

Educational Software Employing Group Competition on an Interactive Electronic Whiteboard

Yoko Otsuki

Department of Computer, Information and Communication Sciences
Tokyo University of Agriculture & Technology, Japan
yhoko@hands.ei.tuat.ac.jp

Hirokazu Bandoh, Naoki Kato, Bipin Indurkha & Masaki Nakagawa

Abstract: This paper presents the design and evaluation of an educational software employing group competition using a large interactive electronic whiteboard. Group competition is a useful method to cultivate originality and communication skills. Sharing the same space and the same large screen, and face-to-face communication with others are very important for group competition. We have designed a kanji pairing software package using the interactive electronic whiteboard. Through experimental use of the application at two elementary schools, we confirmed the potential of this software to motivate children to learn and the necessity to adjust competitive factors according to children's personalities. Moreover, the children kept their concentration and the teacher could get feedback of children's study process. Therefore, the interactive electronic whiteboard and group competitive software can be effectively employed for classroom learning.

Introduction

In recent years, many schools are making an effort to incorporate computers into teaching and the field of CAI has developed several software systems to assist in this task. More recently, CSCL systems have also been proposed, which allow students to collaborate with each other in a group (Strijbos, 2001). However, little attention has been given to the role of competition in learning.

While an undue emphasis on competition may be stressful, a certain level of competition is useful to motivate and inspire students. If the competition is between teams, it also fosters cooperation among team members and promotes improvisation. With proper supervision and guidance, the teacher can help the development of individual students, and students get a sense of achievement and feel encouraged to study further.

Introducing computers into group competition-based teaching reduces the time needed by the teacher for preparation, which in turn allows the teacher to pay more attention to the students and to monitor their growth and development. The teacher can check the students' answers and their results can be discussed in the group to encourage the students' ideas naturally.

The interactive electronic whiteboard has previously been used in classroom teaching, and has been shown to possess many advantages. The electronic whiteboard is a large whiteboard with a pen-input tablet, which works like a normal chalk and eraser. We have already developed several useful interfaces for the electronic whiteboard (Nakagawa, 1999). More recently, we have been working on incorporating the electronic whiteboard into classroom teaching to integrate the advantages of traditional classroom teaching with those of using computers in the classroom (Bandoh, 2000, Otsuki, 2001).

In this study we focus on developing a competition-based study environment using the electronic whiteboard in a classroom. We believe that the use of an electronic whiteboard fosters teamwork and face-to-face communication. Towards this goal, we present the design of competition-based educational software for learning kanji pairs. We also describe how it allows competitive elements to be adjusted depending on the personality of the students in a class, and how it assists the teacher in directing the flow of teaching. Further, we studied the effectiveness of the software in monitoring the learning progress of the students and their abilities to improvise and cooperate.

Design of Educational Software based on Group Competition

We feel that a procedure-oriented approach is necessary for educational software aimed at elementary schools. Thus, the teacher should focus on how the students approach problems, and how they think and cooperate. In designing our system, the following issues are considered to be central:

- Facilitating teamwork and improvisation.
- Feedback on the logic and reasoning used by the students.

Since our system is designed for classroom use, the following issues are also given consideration.

- The class can be lead easily without extra preparation.
- The students can make use of their learning experiences in later studies.

Competitive element

Each class has different characteristics since students have many different personalities. An effective teacher must adapt an atmosphere and teaching technique to the characteristics of an individual class. In particular, it is important to adjust the level of competition in group-competition-based activities. For example, in a class with a wide range of student ability, only highly able students may be strongly motivated, thereby limiting other students' participation when the software is such that the winner is clearly identified. On the other hand, in a class where all the students are roughly at the same level, the same software feature may motivate students to plan a winning strategy. This applies not only to the students' ability to study but also to their ability to cooperate, ability to think positively, and so on. Consequently, in designing our system, we allowed the following competitive elements to be set depending on the characteristics of an individual class:

- Displaying the winner
- Displaying the points earned in the game
- Awarding points to the team that answered first
- Limiting the length of the game according to the time or the number of correct answers

Displaying incorrect answers

An effective teacher is always conscious of the level of students' understanding in classroom teaching. It is important for the teacher not only to make the students solve problems but also to explain the logic used to solve the problem. Wrong answers are often very helpful, for they point out mistakes in the student's logic. Based on this information, teachers can adjust the focus of their teaching to correct students' misconceptions. Then students can correct their thinking and proceed to the next step. If the teacher skips over wrong answers, the supporting software becomes a mere tool to measure achievement levels. Therefore, to increase the level of educational effectiveness, we have designed our software so that it displays not only the correct answer but also incorrect answers.

