Autonomous Collaborative Environment for Project Based Learning

Mihoko Otake [a,b,1], Ryo Fukano [c], Shinji Sako [c], Masao Sugi [d], Kiyoshi Kotani [d],
Junya Hayashi [c], Hiroshi Noguchi [c], Ryuichi Yoneda [c], Kenjiro Taura [c],
Nobuyuki Otsu [c,e], and Tomomasa Sato [c]

[a] *Division of Project Coordination, The University of Tokyo*
[b] *PRESTO program, Japan Science and Technology Agency*
[c] *Graduate School of Information Science and Technology, The University of Tokyo*
[d] *Graduate School of Engineering, The University of Tokyo*
[e] *National Institute of Advanced Industrial Science and Technology*

Abstract. The importance of integrating different discipline of information science and technology is growing for the realization of information system which works robust in real world. Such system should be achieved by integrating super robust algorithm, large-scale dependable network and devices or interfaces which sense and/or actuate in the real world. It is necessary to encourage collaboration among specialists of different disciplines, since it is difficult to cover all area in information science and technology by only one person or group. In order to support collaboration among various kinds of experts, the autonomous collaborative environment for project based learning was developed. The environment comprises the workshop protocol and the community site. The workshop named "A Hundred Hour Workshop" for graduate students who belong to different departments was carried out during summer holidays. The community site named "WS100H.NET" was developed for supporting and analyzing autonomous collaboration process. Novel interdisciplinary technology, fusion of recognition and parallel computation was successfully developed. Collaboration process among the participants was autonomous with minimal facilitation by the tutor in the environment.

Keywords. computer supported collaborative learning (CSCL), workshop, project based learning (PBL), contents management system (CMS), real world information system

1. Introduction

Information technology of the 20th century centering on information equipment represented by the Internet and personal computers is about to come to a turning point, after the start of the new millennium. The real-world-based information scientific technology of the 21st century should stand on a wide range of researches, namely, computer science, mathematical informatics, information physics and computing, information and communication engineering, mechano-informatics, and precision engineering. Information system of the next generation should be realized by fusing different discipline of informa-

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[1]Correspondence to: M. Otake, E-mail: otake@cb.k.u-tokyo.ac.jp

tion science and technology, which are studied in different departments. Collaborative learning environment will promote cross-disciplinary research projects. Participation of graduate students with flexibility and mobility would accelerate such projects. The goal of this study is to develop collaborative learning environment which support PBL for such next generation information systems. PBL stands for People-, Problem-, Process-, Product-, Project-Based Learning [1]. It originates from medical education[2,3]. Nowadays, PBL is widely used in engineering education. PBL Lab was created to provide a learning environment where architecture/engineering/construction students would collaborate in multi-disciplinary, geographically-distributed teams on project-centered activities that produce a product for an industry client[4]. In PBL, Cross-disciplinary learning is conducted which is a journey from the state of island of knowledge (discipline-centric) to a state of understanding of the goals, language, and representations of the other disciplines. Students learn through solving problems and reflecting on their experience. They work in small groups guided by a facilitator. The role of the facilitator is guiding students on the learning process, pushing them to think deeply, and modeling the kinds of questions that students need to be asking themselves[5]. The role of the tutor is changing in a PBL learning environment, from the traditional teacher who delivers the course material in class to the coach. In order to support such collaborative learning process, the community has emerged in the past decade known as computer-supported collaborative learning (CSCL) [6,7,8] among those researchers working on computer-assisted learning[9]. One of the aims of CSCL is to promote mutual learning through interactions and discussions among learners[10]. Advanced technology can facilitate the students' collaborative effort, but does not, by itself, provide sufficient support without appropriate pedagogical arrangements and scaffolding of the collaborative learning endeavor[11]. Therefore, the goals and strategies of an expert facilitator has been studied and how to implement system with built-in facilitation function [5].

