text mining technologies;
- Community structure detection regarding keyword network, which provides another perspective toward the concerned topic, etc.

For detailed introduction of these functions embedded in different tools, please refer \textsuperscript{[4]} for GAE-BAR, \textsuperscript{[5]} for AIS-GAE, and \textsuperscript{[3]} for the overall design and idea viewer. Till date, different applications have been tried. Following are some typical applications and experiments,

\begin{itemize}
\item 1) XiangShan Science Conference\textsuperscript{[4,6]}
\item 2) Analysis of various academic workshops, such as CSM’2003 and special session on meta-synthesis held at International Institute for Applied Systems Analysis on September 11, 2003, the Workshop on Complexity of War held on October 17, 2003, the Sino-Japan Workshop on Meta-synthesis and Creativity Support Systems (MCSS’2005) held in Beijing on July 11–12, 2005, etc.
\item 3) Faculty discussion on new policies toward the project management at Academy of Mathematics and Systems Science (AMSS)\textsuperscript{[7]}
\item 4) Analysis of the achievements of a major project on meta-synthesis study supported by Natural Sciences Foundation of China (NSFC)\textsuperscript{[8]}
\item 5) Workshop on Emergency Management for the SARS (Severe Acute Respiratory Syndrome) crisis (held on June 6, 2003, and analyzed on January, 2005)
\item 6) AMSS meeting on Strategic Development (April, 2005)
\item 7) AMSS meeting on graduate education (May, 2006)
\end{itemize}

All the above applications are mainly postanalysis of the event. The authors had attended some of the events. By various records of these meetings (such as audio records, paper notes, and newsletters), the process of these discussions is generated and specific tasks of mining and visualization are conducted. When GAE is applied to the analysis of the NSFC major project, the authors of study are “participants” of the discussion, the title of the paper is one utterance of the author, the given keywords of the paper are the keyword set of one utterance, and publishing time could be regarded as the addressing time. Thus, the group discussion about the meta-synthesis study is generated by all publications during the project period. All these trials help to test the functions of GAE and to bring out several further improvements. As a matter of course, GAE is originally designed to support online group argumentation. It is desperately expected to observe its various functions by online discussion process for feedback and effects. Subsequently, a real online experiment with GAE is addressed.

3 Experiment: opposing Japan’s bid for a permanent seat in the UN Security Council

GAE is oriented to online small-scale group argumentation. The designers of GAE expect those various types of functions to help to stimulate the participants expanding individual thinking with the visualized evolving group thinking structure from correspondence analysis for more creative ideas. The participants of the online experiment introduced in this section are first-year graduate students taking decision support systems (DSS) class at the Graduate School, Chinese Academy of Science at the 2005 spring semester. The experiment was the last content of the DSS class, these students were then taught basic ideas of meta-synthesis system approach together with basic functions of GAE-BAR. They were expected to have more understandings regarding meta-synthesis approach, which is oriented to complex system modeling and problem-solving process proposed by a Chinese system scientist Qian Xuesen in early 1990s.

3.1 Brief introduction of experiment

In April 2005, two experiments were carried out to compare efficiency of output of group discussion between the GAE-supported and the non-GAE-supported. One of the experiments selected a highlighted social event of anti-Japanese movement held at that time. That social event was invoked by Japan’s bid for a permanent seat in the UN Security Council during the UN reform movement. The financial contributions to the UN budget and to the developing nations in the form of official development assistance are main reasons for Japan’s bid. Because of the privileges of the UN Security Council and the historical reasons, various mass protests were held across many domestic cities in China. Also, there was a large-scale online voting, such as in sina.com. However, when checked with CNN online voting, more than 60% votes supported Japan’s bid till April 10, 2005 (the support ratio was still greater than 50% one year later, see QuickVote at cnn.com).

