Design Experiments for Integrating a CSCL Technology into Japanese Elementary Science Education

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ABSTRACT

We designed CSCL-based science lessons for 4th and 6th grade. The CSCL technology we used was Knowledge Forum (KF), the second generation of CSILE software. In the first year, we designed the lesson in which KF was used as an extra communication tool. Goal-sensitive assessments for the lesson showed that students did not frequently discuss on the lesson concepts in a cognitive manner. The lesson design in the second year was revised by providing students with cognitive scaffolds so that they could more articulately discuss their thoughts as objects. Comparative analyses manifested that students in the second year were more engaged in science activities through social construction of their knowledge on KF. Design principles we found to be effective are discussed.

Keywords

CSILE, Knowledge Forum, design experiments, Japanese elementary science education

INTRODUCTION

"Computer-Supported Intentional Learning Environments (CSILE)" proposed by Scardamalia, Bereiter and their colleagues is an educational philosophy for the design of computer-supported learning environments (Scardamalia, & Bereiter, 1996). CSILE software is a communal database system in which learners are allowed to externalize their thoughts mainly in the form of texts or/and graphics called "notes," then engage in collaboratively organizing their knowledge as objects to advance their communal understanding as a whole. This communal database structure has been found to provide learners with opportunities to be involved in knowledge advancement through distribution of their expertise, and to eventually facilitate learners' conceptual understanding of complex scientific phenomena in comparison with traditional instructions. (Oshima, Scardamalia, & Bereiter, 1995).

DESIGN EXPERIMENTS AS EDUCATIONAL RESEARCH

The design experiments is not just compiling all we have known on learning, but an attempt to blend expertise from different areas. In our design experiments, we referred to the basic system of the community of learners by Brown and Campione (1996). In the community of learners, the basic components are research (student-directed learning), information sharing, consequential task (i.e., students' recognition of their knowledge as applied to problem solving in the future), deep disciplinary content (beyond textbook levels), and students' reflection on their own activities (i.e., metacognition). In the framework, our challenge for the curriculum design was to effectively use KF to facilitate students' sharing information and reflection.

ACTIVITY STRUCTURE IN JAPANESE ELEMENTARY SCIENCE EDUCATION

In Japanese elementary schools, teachers have a widely shared framework of science activities for students to do in the classroom which we think is similar to the community of learners. The activities are supported by Japanese school cultures (Linn, Lewis, Tsuchida, & Songer, 2000). Students are regularly educated to listen to others and collaborate with one another in small groups. They are also required of reflecting on their own activities in the classroom with their classroom goals determined by themselves at the beginning of the year. Thus, students' dispositions to learning help them to engage in the organized science activity. Science activity at Japanese elementary schools is well-structured based on instructional goals to make students think of science through their investigations as involvement in authentic science activities.

DESIGN EXPERIMENTS ACROSS TWO YEARS

LESSON PLAN 1: "NATURE AROUND US" FOR GRADE 4

We planned the lesson for sixteen periods (a period was 45 minute long). The lesson started with the teacher's attempt to connect his students' interests to learning goals in the lesson. After the training session for KF, students in small groups conducted their investigations on how plants and insects changed in the winter out of the regular schedule. The lesson was proceeded with several cross talks in the classroom. Students were encouraged to report what they found in their investigations on KF and then comment on one another. Further, in the final stage of the lesson, students were asked by the teacher to discuss "how plants and insects look like in the winter."

LESSON PLAN 2: "AIR AND HOW THINGS BURN" FOR GRADE 6

Students were expected to understand that oxygen is needed for things to burn in the air, then why and how things stop burning in relation to the existence of oxygen in the air. Based on our lessons from the first year, we invented the followings as scaffolds: (1) The lesson plan was designed so that students were more concerned with conceptual understandings by structuring students' activities as theory building through construction of their explanatory models. (2) Students were instructed to report, on Knowledge Forum, their thoughts in a specific form of scientific thinking such as hypotheses, experimental designs, predictions, results, and their discussion. (3) The participatory structure of students' science activities was more articulately designed. (4) Researchers and graduate students regularly discussed with students on their modeling, hypotheses, experimental designs, or their interpretations on results. (5) We changed the interface so that students could more easily recognize and use the database as a tool for their reflection. One feature was a graphical view to show them their understanding in progress. Secondary, we created a new sub-window called "diary."

RESULTS AND DISCUSSION

One of remarkable differences between the two years was that the second year students reported their thoughts in more cognitive or socially cognitive manner. The teacher did not consider that the difference was from the difference in ages. Rather, he thought that it was more difficult to have students at the older age engage in social knowledge construction. In Japanese schools, we usually see older students (particularly, at junior high schools) not report any ideas in the classroom or be afraid of expressing themselves. In the second year, we designed students' activities at individual, small group, and whole class level. KF was used mainly for reflecting on their and others' work at the small group level. The teacher and students also used notes in KF for presenting their thoughts in front of the class. Thus, they had articulate objects to talk about for improving their understanding in the collaborative manner. Our video research in progress has manifested that teacher and students talked in more cognitive or socially cognitive manner in face-to-face discussion as well as on KF.

ACKNOWLEDGEMENT

This study was financially supported by the research grant of the Ministry of Education and Science, Japan (Grant #: 11480030). We would like to thank students and teachers who welcomed us as action researchers and collaborators for their curriculum design. We also thank Hiromi Nagai, Hidefumi Nomura and Yoshihito Endo for their help in coding data.

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