Creativity Education by Distance Learning Connecting Kyoto University and UCLA

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Abstract: Education on creativity is getting more and more important as the human beings proceeds toward the knowledge society. To think on how computers can perform for supporting the education on creativity is an important issue. We are carrying out two advanced projects: TIDE project and ALAN-K project. The former is to provide distant education between Kyoto University and UCLA, while the latter is to develop a new education environment to foster young children's creativity through computing. In this paper, we report a course focusing on creativity education, in conjunction with these two projects. The course well performed for cultivating creativity, ability of group work and understanding of international friendship of both university and elementary students.

Introduction

Education on information is getting more and more important as an education program from elementary level to higher and further education levels. In Japan, the number of schools which have classrooms with computers and network connection is increasing in these several years. Training for teachers to improve their ability to use computers in class has been also conducted, and 66.3% of elementary school teachers and 46.1 % of junior high school teachers answered in the questionnaires in 2002 by MEXT (Japanese Ministry of Education, Culture, Sports, Science and Technology) that they could perform the teaching activity with computers.

This is indeed preferable direction, however, the problem is that most schools are focusing on just the way of using computers. Students are struggling with the pre-defined user interface of common software for e-mails, web browsing and document processing, but the main focus should be on learning how their intellectual activities can be supported and performed effectively by using computers.

To try to pursue the new possibility of the usage of computers, we planned and held a course for thinking of roles which computers can perform to cultivate creativity and learning, through various kinds of experiences such as developing computer-based curricula, group discussion and work, and inter-cultural exchange. This course was conducted in the 2004 spring semester on our distant interactive education system between Kyoto University and UCLA (University of California, Los Angeles).

In this paper, we introduce two projects in Kyoto University related to this course at first and then describe the overall organization of the entire course. The curriculum development project is also presented with some examples developed by students. Finally, evaluation of this course is discussed based on the results of questionnaires.

Background

The ALAN-K Project

We are carrying out a research project, called the ALAN-K (Advanced LeArning Network in Kyoto) project (2002-2005) (Konomi & Karuno, 2003), which aims at building education environment required for the coming knowledge society. As an activity of this project, we are developing computer-based curricula to enhance math and science learning, utilizing an object-oriented programming environment "Squeak," and its component "eToy" which enables even children to make computer programs easily.

We think that "creativity" can be regarded as an ability of children to build up "invisible" images in their mind to "visible" objects in real world, and also that logical and mathematical ways of thinking and scientific concepts are inevitable to achieve this. We are developing and evaluating curricula for supporting this learning through practices in two public elementary schools in Kyoto.

The TIDE Project

TIDE (Trans-Pacific Interactive Distance Education) Project which started in 1998 is a distance and collaborative education program between Kyoto Univ. and UCLA. It uses a system that can transfer live video and audio, computer screen and white board writing via a leased line communication. Students and instructors can ask questions and give answers interactively from both sides. Scenes at the distance class are shown in Fig. 1. TIDE Project offers one course in each semester for the general education program and the Kyoto University International Education Program at Kyoto University. The class is taught in English.

A characteristic feature of this course is to give Kyoto University students an opportunity to visit UCLA in order to support international exchange between them. This intends to foster young and active students in the international society. This semester twelve students visited UCLA for about a week in May.

Figure 1. Scenes at the distance class

The Creativity Education Course

General Condition of the Course

The course in the spring semester starting in April, 2004 was planned as the second series of the same course conducted in 2003 (Yoshimasa, Ohshima & Rose, 2004). Classes of the course were conducted from 8:30am to 10:00am on every Wednesday and Friday, April 9 to July 14 (because of the time difference between Kyoto and Los Angeles, the time of classes at UCLA was from 4:30pm to 6:00pm on the previous day). Due to the difference of the semester period of both sides, the course was organized in two parts: the first two months were for a lecture and presentation part with connection between Kyoto University and UCLA, while the latter one month was for a practice part only at Kyoto University.