The topic of the designed experiment was not the general theme as anti-Japanese event but the specific question as how to prevent Japan’s bid for the permanent seat in the UN Security Council. The whole experiment held in the morning of April 25, 2005 lasted 50 minutes. All 10 participants were divided into two groups, one was face-to-face discussion (without GAE) group, and another group was GAE-supported group. Because of time pressure, all students were required to review recent relevance from the Internet and to
prepare their original ideas. The experiment designer also delivered the latest commentaries published by DW-World.de (Deutsche Welle) to encourage different viewpoints.

### 3.2 Test process and result analysis

Five members, whose registered IDs are *dong, fan, gao, long*, and *Tang*, participated GAE-supported online discussion. Because of better preparation, each participant submitted many personal views at the beginning. Figure 1(a), (b), and (c) are three snapshots captured from the common viewer of GAE-BAR, which shows the correspondence between ideas (keywords) and the participants during various times all through the whole discussion process. Figure 1(d) is the final map regarding all 69 utterances. These snapshots show the dynamic evolution of the participants’ thinking about the theme. GAE-BAR provides functions to allow users save their interested visual correspondence maps shown in common viewer or personal viewer of GAE-BAR for a discussion editing and summarizing.

The rectangular icon refers to the user ID of participants in the discussion process, and the oval icon refers to keyword (idea). If the mouse locates at a rectangular, then all utterances given by the corresponding participant are popped up as shown in Figure 2. Users can make full use of these functions provided by GAE-BAR to observe his or others’ contributed viewpoints, to sense the common grounds of group thinking along procedural evolution, and then to explore different facets about the whole discussion. Figure 3 shows different analysis of this experiment. Figure 3(a) is the visualized correspondence between ideas and each utterance captured at the personal viewer of GAE-BAR. Both common viewer and personal viewer exhibit the correspondence between ideas and people during group-divergent thinking. Subsequently, some salient functions are introduced.

#### 3.2.1 Tracing the process — retrospective viewer

Retrospective viewer of GAE-BAR applies same visualizing mechanism applied to the common viewer and provides visual correspondence between ideas and people by the selected intervals of discussion or by the combination of any selected participants. The users can then “drill down” the discussion process by combining the topics and backgrounds of involved participants to understand the context of discussion, to become aware of the existence or formulating process of a microcommunity, and to acquire further understanding about thinking structure of the participants.

Figure 3(b) shows the correspondence map of 4 people (except the participant *long*). During the discussion process, user *long* can check the status of others, can become aware of the rich context and, can submit his further viewpoints.
3.2.2 Recording original idea provider

With all keywords proposed during a discussion process, GAE-BAR can tell the users who firstly proposed these keywords, and when and how often they are referred. Higher citation may indicate higher concerns. As shown in Figure 3(c), the participant gao firstly proposed “Boycott of Japanese goods”, which has been referred seven times later.

Such a mechanism referred as P-creativity recorder is helpful to detect the source of some original ideas regarding the concerned topics and to provide some basics to evaluate the originality or contributions of the participants. Less referred keywords may also be noticed by active participants.
Such a record then helps the users to become aware of these which have not been much noticed thus far. For divergent thinking, more ideas scattered across the visualized correspondence map are always encouraged. The P-creativity recorder is then considered to be a supplement to the users’ awareness of diverse ideas, instead of only focusing the highlighted ones.

3.2.3 Affinity diagramming — KJ editor

This function borrows idea of KJ method (because of its inventor, Kawakita Jiro), which was developed to discover meaningful groups of ideas within a raw list. Automatic affinity diagramming at GAE-BAR maps the whole utterance set into $16 \times 16$ (or $8 \times 8$, $24 \times 24$) cells based on their spatial correspondence relationship shown at the personal viewer. The utterances which fall into same cell are regarded as one cluster. The number of utterances within one cell may reflect the density of viewpoints regarding the ideas. Thus, users can acquire a rough grouping regarding these viewpoints contributed by participants. Human analysts can go further and can refine such divergent thinking results, such as merging some adjacent groups with close contents and undertaking basic summarization, which may be extended as qualitative assumptions hypotheses about concerned topics.

