

A System for Supporting Group Learning that Enhances Interactions

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Abstract: In this paper, we describe and evaluate a system for supporting group learning that enhances interactions among learners. To date we have constructed several systems for supporting collaborative learning. One of the aims of CSCL is to promote mutual learning through interactions and discussions among learners. Our previous experiments, however, have shown that these systems may not be so effective for supporting interactions and discussions at times. In order to enhance interactions further, a system should support externalization of each learner in an easily recognizable manner. Through such externalization, learners can actively collaborate or conflict with each other through discussions.

The proposed system integrates a board game and a computer simulation, and is used for studying urban planning and environmental problems. Each learner externalizes and represents his/her own ideas on a board game, which allows him/her to actively participate in a learning situation and to share the representations with other learners. The computer simulation helps the learners to understand the status of the town constructed on the board game.

Several experiments were carried out in a public elementary school. The results show that our system is effective for enhancing interactions, discussions and learner engagement.

Keywords: game, simulation, evaluation

Introduction

In this paper, we describe and evaluate a system for supporting group learning that enhances interactions. To date we have constructed several systems for supporting

collaborative learning [Kusunoki97][Kusunoki98]. One of the aims of CSCL (Computer-Supported Collaborative Learning) [Koschmann96] is to promote mutual learning through interactions and discussions among learners. Our previous experiments, however, have shown that these systems may not be so effective for supporting interactions and discussions at times [Kusunoki98]. In order to enhance interactions further, a system should support externalization of each learner in an easily recognizable manner. Through such externalization, learners can actively collaborate or conflict with each other through discussions.

The proposed system integrates a board game and a computer simulation [Arias97], and is used for studying urban planning and environmental problems. Each learner externalizes and represents his/her own ideas on a board game, which allows him/her to actively participate in a learning situation and to share the representations with other learners. The computer simulation helps the learners to understand the status of the town constructed on the board game, in terms of air pollution, water pollution, etc..

We carried out several experiments with the system in a public elementary school. The experiments showed that our system is effective for enhancing interactions, activating discussions, and raises learner engagement as it increases the game sense [Kafai95] and authenticity of a problem [Norman96].

System Configuration

Overview

The system is comprised of three components: a board game, scenario cards, and a computer simulation.

- **Board game:** The board game is composed of a checkerboard, game pieces, and geographic objects (Figure 1). There are three kinds of pieces: "houses", "factories", and "trees." Geographic objects include "mountains", "rivers," and other similar elements of nature. Learners first discussed where to arrange these geographical objects on the board in order to construct a town resembling their own.
- **Scenario cards:** Scenario cards give learners a certain direction or contextual message regarding their learning situation. Figure 2 shows an example of these cards with messages such as "You cannot build a house next to a factory," "You should be careful of the increase in air pollution in your town." Before putting a game piece on a board, a learner must draw a card. Based on its written message, a learner confirms the current status of the town through the board and a computer simulation, and talks about his/her next action with other learners. The cards, therefore, enhance learners' reflections and promote their paying attention to the board, computer simulation, and other learners.
- **Computer simulation:** Figure 3 shows an example of the results of a computer simulation. When a learner completes his/her action, a computer simulation updates the status of a town. In the upper left of the image, the status of town's air, water and soil pollution are anthropomorphically visualized, as this makes it

easier for learners to relate to the simulation. When a serious environmental problem happens, the simulation not only changes its visualization (i.e., changes the expressions of each object in the figure), but also shows a textual message, such as "the air is heavily polluted" in the center of the image.

Currently the computer simulation is not linked to the board game, and the experimenters had to input the actions of the learners manually (for example, the location of a placed piece and the cards drawn).



Figure 1: A Board Game that Supports the Learning of Urban and Environmental Problems

Usage of the System

Learners first set up a board by arranging geographic objects. Then, one learner draws a card and puts a piece on the board by following the direction of the card. Each learner does the same in turn. After each learner completes his/her move, the computer simulation calculates and visualizes the current status of the town.



