SUPPORTING PROCESS GUIDANCE FOR COLLABORATIVE DESIGN LEARNING ON THE WEB

Development of "Plan-Do-See cycle" based Design Pinup Board

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Abstract. This paper proposes the collaborative design education program on the web, based on "Plan-Do-See cycle" process model and develops the special Design Pinup Board system for running it. This program focuses on very limited environment; distributed collaboration beginners, asynchronous, first meeting, plural teams. The authors applied it to DCW2005 project and evaluated its effect from some questionnaire survey and fundamental analysis of logged data.

1. Introduction

Recently, it becomes possible to carry out collaborative design between distributed members via Internet synchronously or asynchronously using web pages for pinup, whiteboard, e-mail, or video-conference systems. Some research groups have developed typical pinup systems effectively to manage project (Morozumi, 1999), to share process (Jeng, 2000), to support team awareness (Mieusset, 2000), to teach architecture (Fowler, 1997) (Kvan, 2000). Also, the authors have developed several systems to visualize process (Matsumoto 2000) or to accelerate interaction by using Internet connected mobile phone (Matsumoto, 2001), through past eleven projects since 1996.

However recently communication support environment are equipped sufficiently, many difficulties are left from viewpoint of educational support, especially how to teach collaborative design process through their own experience effectively to distributed students who don't know each other and also collaboration beginners.

This paper proposes one of the collaborative design education programs, which is based on "Plan-Do-See cycle" process model and develop the special Design Pinup Board (DPB) system for running it.

2. Problem and Related Works

Many VDS projects provide various kinds of educational support such as operation-tutorials of CAD and communication tools before the teamwork kick-off by using web pages asynchronously or video-conference system synchronously. Although such educational supports facilitate team design to some extent, the management of design process mainly depends on the ability or effort of the team members or someone's leadership in most of such projects. Similarly, design work itself often depends on someone in the team too much. In addition, inexperienced asynchronous communication between collaboration beginners often causes serious fragmentation of discussion and creation.

Because, in such situation, teacher's process-guidance one by one is actually important, some frameworks and methodologies, for example Design Guidance (Chiu, 1998), has been proposed. However, of course those outcomes help us to guide process reasonably, it is yet necessary for teachers also for members to monitor the large amount of information in order to grasp "what is going on in the team". Actually, most of such information is not well structured and includes various phases of discussion or design. On the one hand, the numbers of researches that focus on development of support tool for learning design process through experience effectively are very few. The Ping-Pong style creation (Schnabel, 1999) and The 24 Hour Design Cycle (Hirschberg, 1999) raise the efficiency of design work by taking advantage of time difference and coordinate discussion, furthermore propose a new method of group-creation. These approaches (controlling the information-stream) can contrast our approach that manages information-class. Our proposal is similar side with Rule-driven coordination by (Jeng 20001) and Games in Early design education by (Woodbury, 2001) in terms of approach.

3. Intended Environment and its Difficulties

Distributed students: In a lot of cases, remote design collaboration project are run connecting between two or three sites; universities, institutes, laboratories or classrooms. In contrast, main target of this paper is awfully distributed-environment that students participate in each team from any place; home, mobile, classroom or other place. In fact, above ninety percent of the

students participated in our recent projects from out of university by using only web pages for the project.

Asynchronous discussion and creation: However video-conference becomes widespread to some extent up-to-date, many difficulties are left to set up those connection stably especially for not a few students who are end user of computer or Internet.

In addition to such a negative factor, now one of needed communication abilities for various creative works (not only design) is proficiently to communicate, discuss, interact, and create asynchronously. Our proposal in this paper focuses on asynchronous design discussion and creation between distributed students.

First meeting: One of the essential points of collaboration is interaction between heterogeneousness. Therefore, interaction between students who are first meeting each other makes collaborative-learning more meaningful. Students in other university are different each other in many ways; learning style, design approach, knowledge, skill, culture and so on. Harmonization of such differences is good training for social interaction , however difficult.

Collaboration beginners: Main target of our proposal is for collaboration - beginners. As you know, collaborative design differs from solo design work in various points. Such differences lead a lot of difficulties form viewpoint of creation and also education. Especially in Japan, architectural design education tends to spend too much effort toward solo designing (not group). Actually, a lot of participants of our DCW projects are entirely first experience in collaborative design, and what is worse, they have a very few opportunities for basic group work in elementary education.