Figure 3(d) is the affinity diagramming resulting from the spatial map as shown in Figure 3(a). It could be seen that the utterances in one cell are related to each other. For example, all 10 utterances within cell [row=8, col=10] and four utterances within cell [row=8, col=11] are about some strategies and advice toward opposing the Japan’s bid for a permanent seat in the UN Security Council, both cells could be then grouped into a single cluster. So are to cell [row=9, col=9] with eight utterances and cell [row=10, col=9] with four utterances, which reflect concerns on strategies regarding economic issues, such as “boycott of Japanese goods”.

3.2.4 Clustering of utterances/keywords for perspective formatting

On the basis of the spatial correspondence in the common viewer as shown in Fig.1(d), GAE-BAR applies $k$-means method for keyword clustering ($k$ is an assumed number of clusters). Each cluster has a centroid. The keyword closest to the centroid of the affiliated cluster could be regarded as label of the cluster. In this case, as $k=4$, then four clusters are generated (Figure 3(e)). The keyword set of each cluster is as shown in Figure 3(f) where the labels for each cluster are “Policy Simulation” (the left window), “Japanese” (the 1st right back window), “History Prejudice” (the right middle-layered window), and “Security Council” (the right top window). The representatives of keyword clusters could also be regarded as another type of summarization of all contributed keywords (ideas) for a comprehensive perspective regarding the concerned issue.

Both the automatic affinity diagramming and keywords clustering” in GAE-BAR are trials of rough grouping fulfilled by machines. On the basis of these rough grouping of ideas contributed by brainstormed discussion, human analysts can study further and do in-depth analysis with their own experiences and knowledge for meaningful senses. Such thinking exhibits the ideas of man-machine collaboration while human plays principal roles proposed at meta-synthesis system approach. Various clustering results reflect some perspectives toward the concerned problems acquired from the collaborative problem-solving process and then serve as hints or strategies for in-depth studies. From the experiment, it could be seen that all five participants contributed different ideas toward the opposing Japan’s bid for permanent seat in the UN Security Council. Both diplomatic and unofficial ways were referred. Economic strategies were also discussed, which may lead to further quantitative modeling and analysis regarding these qualitative hypotheses.

3.2.5 Measures of participants’ contributions to the discussions

Group divergent thinking typically occurs in a spontaneous, free-flowing manner for idea generation. The more diverse ideas emerge, the better the outcome of the group work is. The performance of each participant affects the outcome of one session. According to the idea-sharing or difference-in-ideas between participants, GAE-BAR constructs two symmetrical matrices, matrix of agreement and matrix of discrepancy. With the eigenvector corresponding with the maximum eigenvalue for each matrix, we get ranks of the participants’. By such a mechanism, it is expected to measure the performance of the participants in the discussion[9]. The accumulated measures of performances may even be used to estimate the individual thinking mode and the effect toward group behaviors. Table 1 lists the evaluation of the involvement of five participants in the experiment.

Currently, GAE-BAR does not supports debate. The higher rank in the agreement measure may then indicate that the corresponding person shares more concerning ideas with others, but may hold contrary views. Above indicators of agreement or discrepancy are only a type of measures. For more convincing results, it is better to check both indicators together with other factors, such as knowledge scope, age, and information at the original idea provider (P-creativity recorder) of the participants. More measures are expected.

| Table 1. Measures of 5 participants’ contributions |
|--------------------------------------------------|
| The eigenvector of maximum eigenvalue of agreement matrix:  |
| Rank of the five participants:  | (0.3164, 0.5530, 0.3441, 0.6659, 0.1796) |
| Meaning of the indicator:  | $Gao > Tang > Dong > Long > Fan$ |
| The human with higher rank may hold more common concerns during the brainstorming session |
| The eigenvector of maximum eigenvalue of discrepancy matrix:  |
| Rank of the five participants:  | (0.4359, 0.4960, 0.4001, 0.4841, 0.4118) |
| Meaning of the indicator:  | $Tang > Gao > Long > Fan > Dong$ |
| Expert with higher rank may be of more diverse perspectives during the brainstorming session |
3.3 Some improvements of GAE after the experiment

