CHAPTER 6
Conclusion

In this thesis, we propose to incorporate game competition and peer-like agent to realize the brainstorming-support system for creativity ability learning. We try to make use of a new Group Support System (GSS) called Idea Storming Cube (ISC) to support creativity learning and Perspective-Modifying thinking.

By taking the notion of Csikxzentmihalyi's model of creativity, flow theory, and Shneiderman's design of Creativity Support Tool (CST), we turn the traditional brainstorming system into a game-based brainstorming system with an intelligent peer-like agent support for creative thinking. The system runs as a game to increase motivation and encourage efficient and effective production of novel ideas in scientific inquiry. In addition, based on the theory of rational boundary, we design a special user interface in the form of Magic Cube to expose limited view of the whole domain to the user in order to infer related ideas. On the other hand, the cube rotation mechanism allows a user to exchange ideas with other users in order to promote diverged perspective-modifying thinking.

In this research, we also have conducted two experiments for system evaluation. In the first experiment, the presence of participant's knowledge and their using behavior were observed. The result shows that the participants were interested in the game but the participants' knowledge for this science topic is almost homogeneous and they may have encountered idea blocking. Another experiment compared the three different types of brainstorming-support systems by experimental manipulation (i.e., ISC_{info}, ISC_{game}, and $ISC_{game\text{-}agent}$ conditions). The result shows that the game-based brainstorming system with appropriate intelligent support outperforms the other types of systems because the game competition environment can make them concentrate on the brainstorming tasks and let them think more from different view points with the support of the peer-like agent.

There is still much future work of this research to be carried out in order to observe the long-term creativity learning effect by this system. For some intelligent supports, we determine some of the thresholds empirically. Furthermore, we did not compare the individual brainstorming and various systems such as Microsoft NetMeeting, MSN, and online forums of a knowledge management system. In addition, the sample sizes of these two experiments are not large, so it is also suggested to replicate pedagogical experiments with more samples in a real classroom to ensure the real effect of this system in the future. Therefore, there are two main future tasks in this research: 1) to improve heuristic methods in this system, 2) to compare more groups with the experimental group in the evaluation.

Many heuristic methods used in designing the idea exchanging mechanism and intelligent support should be revised for more precise supports for creativity thinking. For example, the user interface for presenting information (i.e., 3x3 array for writing and exploring ideas), the rotating mechanism for exchanging ideas (i.e., only to find the suitable ideas from the user's near neighbors) all have room for improvement.

In addition, the validation of new potential ideas is only judged by mapping between users' ideas, and there is no gatekeeper for verifying whether the idea is meaningful in the task. By collecting all users' ideas into the incremental Field-Domain fUP, applying the Field-Domain fUP into further learning activities is another possible enhancement. We hope that the Field-Domain fUP can collect more different various words for each idea because it could play an important role in the mapping of the concepts or the evolution of knowledge. Therefore, it is worth to explore how to utilize the Field-Domain fUP in further learning activities.

As for measuring creativity, we know that it is a long-term mental activity in mind, and we cannot know its learning effect by one or two experiments. At this time, we did not have the comparison between individual and group brainstorming in our experiments. Although many studies [40][29] indicated that the individual is more efficient than group in idea generation, we still want to discover the possibility for efficient idea generation in group brainstorming. Besides, the group brainstorming activity is suitable for the people from different filed because their different perspectives will stimulate each others. However, our participants of this experiment are homogenous in their age, education, and living environment. In addi-

tion, we should conduct more qualitative analysis to evaluate this system for examining the quality of ideas because the psychometric approach is not enough to measure creativity [1]. It is worth to conduct pedagogical learning activities for more subjects and then observe the long-term effect of creativity learning.