An Interactive Learning System in Elementary Schools

Masaaki Tanaka[†] *, Tokuro Matsuo*[††] *, Takayuki Ito*[†]*, Tadachika Ozono*[†] *, Toramatsu Shintani*[†]

[†]*Graduate School of Engineering, Nagoya Institute of Technology, Nagoya, 466-8555 Japan*
[††]*School of Project Design, Miyagi University, Miyagi, 981-3298 Japan*

Summary
This paper is to examine interactive integrative learning support system for elementary school students. Our Web-based system enables a group of some 5 students and teachers to learn interactively by collaboratively creating outcome (i.e. Web pages) through a shared Web site. Three main functions of the system are followings;(1)To build a shared Web site directly from Web browser in order to support students and teachers who are inexperienced in composing HTML. (2) To modify and edit a shared Web site directly from portable terminals to support students at on-site training in real time. (3) An agent function that supports plan modifications and rerouting in case of students choose a wrong route. We have applied our system to research training and on-site training of elementary school students who are studying in a group as a part of integrative learning curriculum.
Key words:
Agent-based e-learning support system, Interactive learning, Cooperative learning.

1. Introduction

Importance of integrative learning [4] has been increasing in the field of education. The integrative learning is collaborative learning curriculum of students and teachers that is consisted of off-campus shared task achievements (on-site training) and on-campus researches (research training) [5]. Our research assumes an actual fieldtrip that was planned and implemented as a research training and an on-site training respectively.

Existing research training has been implemented by paper-based teamwork where members fill out their plans on a sheet of paper. We are proposing Web-based system which build fieldtrip plan on Web page. However in general, there are few teachers or students who stay on top of Web page building. In order to solve the problem, we have applied direct and easy to operate Web editing technologies.

As far as existing on-site training concerned, students along with paper timetable has been contacting their teachers by cellular phones. By deploying compatible function between cellular phone and Web and by deploying JAVA executable function within cellular phone, we have succeeded creating an agent that supports real time Web communication between teachers and students while multiple students are on a fieldtrip.

The overviews of integrative learning conducted in the research are as follows. Overall fieldtrip plan is drawn at research training phase and then actually implemented at on-site training phase. In the research training phase, teachers and students are required to collaboratively draw time constrained one day fieldtrip plan. After destination, attractions, and transit points are decided, learners verify the transit route by using internet service such as Google. The field trip plan is built on the internet as a shared Web page (Hereinafter referred to as "bookmark"). Learners are free to fill out the bookmark with necessary information needed for the fieldtrip collected from and confirmed by the internet. Information such as train destination and departure time, boarding, transit, and arrival stations are listed in orders. Also, information regarding destination or types of souvenirs sold could be found on the internet and are filled out in the bookmark. At on-site training, learners behave in accordance with their planned fieldtrip schedule. They can sequentially confirm their transit schedule planned at research training phase by browsing bookmark with PDA or by talking their teachers over a cellular phone. In the case students miss the train, agent within PDA will modify the original plan and propose new one.

The components of this paper are as follows; in chapter 2, supporting mechanisms of research training and on-site training are explained. An example of the system execution is presented in chapter 3 and the system features are presented in chapter 4 and summarized in chapter 5.

Manuscript revised August 22, 2005.

2. Interactive integrative learning supporting system

2.1 Investigation training supporting mechanism

As a part of integrative learning supporting system for elementary school students, we proposed educational technique that urges students to make the brochure for an excursion by themselves (research training) and to proceed excursion according to the brochure (on-site training). Using budget train tickets, a group with 5 to 6 students carries out an excursion heading toward their destination and returning back to their starting point. Students are required to find out the route and timetable for their desired destination in advance and to make brochure, which is an itinerary for the excursion. In conventional way, it is a big burden for the teachers to fully review and confirm students' multiple itineraries since it is written on the paper. However in our system, all itinerates are written through Web page by entering brochure so that teachers can review and confirm the itineraries by Web browsing. The system doesn't require printed brochure brought on the day of excursion as students can browse through portable terminal such as a cellular phone. However, it will take time for teachers to teach students how to make Web page since only few of them know how to do so. In our research, we focused on research training in interactive integrative learning.