Figure 2: An Example of Scenario Cards

After reviewing the simulation, the next learner considers what move to play next. For example, if air pollution is a problem, the learner may change his/her initial idea and place a "forest" piece. Finally, when the design of the town is complete or time has run out, the computer simulation diagnoses the design of the town and points out planning problems.



Figure 3: An Example of a Computer Simulation which Visualizes the Status of the Town Being Constructed

Experiments and Evaluations

Overview

The experiments were carried out in a Japanese public elementary school located in Yokohama city in Kanagawa prefecture. Thirty fifth-grade pupils who had studied environmental problems in school were divided into six groups of five. Due to the time limit of one school period, we carried out the experiments over three days. Each experiment lasted twenty minutes.

Before starting the experiments, brief instructions, such as the usage and rules of the system, were given to the children. Two video recorders were used to record the experiments. One was placed in a fixed position to record the motions and interactions of the children around a board, while the other was used to record the expressions and actions of each children making a move, such as placing a piece on the board. A post-experiment interview of each group was also carried out.

Evaluation

The children did not interact very frequently in the early phase of each experiment. We believe that this is because there were few pieces on a board at these times so pieces could be placed relatively freely. As an experiment went on, however, interactions among the children became remarkable. Every learner read aloud what was written on a scenario card that he/she had drawn (although we did not ask them to do so). In this manner, the message or direction of the card was shared with the other children, who then discussed which piece should be used next. Some children even offered advice of where to place a piece. Collaboration and conflict among the children occurred regularly during these moments.

The children also externalized their ideas at the same time. Every time a piece was placed, all the children paid attention to the computer simulation. The results of the simulation (improvement or deterioration of the town's status) excited the children and led them to further externalize their own ideas.

In our current system, the number of different pieces and rules are not large. However, some groups tried to extend the system by creating new rules, such as "there must be vacant land near houses or factories," or by proposing new pieces, such as "a park."

Throughout the experiments, we were able to confirm that a board game can enhance interactions among learners and is an effective medium for collaboration and conflict. The integration of a board game and a computer simulation was also successful in that both were used smoothly by the children. During post-experiment interviews it was determined that the contents and usage of the system was not difficult, and was enjoyable (most of the children stated that they would like to play the game again).

Several issues, however, were not made clear with these experiments. In one group, there was one leader type pupil who had strong control over the other players. Interactions

among the children in this group were not so obvious as that in the other groups. In future research we would like to clarify the influence of individual personalities on a group.

Another important issue is related to distributed cognition [Norman93]. In another group, one child watched the computer simulations and always informed others of the results. In our experiments, the tasks given to the children were not so complex: each child should have been able to understand, judge, and decide what to do by him/herself. The relation between task complexity and distributed cognition will be investigated in the next experiment. Finally, the extensibility or evolutionary design of the system is critical [Fischer98]. It should support learners' addition or modification of artifacts based on their needs in their learning processes. Such systems seem to raise learners' engagement and promote further externalization, interactions and collaboration.

Conclusions

Using the experience of our previous system for supporting group learning, a new system that integrates a board game and a computer simulation was proposed in this paper. Several experiments were carried out in a public elementary school in which it was shown that the system could enhance interactions among learners and could promote collaboration and conflict during their learning processes.

Recently many systems that support learning focus on the utilization of multi-media technologies. However, the learners in most of these systems are just passive receivers of information and are not active participants of the learning situation[Fischer98b]. The system we proposed in this paper enables learners to interact with real objects, represent their own ideas, share them with other learners and confirm these ideas through a computer simulation. This allows learners to be active participants, and raises their engagement in the learning process. We think that the system and its evaluations show one of the critical issues regarding the use of multi-media technology in learning support systems: how to raise learners' motivation, and the importance of interacting with real and virtual worlds.

Acknowledgments

The authors greatly appreciate Professor Ernesto G. Arias and Gerhard Fischer of the Center for Life Long Learning & Design, University of Colorado, for their kind help.

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