At the Kyoto University side, backgrounds of students ranged widely over all faculties, and from freshmen to seniors, while students on computer science participated at the UCLA side. About one third of the Kyoto University students were from foreign countries, including students from partner institutions of the Kyoto University International Education Program.

Purpose of the Course

The course was titled "How Children Will Finally Invent Personal Computing" and the purpose was stated as follows in the syllabus.

"To gather together students from two continents and multiple disciplines - computer science, education, media, theatrics - and to explore and design with children a new approach to personal computing that creates the future rather than imitating the past."

The final goal at the Kyoto University side was that the university students designed curricula for 5-6 grade elementary students to learn mathematical and scientific concepts through making programs on Squeak. This was intended for the university students to learn education on creativity and roles computer can perform for this education through this experience.

To achieve this goal, the following lessons were provided: lectures on creativity from various points of views, tutorial of Squeak necessary for the curriculum development, design and presentation of curriculum by groups. During the latter period of the course at Kyoto University, the university students tried to make programs on Squeak and the curriculum development for elementary students.

Lectures on Creativity

Dr. Alan Kay, who is an adjunct professor at UCLA and a visiting professor in Kyoto University, and Prof. Hajime Kita at Kyoto University, presided over the lecture. Some guest lecturers, Prof. Seymour Papert who is known as the inventor of the programming language LOGO, Mr. Bran Ferren who is a movie stage designer, Prof. Kazuyuki Moriya who engages in environment education in Kyoto University, were also invited to give their research and experience.

In order to give the students some necessary backgrounds for the curriculum development, activities of Squeak-based lessons at elementary schools in Kyoto were introduced by Dr. Hideyuki Takada, and those in Los Angeles were did by Ms. Kim Rose at Viewpoints Research Institute. Tutorial on Squeak was also conducted using the textbook (Allen-Conn & Rose, 2003), with the help of teaching assistants. As an extension of the Squeak environment, the "World-Stethoscope" which has been developed to utilize the real world phenomena like light, temperature and voltage in Squeak was introduced by Mr. Kazuhiro Abe at Viewpoints Technology, Inc.

Curricula Development Project

After taking lectures and learning the basics of Squeak, students engaged in the development of Squeak-based curricula for elementary school children. Groups consisting of about 5 students were organized and each group was expected to develop one curriculum. Because of the different academic backgrounds Kyoto University students have, groups were formed consisting of members of different majors and both Japanese and foreign students.

Squeak

"Squeak" is an object-oriented programming language that inherits most of features of Smalltalk-80 and is extended to have modern multimedia processing capabilities. Squeak has some features, such as compatibility on major operating systems like Windows, Macintosh, and Linux, development as an open source project, and capability to handle various types of media. Squeak is a common environment enough to realize variegated functionalities such as a web browser, a web server and a 3-D manipulation. Moreover, Squeak is based on a simple but powerful architecture, called the "Morphic Framework," inherited from Smalltalk. The Morphic Framework enables every visual object, called "Morph", to be operated as an object through the visual interface that Squeak provides.

In Squeak, the tile scripting function and user interface like generation and operation of objects on Squeak are implemented using the Morphic Framework. Fig. 2 shows the tile script function for describing an action of a drawing object. It is possible to make a program with drug & drops by combining the tiles that perform operation such as "forward by" or "turn by" or check the conditions such as "isUnderMouse."

Squeak is designed so that 8 to 12 years old children can quickly create projects and express their ideas in easy-to-understand environment.