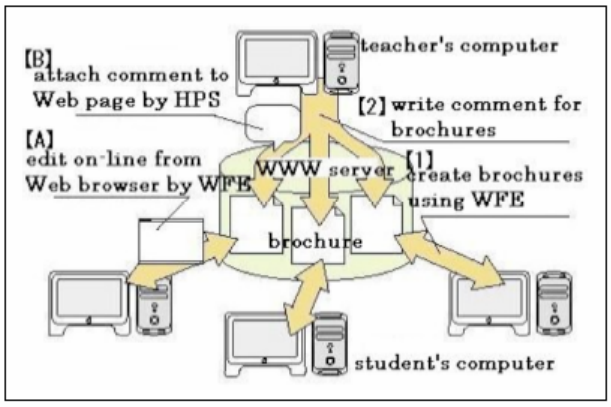

Figure 1: Investigation training supporting mechanism

As a WFE, application, we have built a brochure creating supporting system that is used for preparation of on-site training. Entry of the itinerary by students (figure 1-1) and entry of comments by teachers are required when creating Web brochure. If we spend much of the time for Web page, the efficiency of research training will decline since both students and teachers are inexperienced. We developed brochure creating system using WFE (figure 1-A) which eliminated the lecture of FTP or HTML authoring software. As the result, teachers can devote their time to research training.

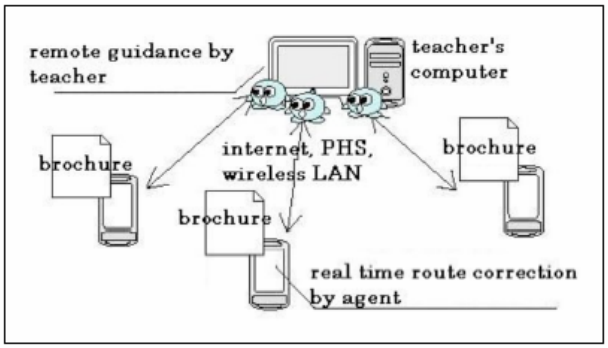

Figure 2: On-site training supporting mechanism

Teachers are required to comment on the students' brochure whether they're appropriate. Because of the structure, HTML can only handle texts and the inserted comments require flexibilities as if they were written on the papers. We have developed Home Page Sticky (Hereinafter referred to as HPS), a Web comment attaching system that enables to attach word balloon shaped notes on Web pages (figure 1-B).

Attached notes can be viewed by other users so students can edit their itineraries. Since research training equivalent to conventional approach is available anytime, HPS makes research training efficient.

An agent allocated to each brochure plans route using route databases on the internet. If there is a Web browser, efficient research training is possible for both students and teachers. All students are able to view other's Web page so that mutual corporation between learners is possible by referring others or pointing out. A shared Web page which acts as a brochure is built by using MiLog [3], a mobile agent entry environment, as a Web server. MiLog is an environment that builds mobile agents and each agent travels between computers while functioning as a Web server. The mechanism of the system supports on-site training learners by providing an agent per one brochure.

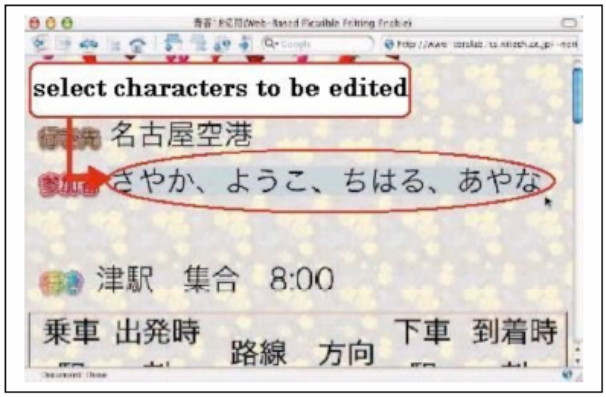

Figure 3: Collaborative brochure work using WFE architecture

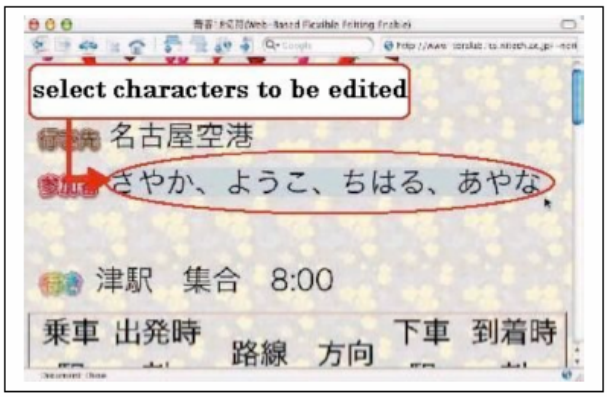

Figure 4: Editing screen using WFE architecture

2.2 On-site training supporting mechanism

On-site training supporting mechanism is shown in figure 2. Each group communicates with teachers by portable terminals and agents support students' decision based on brochure in real time. The brochures made at research training phase can be shown on portable terminals and pictures can be pasted to the brochure via portable terminals using HPS architecture. Students can keep the records of on-site training in real time by actively reconstructing the brochures.

