Fostering Students’ Participation in Face-to-Face Interactions and Deepening Their Understanding by Integrating Personal and Shared Spaces

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Abstract: In this research, we introduced *CarettaKids* into the social context of a classroom environment to evaluate whether integration of personal and shared spaces can help promote students’ participation in synchronous/co-located interactions in the classroom and deepen their understanding of subject matter. Analysis of videotaped interactions and pre- and posttests clarified the following three points. (1) Students who used *CarettaKids* presented the simulation results and rules for object arrangement they worked out individually in their respective personal space, by using *CarettaKids*’ function of projecting object arrangements and simulation results from a personal digital assistant onto a sensing board. (2) Many of the students who used *CarettaKids* examined individually generated ideas collaboratively in the shared space. The patterns of collaborative examination are: (a) Induce a rule for object arrangement from object arrangements devised in personal spaces; (b) Deduce a new object arrangement from the rules discovered in the personal spaces; and (c) Refine the rules discovered in the personal spaces through group discussion. (3) Students who used *CarettaKids* not only considered all of the three factors, i.e. residential area, industrial area and forest area, but also understood relations between these factors, thereby deepening their understanding of city planning that takes environmental and financial aspects into consideration. We suggest that the degree to which students deepen their understanding is affected by the presence or absence of collaborative examination of individually generated ideas in the shared space.

INTRODUCTION

In the field of computer supported collaborative learning (CSCL), less research has been conducted on support for synchronous/co-location interaction than on support for other types of interaction (Lonchamp, 2006; Scott, Mandryk, & Inkpen, 2002). However, in the social context of the classroom, students learn not only individually, but also collaboratively while interacting face-to-face with the teacher and other students in the same classroom. Therefore, while amplification of classroom learning is defined as the main agenda of the CSCL research field, working more actively on computer-mediated support for synchronous/co-location interaction is more necessary than ever before.

Regarding computer-mediated support for synchronous/co-location interaction in the classroom, several systems for providing a socially shared space have been developed and evaluated (Suthers, 2006). One system has been developed in which students input information by operating three-dimensional physical objects and the input results are superimposed on the physical objects (Arias, Eden, & Fisher, 1997). This system not only allows simultaneous input from about six users, but also can integrate the computer-supported shared space seamlessly with the face-to-face interaction in the classroom. Because of these characteristics, this type of system helps increase students’ feelings of being immersed in collaborative learning, while promoting shared interaction (Eden, 2002). Furthermore, this type of system can support a high level of collaborative problem-solving performance by elementary school students (Sugimoto, Kusunoki, Inagaki, Takatoki, & Yoshikawa, 2003).

However, this type of system has two problems with respect to individual students' interaction in shared space: (1) Some students do not present their own ideas in the shared space; (2) The ideas generated by some individuals are not examined by others in the shared space (Fischer & Sugimoto, 2006). These problems are associated with a lack of feedback on individual ideas from other students, and are considered important causes of inhibition among students that prevent them from deepening their understanding through participation in collaborative problem-solving activities in the shared space. Once these problems are overcome, however, it will be possible to add a new advantage to the existing system (i.e. support for individual cognition), without impairing its existing advantage (i.e. support for group cognition).

By using hand-held devices, we have attempted to create a personal space in which individual students can work without being disturbed by other students, and to integrate individual personal spaces into the existing shared space. The approach to creating a personal space using a hand-held device has been attempted in other CSCL research projects, achieving some positive results (e.g., Iles, Glaser, Kam, & Canny, 2002; Roschelle, Rosas, & Nussbaum, 2005).

We have developed a system called *CarettaKids* (Deguchi, Yamaguchi, Inagaki, Sugimoto, Kusunoki, Tachibana, Yamamoto, Seki, & Takeuchi, 2006; Sugimoto, Hosoi, & Hashizume, 2004). This system uses a sensing board based on the radio frequency identification (RFID) technology to support collaboration in a shared space, and a personal digital assistant (PDA) device to support activity in personal spaces. This system enables students, in collaboration with one another, to simulate city planning with consideration of environmental and financial aspects. However, no evaluation has been conducted on the effectiveness of *CarettaKids* in the classroom setting. More specifically, it has not yet been evaluated whether *CarettaKids* is effective in supporting students' generation of ideas and careful examination of others' ideas in the shared spaces and deepening the understanding of individual students.

RESEARCH QUESTION

Our study aimed to answer three research questions. (1) Were the students who used *CarettaKids* able to propose ideas in the shared space that they had generated in their personal space? (2) Did the students who collaboratively used *CarettaKids* examine the individual proposed ideas in the shared space? (3) Were the students who used *CarettaKids* able to deepen their understanding of city planning that concerns environmental and financial aspects?

METHOD

Participants

The curriculum that used *CarettaKids* was implemented in a sixth-grade class (33 students aged 11 to 12 years) in a university-affiliated elementary school in Japan. The class was divided into six groups (Groups 1–6), each comprising five or six students. Each group was provided with one set of the system. None of the students had used the system before. One of the authors was the teacher. She had more than 10 years teaching experience and had knowledge in science education and biology at bachelor's degree level participated. All the other authors participated in the class for purposes of data collection and technical support.

Curriculum

The curriculum was designed for creating the situations that allow students to move seamlessly between the two spaces using *CarettaKids*. So, three types of activity (shared-space, personal-space, and mixed-space learning) were included in the curriculum. And the curriculum was designed for creating the situations that allow students generate ideas and examine others' ideas using *CarettaKids*. So, the learning cycles consisted of three types of activity were repeated several times and the inter-group interaction activity was included in the curriculum.

Data sources, measures, and analyses

Regarding the evaluation methods for answering the three research questions, for Questions (1) and (2), the interaction analysis (Jourdan & Henderson, 1995) was used to analyze videotaped records of the students' classroom activities; and for Question (3), pre- and posttest analyses were conducted.

RESULTS

Analysis of videotaped interactions and pre- and posttests showed three main findings. (1) Students who used *CarettaKids* presented the simulation results and rules for object arrangement they worked out individually in their respective personal space, by using *CarettaKids*' function of projecting object arrangements and simulation results on the PDA onto the sensing board. (2) Many of the students who used *CarettaKids* examined individually generated ideas collaboratively in the shared space. The patterns of collaborative examination are: (a) Induce a rule for object arrangement from object arrangements devised in the personal spaces; (b) Deduce a new object arrangement from the rules discovered in the personal spaces; and (c) Refine the rules discovered in the personal spaces through group discussion. (3) Students who used *CarettaKids* not only considered all of the three factors, i.e. residential area, industrial area and forest area, but also understood relations between these factors, thereby deepening their understanding of city planning by taking environmental and financial aspects into consideration. We suggest that the degree to which students deepen their understanding is affected by the presence or absence of collaborative examination of individually generated ideas.

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ACKNOWLEDGMENTS

This research project has been supported by Grant-in-Aid for Scientific Research (B) (No. 16300248) and (A) (No. 18200048).