Plural teams: Even under the above limited environment, in case of one or two teams, it is easer for experienced teachers to guide process attentively in some degree. Still, it should be realized that necessity of facilitating process guidance increase in case of plural teams education. One of the reasons is that teachers are needed to observe closely not well structured each discussions and those context constantly in order to guide each process reasonably and also timely. Honestly, in our past experiences, teachers often spend too much time for defragmentation of large amount of entirely fragmented asynchronous communication.

4. Plan-Do-See cycle Education Programming

4.1 CONCEPT OF EDUCATION PROGRAM

The fact of the matter is that collaborative design process is wide-ranging, and also is changing dynamically. However it is fruitful for students to lean such complexities itself little by little generally through their unsuccessful experiences, the authors place such a way as next advanced step.

Well known other approach for teaching collaboration is extracting some essential points form complex mechanism of collaboration and making simple model like as roll-playing game or simulation game. (However this approach sometime are done unconsciously) For highly suggestive example, Jeng's DCM; rule-driven design coordination model is structured by very simple essences and also provides flexibility, however its primarily target is not education. In addition, our past experiences suggest that the suitable model for above-mentioned limited environment should be as 1) simple, 2) leading to interaction, 3) applicable, 4) friendly and lighthearted.

4.2 WHAT IS PLAN-DO-SEE CYCLE?

Deming's Plan-Do-Check-Act cycle (Deming 1982) is widely known as quality management process model and these days become applied to various group works for problem solving and project managements. We remodels from this PDCA to Plan-Do-See cycle in order to simplify and run the cycle more times. The reason for transporting "Check" to "See" is to make student's discussion friendly. And Deming's Act step is adopted in next Cycle. Outline of our Plan-Do-See cycle is as follows;

Plan-step: Set the problem, direction of discussion, start point. / Propose the concepts, establish or abstract idea.

Do-step: On the basis of represented "Plan"s, Shape up into sketch, drawing, model, diagram and etc. / Propose the way of problem solving or specific approach to the concept.

See-step: About presented "Do"s, Comment, Analyze, Evaluate, Suggest, Compare or Discuss each other.

In case of our DCW project, team design period for 60 days has been divided into 6 periods. Through whole 60 days, 5 PDS cycles and 10 days free-discussion are run. For just 5 days, each step of Plan, Do and See is opened (possible to pinup) in each cycles; 2 days for simultaneous steps (P-D, D-S) in order to run asynchronously at their own pace. If someone has present "Plan" within 3 days, members can step up to "Do" from 4th day. On the other hand, if there is no "Plan" registered in first 5 days, it is unable to link

up to Do in a rule (this rule also applies to stepping up from "Do" to" See"). In a word, each registration buttons for Plan, Do, See appear or disappear according to the program (Figure 1). The last 10 days free-discussion is for getting their ideas into a shape for the final presentation.
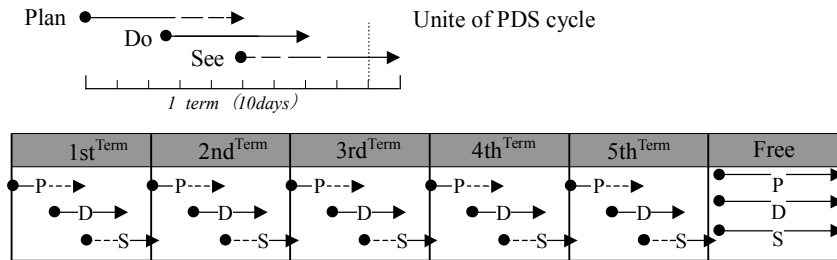

Figure 1.   Plan-Do-See cycle Education Programming

5. Development of Plan-Do-See cycle Design Pinup Board

The authors developed special Design Pinup Board (DPB) system for PDS cycle process guidance. Proposed DPB system (Figure 2) provides pinup-pages cycle-by-cycle (cycle-switching-buttons are on the upper part of every page). This page is divided three flames (areas); "Time-series flame", "Small-image table " and "Focus-view area". These areas provide following basic functions and function interactively each other.