The agents are stored in the server and roughly tracking students' current location by GPS function in students' portable terminal. Alert will be sent to students from agent if the time and place in the brochure widely differ from current location so that teachers can give appropriate directions to students.

3. An executive example

An executive example of corporative brochure work directly from Web browser using WFE architecture is shown in figure 3. Transit planning of the train based on timetable is used as the example. Teachers prepare basic template in brochure in advance and students are to edit it if necessary. Selection of member field in brochure to add member to the group is shown in figure 3. Editing screen is shown in figure 4 where member had actually been added to the group.

An example of confirmation from portable terminal at on-site training is shown in figure 5. In the example, transit of train in fieldtrip plan is fit to shown on portable terminal's small screen.

The real time comment of the teacher to the students' brochure can be reflect on the web pages using our system. Label that has a shape of word balloon is pasted to Web page and students are able to view it from portable terminal or computer.

4. Features

The features of the system are shown in (1) to (3).

(1) At on-site training, it's essentially important for the students to build brochures freely with the interaction with the teachers. To learn HTML grammar or FTP operation to make brochures is not essentially important. By introducing WFE and HPS architectures, we have enabled students and teachers who are inexperienced HTML composition to build a shared Web site directly from Web browser.
(2) The system can modify and edit Web pages directly from portable terminal to support on-site training in real time. Contrary, it is difficult to reflect the pictures taken by students at outside to the brochure in traditional on-site training since the brochures are made of papers.
(3) The system has the agent function that support plan modification and rerouting. In the case students take wrong route or emergency where teachers need to provide appropriate advice, the agent in the system revises original plan and proposes alternative route if the situation is simple. To realize much

safer on-site training, alerts will be sent from the agent to both students and teachers if the case is complicated.

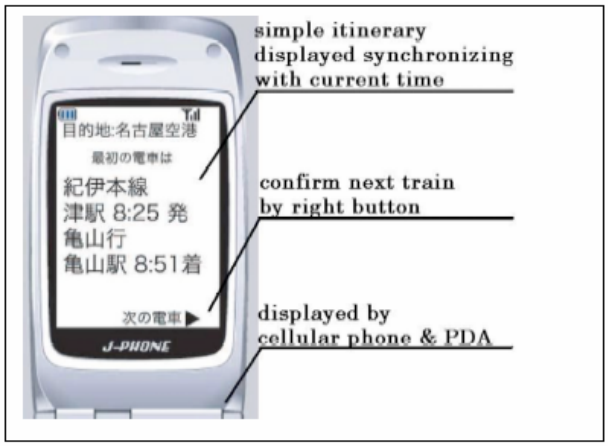

Figure 5: Browsing on-site training brochure

5. Conclusion

In our research, we have proposed research training supporting mechanism and on-site training supporting mechanism to develop research training and on-site training efficiently in integrative learning. By introducing WFE and HPS architectures, research training supporting mechanism enabled students and teachers who are unfamiliar to HTML or FTP to easily revise and edit Web pages. On-site training supporting mechanism enables real time reconstruction of brochure via portable terminal and real time modification of fieldtrip plan by agent function. By introducing the system, we have confirmed dramatic reduction of learner's burden of research training assignment as well as efficient and smooth development of on-site training from research training. We can expect the promotion of educational effect by introducing the system.

Many e-learning systems have been developed in the past years [6] but most of the recent systems [1] are lecturing type system represented by Web-based Training (WBT) and remote education. Not only has the importance of lecturing but on-site training been confirmed in recent educational reforms [4]. On-site training is interactive activity between problem finding and solving involving five senses. Also, on-site training is the learning method to obtain facts, laws, and social functions through the activity. The decline in social contacts and insufficient personal development of learners explains the growing importance of on-site training. In addition to traditional lecturing approach, our system supports fieldwork type on-site training.

References

[1]Kenji Ito, "~Special Feature: Front Line of e-Learning~ What is e-learning?", Data Processing Conference Journal, Vol. 43, No4, pp.394-400, 2002.
[2]Noriharu Tashiro, Takayuki Ito, and Toramatsu Shintani, "The partial on-line editing mechanism of the Web page and that application", The 20th Japan Software Science Conference, 2003 (to be printed).
[3]Naoki Fukuta, Takayuki Ito, and Toramatsu Shintani, "A Logic-based Framework for Mobile Intelligent Information Agents", Poster Proc. of the 10th International World Wide Web Conference (WWW10) ,pp.58-59, 2001.
[4]"Progress of Japan's Elementary and Secondary Education Reform and Future Issues", Ministry of Education, Culture, Sports, Science and Technology, 2002.
[5]Education Development Laboratory Glossary
http://www.kyouikukaihatu.co.jp/tokushuu/sougouyougo.htm
[6]"e-Learning white paper 2003/2004", Ohmsha, 2003.