Using an electronic whiteboard

A normal personal computer display is too small to be shared among many students. A network connection is one way to share information among the members of a group, but working in a network setting precludes face-to-face communication, which in turn removes the sense of physical presence. Also, the teacher cannot get visual feedback from the students, and is therefore unable to adjust the teaching pace appropriately. For this reason, our system is designed to use an electronic whiteboard having a large display so that the students can share it as a working space as well as they can enjoy the benefit of IT. We believe that the large electronic whiteboard has the following advantages:

- It generates a sense of team spirit that promotes cooperation and improvisation.
- Direct communication in the same space facilitates sharing of knowledge and information.

- IT has the potential to enhance the efficiency and effectiveness of learning.
- The teacher can concentrate on observing what the students are doing and can give them proper instructions.

Kanji-pairing Software

The kanji-pairing software is designed to emulate a classroom teaching activity in which students pair kanji characters to make a word using a kanji character suggested by the teacher. Prior to using this software, the teacher sets parameters that determine the level of competitiveness suitable for each group of students. The teacher also specifies the kanji characters that are being studied in the class, and any restrictions to be placed on the order in which they will be used in the game. The game starts with the teacher announcing one kanji character that must be used in the pairing game. Each group thinks up a meaningful kanji pair that starts or ends with the suggested kanji and writes it with an electric pen, the result of which is passed to a frame-based character recognition system. The software checks the answers in real time, and displays correct and wrong answers separately. If more than one group gives the same correct answer, the order in which the answers were given is indicated by the font color.

The work of the teacher is considerably reduced as the computer handles the checking of answers and the evaluation of students' performance. The teacher can suggest kanji characters on which he or she would like the students to focus. This allows the teacher to organize the teaching material and also allows students to participate freely. The computer can also check unexpected or rare kanji pairs by referring to its electronic dictionary.

Trials at Elementary Schools

In order to evaluate the efficacy of the electronic whiteboard and the kanji-pairing game, we used the prototype in actual classrooms (Fig.1). Two elementary schools (*A* and *B*) participated in this study.



Fig 1: Trial of the Kanji pairing software at an elementary school.

Q1. Did you regard this lesson as pleasant?			
A. Very pleasant.	86%	<i>79%</i>	
B. Pleasant.	14%	<i>21%</i>	
C. Not so pleasant.	0%	<i>0%</i>	
D. Not pleasant at all.	0%	<i>0%</i>	
Q2. Did this make you interested in pairs of kanji characters?			
A. Became very interested.	45%	<i>36%</i>	
B. Became somewhat interested.	47%	<i>57%</i>	
C. Not interested so much.	8%	<i>7%</i>	
D. Not interested at all.	0%	<i>0%</i>	
Q3. Will you review this lesson at home?			
A. Will surely review.	3%	<i>0%</i>	
B. Will probably review.	72%	<i>50%</i>	
C. Will probably not review.	22%	<i>32%</i>	
D. Will not review at all.	3%	<i>18%</i>	
Q4. Did you cooperate with other members of your group?			
A. Cooperated very much.	50%	<i>21%</i>	
B. Cooperated some.	39%	<i>68%</i>	
C. Did not cooperate so much.	11%	<i>11%</i>	
D. Did not cooperate at all.	0%	<i>0%</i>	
Q5. Do you want to participate in such lesson from now on?			
A. Want to participate very much.	81%	<i>79%</i>	
B. Want to participate.	19%	<i>21%</i>	
C. Do not want to so much.	0%	<i>0%</i>	
D. Do not want to at all.	0%	<i>0%</i>	
Bold face School A <i>Italics</i> School B			

Fig 2: The contents of questionnaire and results.