   Time-series flame: Whole titles and its register name of pinups are stacked to upward with the date and time of registration.
   Small-image table: Small images, resized automatically, or icons of uploaded files such as image, CAD or DTP are arranged each "Plan-group"(P-D-S hierarchy group). Backgrounds of table-cell are colored in each specific color (Plan, Do, See). When mouse on the small image, its pinup in time series flame becomes bright interactively (vice versa).
   Focus-view area: When user clicks on title or small images in the above 2 areas, detail of clicked pinup is shown like as message-card included its title, comments, register name, button for attaching "See" and middle size image for access to its uploaded file.
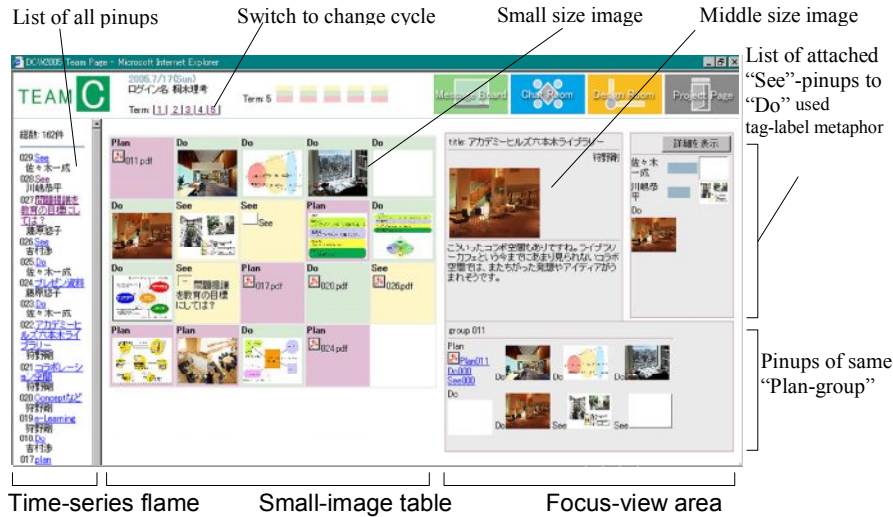
Figure 2. PDS cycle-Design Pinup Board

Interface of this DPB are designed in consideration for following points;

Overview and Forces: Just on one page, user can both review whole and check details in each cycle.

Visualization: Students and advisers can grasp (aware) accumulation of their effort at a glance, however roughly.

Interactivity: In order to brows pinups from different kinds of viewpoint; time-line, registrant and cluster of pinups, above three flames (areas) work together with each other interactively. Of cause, such interactive interface contributes to fun of browsing.

6. Case study; Design Collaboration on the Web 2005

6.1 OUTLINE OF DCW2005

DCW2005 project applied PDS cycle program was carried out between Kyoto Institute of Technology and Tokyo Denki University in Japan from April to July 2005. Nineteen undergraduate students participated, and four teams composed of four or five students each. The theme of design was Next University; 1) make the concept of university, educational program, teacher organization, 2) design the building, facilities (Real and Virtual space for education and research); and finally 3) present them on the pamphlet.

Whole fourteen weeks of project was divided into three periods; preparation period, solo design period and team design period. First three

weeks was preparation period for learning basic skill for remote collaboration; setting up connection from he/her home, CAD operation, exchanging files and etc. Second two weeks was solo design period, in which students present case research, propose early ideas, and additionally evaluate each other by using simple pinup board (shown in Figure 3). Third nine weeks (60 days) was team design period based on Plan-Do-See cycle.

   Project-page (shown in Figure 3) provides various types of information for all participants; home works in preparation period, references, description of design theme, consultation& column from graduate students, links to simple pinup page for solo design period and links to each Team-pages.

   Team page include four communication tools; above Design Pinup Board for asynchronous design discussion (developed in this paper), Message Board for notice (not for design discussion), Chat room for synchronous communication, AMPIS for accelerating asynchronous communication and supporting awareness. This AMPIS (Active Messaging Pinup Information Service) sends e-mails toward member's mobile phone automatically when someone pinups information on DPB or Message Board (Matsumoto 2001). In team design period, students collaborate through only this Team page.

Simple pinup for solo design period

Project page

Include
Home works,
References,
Description of
design theme

Team page

Include
Message Board
DPB
Chat room
AMPIS

Figure 3.   Web pages for DCW2005

6.2 EVALUATIONS

The authors evaluated the effect on our Plan-Do-See program from some questionnaire survey after the project and fundamental analysis of logged data.