Author Profile

Masaaki Tanaka: He is a Doctor candidate of He is a Doctor candidate of Engineering from Dept. of Computer Science at Nagoya Institute of Technology. He is also working as an associate professor at Suzuka International College. Before he belonged the institute, he was in the School of Management Information at Chubu University [1996-1998] and he was in Aichi University [1979-1983]. He got his Master degree of Management Information from Chubu University and got his Bachelor of Legal Economics from Aichi University. His major areas include designing and implementation of agent-based e-learning systems and e-commerce. He is a member of JSSST, OR society in Japan.

Tokuro Matsuo: He is a research associate at School of Project Design in Miyagi University. He received the Doctor degree of Engineering from Dept. of Computer Science at Nagoya Institute of Technology. Before he belonged the institute, he was in the School of Knowledge Science at Japan Advanced Institute of Science and Technology [2001-2003] and he was in Saga University [1997-2001]. He got his Master degree of Knowledge Science from JAIST and got his Bachelor of Education from Saga University. His major areas of study were analysis of Dynamic Systems and Differential Equations in

Saga University. In JAIST, his major areas of study include Artificial Intelligence, Computer Science and Economics on the Internet. His current research interests include designs on Agent-mediated Electronic Commerce Support Systems, designs on e-Auction Protocols, Qualitative Reasoning and Simulations, e-Learning Support Systems and University Information Support Systems based on Information Reuse and Integrations. He is a member of AAAI, IEEE, and several others. He is a conference organizing chair (program chair) of IEEE-PRIWEC 2006, RRS 2006, and RRS 2005.

Takayuki Ito: Dr. Takayuki ITO received the B.E., M.E, and Doctor of Engineering from the Nagoya Institute of Technology in 1995, 1997, and 2000, respectively. From 1999 to 2001, he was a research fellow of the Japan Society for the Promotion of Science (JSPS). From 2000 to 2001, he was a visiting researcher at USC/ISI (University of Southern California/Information Sciences Institute). From April 2001 to March 2003, he was an associate professor of Japan Advanced Institute of Science and Technology (JAIST). He joined Nagoya Institute of Technology as an associate professor of Graduate School of Engineering in April 2003. From 2005 to 2006, he is a visiting researcher at Division of Engineering and Applied Science, Harvard University and a visiting researcher at Sloan School of Management, Massachusetts Institute of Technology. He aslo joined Master Course of Techno-Business Administration in Nagoya Institute of Technology in April 2006. He is one of three Nominees of AAMAS2006 Best Paper Award. He received the Best Paper Award from Japan Society for Softoware Science and Technoglogy in 2005, the Super Creator Award from IPA Exploratory Software Creation Projects in 2004, the Best Paper Award for Young Researcher and the Best Paper Award of the 66th IPSJ National Convention. He was one of 5 nominees IEA/AIE2004 Best Paper Award. He also won the third place in Rescue simulation league of RoboCup WorldCup 2001 Seattle, and the second place in Rescue simulation league of RoboFesta 2001. His main research interests include multi-agent systems, intelligent agents, group decision support systems, and agent-mediated electronic commerce.

Tadachika Ozono: Dr. Tadachika Ozono was born in 1972, received his bachelor degree in engineering from Nagoya Institute of Technology, his master degree in engineering from Nagoya Institute of Technology, and his Ph.D in engineering from Nagoya Institute of Technology. He is a research associate of the Graduate School of Computer Science and Engineering at Nagoya Institute of Technology. His research topic is a web intelligence using multiagent and machine learning technologies.

Toramatsu Shintani: Professor, Graduate School of Engineering, Nagoya Institute of Technology. Prof. Toramatsu Shintani received the B.E., M.S., and Doctor of Engineering degrees from the Science University of Tokyo in 1980, 1982, and 1993, respectively. From 1982 to 1994, he was a Research Staff at the International Institute for Advanced Study of Social Information Science (IIAS-SIS), FUJITSU LABORTORIES LTD. Since 1994, he has been a professor of department of Intelligence and Computer Science at Nagoya Institute of Technology. From 2000 to 2001, he was a visiting professor of Robotics Institute at Carnegie Mellon University (CMU). His research interests include logic programming, decision support systems, multi-agent systems, and case-based reasoning. He is a member of AAAI, JSAI, IPSJ, IEICE and JSSST.