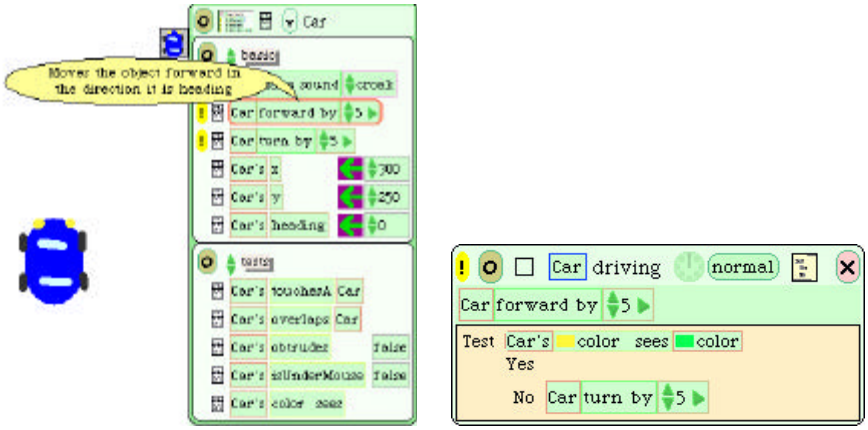

Figure 2. Tile scripting function of Squeak

The Process of the Curriculum Development

The purpose of this development was stated as "the development of curricula for children to promote creativity, learn logical thinking and mathematical/scientific concepts, through realizing 'something' on Squeak. Think on this 'something.'" Each group was expected to develop one curriculum. The students were encouraged to include not

only experiences on computers but also physical phenomena in the real world and expressions of human recognition into the developed curriculum. Furthermore, some guidelines were also given like the period of a class limited to about two hours at the elementary schools and avoidance of harmful subjects such as killing life.

The curriculum development proceeded in the following three phases.

Phase 1: Initial Design
Draw a rough sketch of a curriculum, and describe how it performs and what children can learn.

Phase 2: Implementation Design
According to the initial design and given comments after the phase 1, design on what should be objects and how these behave. (The UCLA side ended at this phase)

Phase 3: Curriculum Implementation
Based on the implementation design, actually make programs on Squeak and discuss how children are taught.

As the result of each phase, each group presented their progress for about 10 minutes and had discussions among instructors and students. Dr. Kay pointed out many important concepts such as that concepts children learn should be focused on one theme, and that a curriculum should be designed for children to be able to do something on it. At the phase 3, the developed curricula were reviewed also by the member of Kyoto City Education Board.

Curricula Developed by Students

The following curricula have been developed at the Kyoto University side.

- Car Race with Lemon Batteries
  Batteries are made from fruits such as grapefruits, kiwi, and metals such as copper. The produced voltage is sensed and input to Squeak by the "World-Stethoscope." Children try to create a car race in which a car runs over longer distance when the produced voltage is higher. Children are expected to learn the characteristics of batteries, parallel and sequential circuits, and the difference of produced voltage depending on the kinds of fruits and metals. A screen example is shown in the left side of Fig. 3.

- Learning Friction
  The acceleration and velocity depending on the force by pulling an object and the friction on the object is simulated. First, children measure the length of a rubber band extended by pulling the object and have experience on how friction works. Then they try to simulate it on Squeak with the function for changing the pulling force and the friction.

- Enjoy Fireworks
  Mixing the primary colors of light in various ratios, children learn how color changes depending on the mixing ratio. The mixed color is represented by the color of fireworks so that children can learn it with fun. A screen example is shown in the right side of Fig. 3.

- Learning Coordinates
  By making a program of a kid walking through a school, home and a store on a grid of streets, children learn the concept of coordinates. As an off-computer activity, children try to express the movement of a person on a grid, like "two blocks to north and three blocks to east." Then children make a program to realize the movement of the person.

- X-Maze
  By making a maze shaped in X with several walls inside and a ball bouncing in the maze, children learn the concepts such as the reflection of objects and proportionality.