No stagnation was confronted due to the hot discussion in this experiment. Therefore, the facilitation agent of GAE-BAR did not work. The participants have good experiences with typical functions of GAE-BAR and understanding of meta-synthesis system approach addressed in their reports. They also proposed problems and requirements, which then led to improvements and enhancement of GAE. For example, users can pull unselected external information via searching engines such as Google and Baidu, based on keywords at the information viewer of GAE-BAR. To help the concentration on discussion of the participants, specific novel searching engine is later implemented as an AIS tool based on text mining technologies. Users can then search news reported at Deutsche Welle (Chinese version) at AIS-GAE.

To acquire more information for perspectives on unstructured problem-solving process, a keyword network is then constructed where the vertex refers to a keyword, and if two keywords occur simultaneously in one utterance, an edge refers to the frequency of co-occurrence of keywords throughout the discussion. Each utterance then corresponds to a complete graph. The aggregation of these graphs of all utterances leads to a keyword network of the concerned discussion, which may be viewed as a knowledge topology map. Network characteristics can then be acquired, such as component, cutpoint and subgroups for in-depth analysis from the perspective of complex networks. Fig. 4 shows the keyword network of this experiment. Several cutpoints detected, such as “Boycott of Japanese Goods”, “Government Intervention”, and “Improving the Competitiveness” could be regarded as important ideas emerged by the group discussion. With the community (subgroup) of keywords detected from this network, more insights toward these concerned topics may be acquired together with clustering of keywords and affinity diagramming. Currently, such an idea viewer has been grown into an individual tool GAE-iView.

4 Concluding remarks

This article mainly introduces an experiment supported by a computerized group support system, GAE, which is designed to support group-divergent thinking for the exploitation of meta-synthesis system approach, especially the concept of qualitative meta-synthesis during problem-solving process. Computerized GAE may avoid disadvantages at face-to-face discussions, and help the participants to express individual ideas more freely, facilitate communication and cooperation, and enable more effective group work. Visualizing the qualitative knowledge expressed by the utterances during the group discussion at a two-dimensional map may help the participants understand others’ opinions easier, find common grounds, stimulate further thinking, and capture insight, emerging wisdom and creative ideas for unstructured problem-solving process.

Social system is a typical open complex giant system (OCGS), and social highlighted events are usually related to complex or wicked problems. This experiment is a trial of collaborative problem-solving process of the unstructured social problems, such as how to prevent Japan's bid for permanent seat in the UN Security Council. By group argumentation, understandings of the issue may be expanded or clarified with more different ideas, where more perspectives may be acquired. Various clustering contribute various summarization and recapitulation, which are of concern and may lead to further discussions and investigations by quantitative modeling, showing how to acquire the “confident hypothesis” regarding the concerned problem by qualitative meta-synthesis. The experiment is a small case to exhibit the computerized support system's effect in promoting exploration, looking for clues or structures of the issue, and enabling humans to expand individual thinking and understanding through computerized supported interactions. Actually, some strategies proposed during the experiment have been verified in reality, such as persistence strategy in online voting. Till May 2006, the number of signatures at some Chinese web sites broke 0.1 billion. Japanese government declared to give up the original G4 proposal temporarily in August 2005; although such an issue should not be neglected, continuous policy study and practice have to be insisted.

As it enters the knowledge and networked times, more and more personalized viewpoints are exposed through BBS (Bulletin Board System) and blogs. How to support people to detect these creative ideas from the public, capture real highlighted foci and absorb public opinions, are among the forth-coming endeavors relevant to GAE.

This experiment was originally designed for a comparison between face-to-face discussion and GAE-supported computerized discussion. Unfortunately, such a comparison was not made due to some abnormal interruption that happened during the experiment. More experiments should be fulfilled later for statistic test.

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