In this study, the autonomous collaborative environment for project based learning was developed which respects initiative of the participants in order to bring out autonomous collaboration. The workshop named "A Hundred Hour Workshop" for graduate students was carried out during summer holidays by some of the members of the real world information systems project in the 21 COE program "Information Science and Technology Strategic Core" at the Graduate School of Information Science and Technology of the University of Tokyo[12]. The community site named "WS100H.NET"[13] was also developed for supporting and analyzing autonomous collaboration process. The originality of this research is to propose a set of protocol as well as platform which shapes collaborative learning environment with practical embodiments.

2. A Hundred Hour Workshop

Activity centered workshop protocol was designed and conducted. The Authors of this paper was the committee, and the first author played a role of the facilitator, instructor, tutor, or coach of the workshop. These terms are used interchangeably in this paper. The committee configured the deadline and called for collaborative project proposal to the workshop. The intended applicants were the groups of graduate students who belong to different labs of different departments of the graduate school of information science and technology and graduate school of engineering. The committee provided research

Figure 1. The community site named WS100H.NET: it was developed for supporting the autonomous collaboration process for the workshop.

funding about a thousand dollar per one team, which mostly equals to the salary of the teaching assistant for a hundred hour in the university. Therefore, we named the workshop, "A Hundred Hour Workshop". The participants have to develop cross-disciplinary technology which demonstrates the information system in the near future based on their proposals. They have responsibilities and obligations to show their results at the final presentation. The application period was 15 days after the orientation. The orientation was on July 22, and the application period was from July 25 to August 8. The kickoff was the next day of the application deadline. The development period started on the next day of the kickoff and lasted for 52 days. The kickoff was on August 9, and the final presentation was on September 30.

3. The Community Site, WS100H.NET

The community site named WS100H.NET[13] was developed for supporting the autonomous collaboration process of the workshop (Figure 1). We expected accumulation of empirical knowledge which usually remains inside the participants. The site is based on one of the typical contents management system called XOOPS[14]. XOOPS is a program that allows administrators to easily create dynamic websites with great content and many outstanding features. It is an ideal tool for developing small to large dynamic community websites, intra company portals, corporate portals, weblogs. XOOPS uses a relational database (MySQL) to store data required for running a web-based content management system. Modules can be installed/uninstalled/activated/deactivated with a click using the XOOPS module administration system. We installed the following modules: forum, album, calendar, news, link, download, wiki, FAQ, and questionnaire. Among them, participants mainly submitted their contents to forum, album and calendar. In other modules, the tutor submitted the contents beforehand.

The contents submitted by the committe are described below. On news module, the tutor announced the orientation, kickoff, and final presentation schedules and acceptance
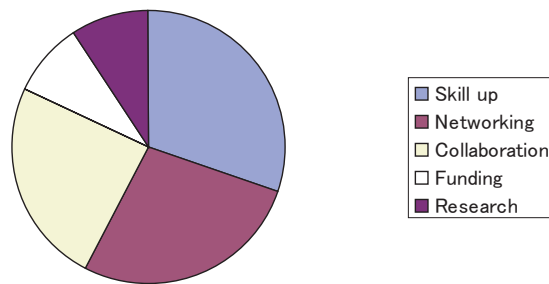
Figure 2. One of the results of the questionnaire to the participants: the reasons for the participation in the workshop were skill up, networking, collaboration experience, part time job, and research interests.

of the proposals. On link module, the committee offered useful links for the participants. On download module, the tutor posted application formats and documents. On wiki module, the committee offered background information of the project. On FAQ module, the tutor offered general information for students and professors who are interested in the projects. On questionnaire module, the tutor prepared questions to the participants.

The contents submitted by the participants are summarized below. On forum module, three forums were created for participants: entry, progress and meeting minutes. Album was used to record the meetings and presentations. Calendar was for announcing the meeting schedules. The site offered the place for submitting self introduction, meeting information and progress reports for participants.