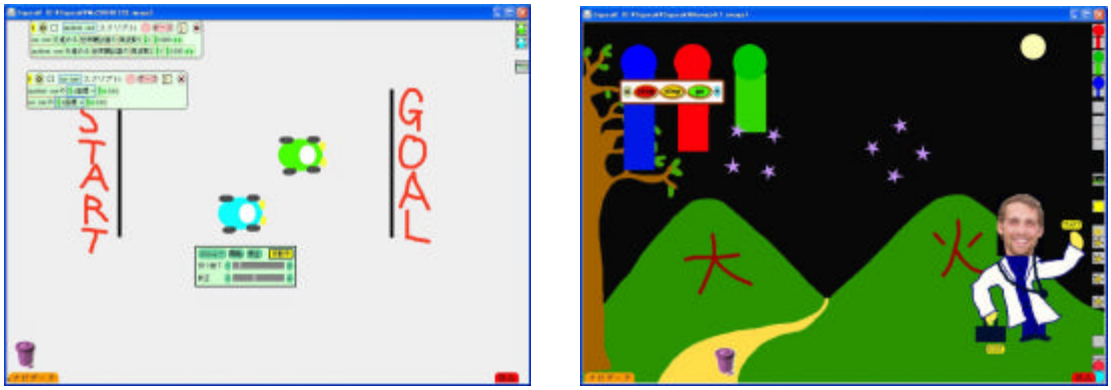

Figure 3. Example screens of the developed curricula

Workshop at an Elementary School

A workshop for children was held at an elementary school in Kyoto to actually teach the curricula they developed and evaluate how they worked for children's understanding. Twenty children participated in the workshop and each child could receive the instruction one by one from university students. A scene at the workshop is shown in Fig. 4.

The university students were encouraged to include the off-computer activity in the teaching process, like experiencing the physical phenomena. For example, children had experience of friction by pulling a thick book placed on a floor with rubber band and observing the effect of changing materials covering the book, as shown in Fig. 5. After their hands-on experiences, the children then turned to the computer to create simulations.

In order to evaluate the workshop, children were asked to answer questionnaires prepared by the university students themselves. Questions included asking if the workshop was "fun" or "boring," and the curriculum subject was "difficult" or "easy," as well as examining whether the leaning objective (like answering which material produces the strongest friction) was performed.

The result of the questionnaires shows that all of the children answered that the workshop was fun or somewhat fun and 70% of the children were interested in the curricula. The learning objectives of the curricula were also almost performed. Some children answered that they had enjoyed with foreigners, that was effective to understand the international relationship.

Figure 4. A scene at the workshop

Figure 5. Off-computer activity

Credit Qualification

The achievement of the university students was evaluated for qualifying credits based on the essay assignment, taking participation in each class into account. The theme of the report assignment was to report "what is worth to be told to whom, through your experiences of taking this course." No more detailed guidelines were given.

Submitted essays had very good quality since they were written based on students' experience of distance learning and project work, and well considered the audience. They also had very wide varieties of contents, such as their thoughts on education derived from their experiences of the school workshop, discussion on difficulties of

group work for the curriculum development and the difference of cultural backgrounds they experienced during the trip to UCLA.

Evaluation of the Course

At the final class of this course at the Kyoto side, students were asked to answer a questionnaire for evaluation. A part of the result of the questionnaire is shown in Fig. 6. As a whole, students were motivated and satisfied with the class and the workshop was effective as a good goal for achieving the aim of the class. The rate of satisfaction with the lectures from UCLA is rather low and this seems because students had difficulty in understanding lectures of theoretical aspects in English spoken at natural speed, and slides sent from UCLA was not so clear.