After the game, the students were asked to answer a questionnaire. Fig. 2 shows its contents and results. The teacher at the school *A* made the following remarks after the game:

- The class was taught more or less as originally planned and the learning of kanji-pair words was made effective.
- It seems to increase the students' motivation and the cooperation among the students.
- The competitive element in the game fits the characteristics of the class.
- Everyone in the class could participate due to the large area of the electric whiteboard.

The teacher at the school **B** made the following remarks after the game:

- The class was run as usual using the material originally intended by the teacher.
- Due to the time limit, the students sometimes wrote kanji characters in the wrong order or incorrectly.
- The competitive element seems suitable for this class. However, the final score should be adjusted to reflect any special circumstances.

The students' remarks included the following comments:

- The game-like setup makes it fun to learn kanji-pairs and we want to play more and more.
- The teamwork in the group during the competition was lots of fun.
- It was fun watching the other games also.

Discussion and Conclusions

The comments from the teachers indicate that the kanji-pairing software can be used in a traditional classroom using the material that the teachers has already prepared for traditional teaching with little extra preparation. The software facilitates the competitive element by allowing simultaneous inputs from competing teams, checking answers for correctness and displaying them, keeping scores, and so on. The teachers also felt that the pairing of teams in the game improved students' cooperation within each team. Moreover, the game setting made it fun and increased the students' motivation to learn kanji pairs.

These conclusions are further supported by the students' comments. About 90% of the students responded that they were able to work together effectively with other members of their team, and that the game increased their motivation to learn kanji pairs. Many students commented that the game helped them to overcome the impression that learning kanji characters is difficult. Most students answered that the game was fun and they would like to play again. Our experience also showed that the teamwork and use of a dictionary and other material helped the students to overcome their natural reluctance and shyness and improved face-to-face communication amongst themselves and with the teacher.

In comparing the results of the two experiments, it can be seen that the students at the school **A** rated the software better than the students at the school **B**. We feel that it shows that the competitive element was set more appropriately for the classroom at the school **A**. In the school **B** set-up, the time limit and the way of resolving ties when both the teams answered at about the same time seemed to be constraining factors. Nonetheless, in both cases, using the large display, the teacher could keep track of the entire game proceedings, and they offered appropriate encouragement to the losing team by emphasizing the experience of the game rather than the result. Thus, it seems that it is useful and may even be necessary to adjust the competitive element of the game to adapt to each individual group of students. In this respect, the software system seems quite effective as it allows adjustments to the game procedure as needed. Moreover, our experience showed that even students who were not playing the game participated indirectly by contributing to strategy, which was possible because of the large display area of the electronic whiteboard. To conclude, our experiences show that the electronic whiteboard is an effective tool for running educational software that increases the students' motivation in the classroom.

References

Bandoh, H., Nemoto, H., Sawada, S., Indurkha, B., & Nakagwa, M. (2000). Development of educational software for whiteboard environment in a classroom, *Proceedings of IWALT 2000* (pp.41-44).

Nakagawa, M., Hotta, K., Bandou, H., Oguni, T., Kato, N., & Sawada, S. (1999). A Revised Human Interface and Educational Applications on IdeaBoard. *ACM SIGCHI 99 Video Proceedings and Video Program and also CHI 99 Extended Abstracts* (pp.15-16).

Otsuki, Y., Bandoh, H., Kato, N., & Nakagawa, M. (2001). Supporting Individual and Cooperative Work Using Scalable Pen Interfaces. *Usability Evaluation and Interface Design, Volume 1* (pp.445-449).

Strijbos, W.J., & Martens, L.R. (2001). Group-based learning: Dynamic interaction in groups. *Proceedings of Euro-CSCL Conference 2001*.

Acknowledgements

This research is supported by the Strategic Information and Communications R&D Promotion Scheme under the Ministry of Public Management, Home Affairs, Posts and Telecommunications.