4. Results

4.1. Participants of the Workshop

Number of attendees to the orientation was 50, and 13 students participated in the workshop. There were two teams, Team A and Team B. Team A consists of 7 members, while Team B consists of 6 members. Members of both teams belong to either Lab X or Lab Y: research area of Lab X in the department of information and communication engineering is parallel computation; Lab Y has been working on recognition in the department of mechano-informatics, a cross-diciplinary area of informatics and mechanical engineering. Four students of Team A belong to Lab X, three of them belong to Lab Y. Team B consists of six members: half of them are of Lab X and rests of them are of Lab Y. The grade of the students was as follows: one was bachelor course fourth year, six were in master course, and four were in doctor course. Both teams try to speed up motion recognition software based on Cubic Higher-order Local Auto-Correlation (CHLAC) feature extraction algorithm[15] through parallel computation on GRID computing environment[16]. The goal of Team A is to speed up recognition software so as to operate in real time. The goal of Team B is to improve accuracy of the recognition which takes unrealistic period of time without pararell computing. Human motion recognition system, which can discriminate strong and weak punching and kicking motions was developed by Team A, while human gait recognition system, which can identify both person and motion by time series of image data by Team B. The development was a big success.
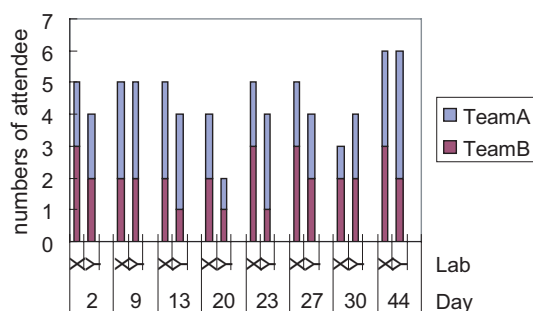
Figure 3. Numbers of the meetings and the attendee to the meetings: horizontal axis shows the date of the meetings while vertical axis represents the numbers of participants at each meeting.

It is very important to make clear which aspects of the workshop are attractive for students, in order to broaden the reach of the workshop. Thus, we sent out questionnaire to the participants what was their motivation. The items of the questionnaire were skill up, networking, collaboration experience, part time job, and research interests. The workshop was appealing in this order (Figure 2).

4.2. Emergence of Autonomous Collaboration

The day of final presentation was fixed by the committee of the workshop. The tutor directed the students to decide the rehearsal date. The final presentation date was set up on 52 days after the kick off. Meetings were held almost once a week. There were meetings on 2, 9, 13, 20, 23, 27, 30, and 44 days from the start. Number of the meetings was eight: six for discussion, one for data acquisition, and one for rehearsal. They were autonomously determined. During these meetings, there was no intervention by the tutor. Only students were participated in the meeting except for one of the rehearsal day. The tutor answered to the questions or requests via e-mail. From six to twelve students attended the meetings among thirteen students (Figure 3).

4.3. Submission of Contents

Numbers of submissions are shown in Figure 4. There were total of 130 submissions before the presentation. Seventy three articles were posted to forums, and 62 of them were submitted by participants. There were 17 schedules to calendar, in which seven were by participants. Participants submitted 25 photos and total numbers of photos were 40.

All members submitted to forums. One of the doctor course third year students played an important role in submitting photos to the album, meeting schedules to calendars, and minutes to the meeting forum. They were registered smoothly. This assignment of role was emerged autonomously. The tutor continued asking the students to register entry data to the self introduction forum until all participants submitted their articles. Everyday task was submitted to the progress forum by the active participants. Once the first record was registered, the author submitted their records successively. We have to keep in mind that each article sometimes contains multiple days of records, although the numbers of articles were counted. Also, numbers of photos were counted for albums,
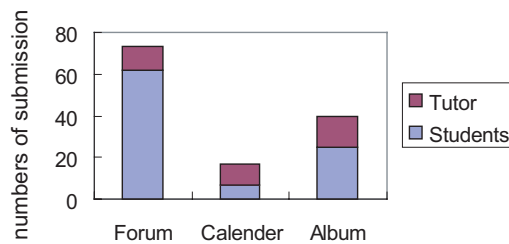
Figure 4. Numbers of submissions to the community site: total numbers of submissions were 130; 73 articles were posted to forums, and 62 of them were submitted by participants; there were 17 schedules to calendar, in which 7 were by participants; participants submitted 25 photos and total numbers of photos were 40.

and numbers of schedules were counted for calendars, both of them were easy to submit compared to the forum articles.