Advantages of Plan-Do-See cycle program

"Which case (PDS cycle or Free-discussion) is suitable to design work on the web?"

(Answer: PDS cycle / Neither / Free-discussion)

This question is to analyze how much advantage can be seen on PDS cycle supported. We selected 11 items included Positive, Negative and Neutral items for the education point of view. The result (Figure 4) shows, however roughly, that PDS cycle can contribute positive-items and overcoming negative-item-6. In particular, the results of item-11 and 8 show reaching the primary target of this development (mentioned 3rd chapter). In addition, item-10 may be trade-off for 9 or 11 in case of ruled process at present.
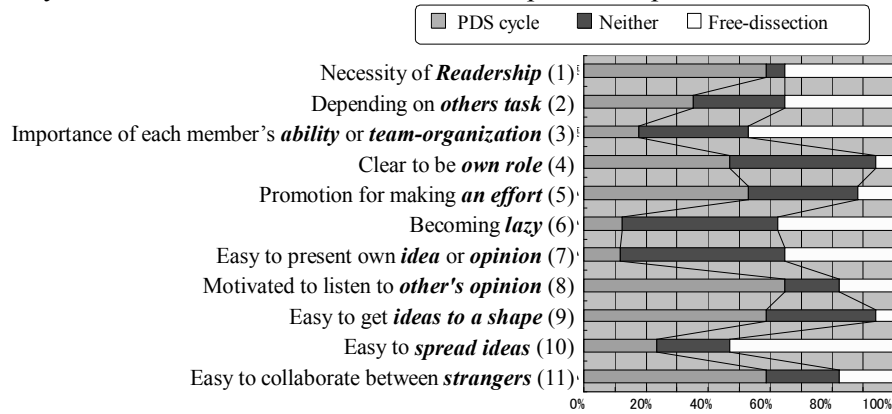

Figure 4.   Which case (PSD or Free) is applied by each item

Effect on activating interaction between students

"How do you feel other student's response to your pinup?"

(Answer: Usually / Often/ Occasionally / Rarely)

Results of this question (Figure.5) show fundamental advantages for activating interaction between students, in other words, motivating students to exchange ideas each other. Roughly description, about 80% of students feel pleasure by other's reaction with answer "usually" and "often" (average of B1-3 items). Results of A1-3 show frequency of disappointment (A1-3) is very low.
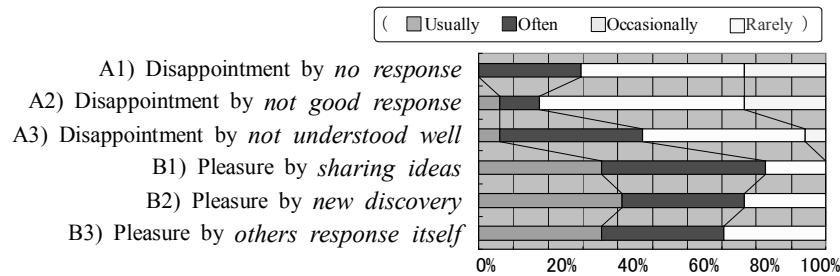
Figure 5.   How students feel others' reaction

Fundamental analysis of interaction between students

   Figure 6 shows rate (total of all four teams) of Do or See pinups derived from other members Plan or Do, in other word, reactions to other members. This result; that amounted to 77% of Do pinups are derived from other member's Plan, shows potential of our proposal for activating interaction between others. Rather because, there are not a few See pinups attached one's own Do (included 29 %) in order to supplementary explanation. In case of past DCW, the authors used to observe more isolated creations.

Figure 6.   Rate of Do or See pinups derived from other's pinup

7. Conclusions

Some necessities of imperilments about DPB-interface and details of education program, such as speed-regulation of P-D-S cycle, are detected from some other questions and observation. Nevertheless, results of DCW2005 illustrate enough effectiveness of our proposal for learning design collaboration interactively between distributed students, particularly, who don't know each other and also are collaboration beginners.
Our proposal is one of process guidance oriented collaborative design education and programmed so simply, therefore the authors think this simple structure enhances the potential to be useful for various type of group design learning.
Future research will involve improvement of user-interface and make developed system more applicable to various types of project.

Acknowledgements

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