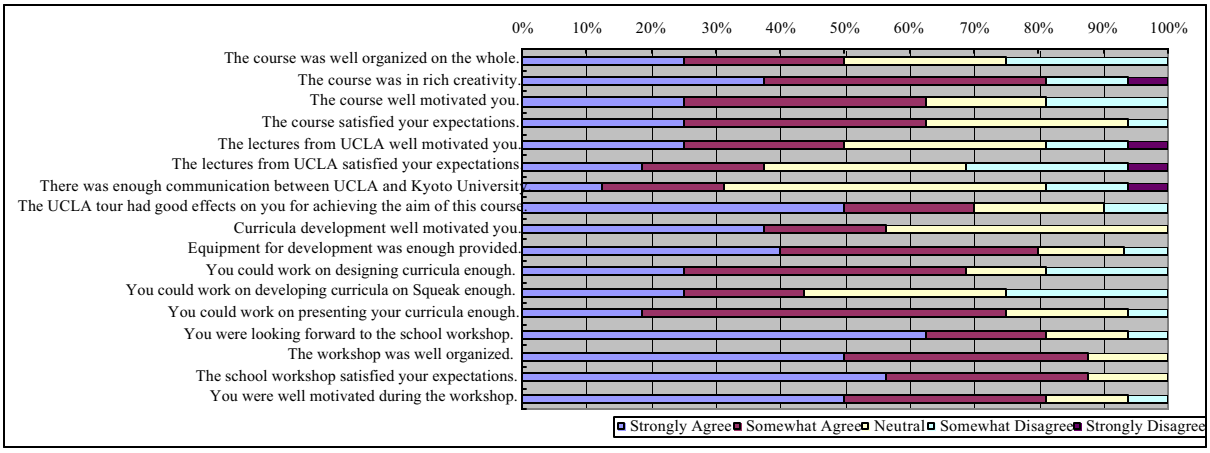

Figure 6. Result of questionnaires for class evaluation

Discussions

Since this course had many aspects such as distance education, exercises with computers, group work and the workshop for elementary children, wide variety of know-how of instructors with different skills was required.

The distance education system has provided enough quality of functions and performance for conducting the class. However, some issues have been left in a management aspect. For example, enough discussions prior to having classes couldn't be made between Kyoto University and Los Angeles, due to the time difference. There were also some cases when proceeding of presentations by students was not performed smoothly. Since a microphone was needed to give questions, interaction between Kyoto University and Los Angeles sometimes couldn't be achieved well enough. Improvement for awareness of classes can be a technical future work.

The entire environment for running Squeak can be carried in a USB memory key. So each student was given the USB memory in which Squeak was installed, in order for them to work at both the university and home. Implementation of the curricula on Squeak was supported by two teaching assistants of graduate students. The result of the questionnaires, however, shows that many students couldn't achieve the programming on Squeak well enough. Students with less programming experience seemed to have difficulties on the implementation, in spite of the easy-to-understand interface of Squeak. This is also because enough tutorial of Squeak couldn't be offered due to the limitation of the class schedule.

Most of the students eagerly engaged in the group work for the curriculum development. However, they had problems such as the difference of academic backgrounds and communication with foreign students. There was a group in which most of the work was concentrated on only one student. This means that enough time for prior discussions on each responsibility should be given.

The workshop at the elementary school was carried out well, but some students pointed out that they had difficulties with teaching and communicating with children. Since it was the first experience to teach to elementary school children for almost all students, prior investigation on a school class had to be done to grasp the overall atmosphere.

Conclusion

In this paper, we have reported the course of creativity education by means of the distance learning system. Exploiting the experience of the course of the semester, we will improve the course and contribute to both higher and elementary education.

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References

Konomi, S. & Karuno, H. (2003). Initial Experiences of ALAN-K: An Advanced LeArning Network in Kyoto. Proceedings of the Conference on Creating, Connecting and Collaborating through Computing (C5), IEEE Computer Society. (pp.70-76).

Allen-Conn, B. J. & Rose, K. (2003). Powerful Ideas in the Classroom: Using Squeak to Enhance Math and Science Learning. Viewpoints Research Institute, Inc.

Yoshimasa, K., Ohshima, Y. & Rose, K. (2004). Developing Squeak-based Curricula through a Collaborative "TIDE" Course at Kyoto University and UCLA . Proceedings of the Second International Conference on Creating, Connecting and Collaborating through Computing (C5 2004), IEEE Computer Society. (pp.152-159).