The tutor could observe the development of the project by the contents management system without attending the meeting. The tutor could also comprehend the tasks of each participant. This kind of process is not usually recorded on time, which limits the reproducibility and accumulation of the empirical knowledge. These recorded processes are definitely good references to people who try to practice project based learning workshop.

5. Discussion

Did Students Participate Autonomously?

The answer to this question is partially yes and partially no. Some of the participants were acquaintance of the tutor. The tutor invited them to participate in the workshop. This process was not autonomous. These students called for participation to their colleagues, who got interested in and participated. This process was autonomous. Three other groups of attendees of the orientation also considered entry for the workshop, but they gave up because of their research schedule. In order to increase the number of participants, the workshop committee should advertise the workshop more effectively. We sent out questionnaire in order to make clear what attracted the participants. The results of the questionnaire show that the major motivation for participation was skill acquisition, networking and collaboration experience. Funding was not the main reason for participation, although it attracted many students for the orientation. It is effective for attracting public interest to the projects, but not enough for participation. We should emphasize the merit of skill acquisition, networking and collaboration experience for attracting many students in the beginning.

Did Autonomous Collaboration Emerge?

Yes. The progress of the project was extremely autonomous. The committee determined the deadline. The tutor didn't lead the development process after kickoff. The tutor only asked the participants to submit progress reports and minutes of the meeting to the community site. The tutor monitored the progress through the system and communication via e-mails without attending the meetings. From the results, not every member could participate every meeting. The members who were absent from arbitrary meetings could

catch up with the next meeting by minutes and photos archived on the system. They could check the schedule of the next meeting with the calendar. In summary, the purpose of the workshop, supporting emergence of autonomous collaboration was achieved by the community site.

Was Knowledge Sharing Achieved?

Meeting data were successfully recorded in the meeting forum, calendar and album, which supported progress of the project. Technical discussions were done with the e-mail list and forum was not used for that purpose. In order to share the generated technical knowledge among the participants, discussion should be recorded by participants or be curated by the tutor. One of the participants played a leading role during the project. He submitted most of the meeting records except for those submitted by the tutor as examples. His contribution was the key for this success. We would like note that his assignment of roles emerged autonomously.

6. Conclusion

In this study, we developed autonomous collaborative environment which supports project based learning. The environment promoted cross-disciplinary study among graduate students of different departments. This doesn't happen without it. The goal was to realize the next generation of the information system through integrating different domains in information science and technology via collaboration. The environment comprises the workshop protocol and the community site. The workshop was proposal based, and the teams consisting of different lab members were recommended for participation. The site was built on one of the typical contents managing system. Autonomous collaboration was achieved which is summarized as:

- Graduate students and an undergraduate student participated who are interested in skill up, networking and collaboration during summer vacation.
- Meetings were held autonomously and different lab members shared their expert knowledge.
- The tutor and committee followed autonomous collaboration process mainly through the community site without attending the meetings after kickoff. The tutor helped them when they need help.
- Facilitation by tutor was required at first for contents submission. Once the participants started to submit, they submitted successively. Empirical knowledge such as scheduling and role assignment were recorded successfully.
- Interdisciplinary technology, fusion of recognition and parallel computation was newly-developed successfully. The goal of this workshop was fulfilled.

Future work includes representing the developed technology through the collaboration with thorough description, in order to share the results among the participants and non participants. We will figure out the general format or scaffold of community site for project based learning in order to provide the universal platform. The autonomous collaboration environment which we developed is one of the role models for supporting cross-disciplinary project based learning.

Acknowledgements

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